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SEASONAL CHANGES OF PHYTOPLANKTON COMMUNITIES IN THE HUNGARIAN PART OF LAKE FERTO

Introduction

Our knowledge on the algae of the Hungarian part of Lake Fertõ is very limited. Systematical studies have not been carried out only some scattered data are available (VESZPREMI 1976, SCHMIDT 1978 - unpublished, BARTALIS 1980 - unpublished).
The primary aims of my studies were first to obtain some preliminary data on the algal flora existing in the Hungarian part of the lake, and second to carry out a pilot study on its quantitative structure. Further on I would like to demonstrate some similarities and differences between the Hungarian and the thoroughly investigated Austrian part of the lake. I based my comparisons on DOKULIL`s (1979) work published as a chapter of the Neusiedlersee-book.

Sampling area

There are no really large contiguous open water areas in the Hungarian part of Lake Fertö, its surface being dissected by reed-stands all over the area. The open areas represent three characteristic types of water:

	depth	colour	transparency	inorganic seston content
1.	about 110	grey	reduced (about 20 cm)	high
2.	about 100	usually	changeable; ranging between the type 1. and type 2.	
3.	between 75 and 100	nearly black	often transparent to the bottom	low

Due to the spatial heterogeneity of the Hungarian part of the Lake above mentioned we had to point out a relatively large number of sampling points (figure 1).

Material and methods

Quantitative water-samples were taken during one year from August 1979 with two weeks to one month intervals any time from 6 to 12 sampling stations with a glass tube. Qualitative samples were also taken any time from all stations. The diatoms have been determined by a rapid H_2O_2 method, the blue greens and the green algae from sedimented material (fixed in formalin). No detailed taxonomical studies have been carried out on the phyla Euglenophyta and Pyrrophyta. The inverted microscope technique (UTERMÖHL 1958) was used for counting the organisms. This paper covers qualitative and quantitative data of 120 samplings.

Results

During the studies lasting one year 246 species have been determined from qualitative and quantitative preparations and samples. The number of species is approximately four times more that mentioned previously in the studies quoted (figure 2). Accordingly this might have be related to the spatial heterogeneity of the Hungarian part of the lake. Comparing the proportion of the number of species by algal phyla to the former results we can detect similarities. My summary contains the data of inner lakes enclosed by reed-belts where there are much more blue-green algae.That is why the proportion of blue-greens is higher.

Disregarding them our results would be very similar to those of DOKULIL (1979).

There are significant differences in the species composition of the main sampling areas. E.g. much more blue-green algae can be find in the inner lakes than in the grey waters. On the other hand grey waters contain much more Chlorococcales.

For the elaboration of quantitative data I devided the sampling stations with similar characteristics into six main types (figure 3).
In the northern part and in the middle of the Râkosi-bay a smaller peak in the spring and a conspicous summer maximum can be observed regarding the number of individuals. The Austrian studies stated the same on the northern part of the lake as a result of studies lasting several years.
The situation is similar in the grey waters of the three eastern bays and - a surprising phenomenon - in the largest inner lake. In the last two cases the summer maxima did not outnumber significantly the spring maxima. In the more or less enclosed brown-water areas there is not any difference between the summer and the spring peaks further on the standing crop is higher in winter and in early spring. Similarly high number of individuals can be observed in winter and in spring in the smaller inner lakes. In April and in May there is not any increase in these small lakes. That phenomenon can be observed only later: in the middle of the summer. Here the changes of the number of individuals can be characterised by the spring - early summer maxima.
The dominance of the different algal-phyla in the different seasons in different areas of the Hungarian part of the lake was studied in details (figure 4). The data on fig. 4 demonstrate the percentage of the year dominated by one or the other algal-phylum. On both indicated parts of the Râkosi-bay and in the three eastern bays the green algae (always more than 92 %) and partly the diatoms (max. 8 percents) dominated. In the more or less enclosed brown-water areas Chlorococcales and Pyrrophyta were dominant in equal proportions. In the greatest enclosed lake three algal-phyla are present in almost even proportions. In the small inner lakes the pyrrophytes were dominant while besides only some diatoms and about 2 percents of green algae were present.
Regarding the euglenophytes and blue-greens it is worth mentioning that their quantities were insignificant in the plankton. The number of blue-greens is higher in late summer and early autumn samples than in the other seasons but even so their quantities are still insignificant

as compared to the above mentioned phyla. Our results concerning the grey waters correspond with the Austrian records.
In the Hungarian part of the lake seven quantitatively significant species could be listed. They can be devided into three groups. The members of the frist group are as follows: Ankistrodesmus angustus, Ankistrodesmus pseudobraunii, Schroederia setigera f. minor and Crucigenia quadrata. These green algae could be found in great quantities in the grey waters. They were at an average level in the half enclosed areas and became insignificant in the smaller lakes. Extreme differences may exist among the different parts of the Hungarian area of the lake. For example Crucigenia quadrata being a dominant alga in early summer in the grey waters is completely absent in the small inner lakes. The second group contains Rhodomonas and Cryptomonas species. Their frequency is just the inverse of the first group. The third group is represented by one species only: Cyclotella meneghiniana. This occured in nearly constant quantities in the different areas.
The seasonal distribution of species was different. This can be regarded as temperature dependence (figure 5). The section on fig. 5 represent the middle range of the graphically approximated distribution.
Rhodomonas and Cryptomonas seem to be euriterms. This is concordant with Austrian studies and to other observations. The results regarding the Crucigenia quadrata are corresponding to the Austrian results on Crucigenia tetrapedia. The dominant green algae occur in large numbers within a narrower temperature interval.

Discussion

The main purpose of these all year round algological studies was to obtain some data from the Hungarian part of Lake Fertő and to define the aims of further research. In my opinion the intensive examination of the Hungarian part of the lake is important because of the following reasons:

Apart from the Lake Fertô there are two other extensive natural shallow lakes in Hungary: Lake Balaton and Lake Velence. Their rapid man - induced eutrophication is evident. The studies on Lake Fertô can be regardet as references to the explanation of the eutrophication of the two other lakes.
The benthic eutrophication that means the last face of the succession process of a lake is usually represented by the multiplication of macrophytes. This all year round examination has already shown that this process is very interesting from the point of view of the reduction of open water surface therefore repressing the area where a "true" plankton community can grow.
It can be concluded from the spring minimum of phytoplankton in the small inner lakes, that there must be competition for the nutrients between planktonic and non-planktonic primary productions. The above mentioned minimum coincides with the most intensive growth period of reed. It also follows that the energy-budget of plankton in the inner lakes cannot be examined in itself even in a very rough approach.
On the other hand the man - induced eutrophication is internationally well studied unlike the natural degradation of lakes. The Hungarian part of Lake Fertô is still suitable for the examination of natural processes.
However the practical and theoretical questions can be answered only by a joint Austro-Hungarian research program.

References

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Abstract

Vom August 1979 wurde ein ganzes Jahr hindurch das Phytoplankton des ungarischen Teils des Fertô (Neusiedlersee) untersucht, über den uns bisher nur sehr spärliche Angaben zur Verfügung standen. Aus insgesamt 120 Wasserproben konnten 246 Arten nachgewiesen werden (Chroococcales 19; Hormogonales 41; Euglenophyta 12; Cryptophyceae 2; Dinophyceae 2; Xanthophyceae 2: Chrysophyceae 2; Bacillariophyceae 80; Volvocales 5; Chlorococcales 71; Desmideaceae 9). Zwischen den Algenbeständen der verschiedenen Wassertypen ließen sich wesentliche Unterschiede feststellen, so z.B. war im schwarzen Wasser des inneren, geschlossenen Teiches die Zahl der Cyanophyten-, im grauen Wasser der äußeren Buchten dagegen die der Chlorococcales-Arten sehr hoch. Die quantitativen Untersuchungen der grauen Gewässer betreffend waren die Angaben denen der österreichischen Untersuchungsergebnisse sehr ähnlich: die Veränderungen des Phytoplanktons werden durch ein kleineres Maximum der Individuenzahl im Frühling und durch ein größeres im Sommer charakterisiert. In den braunen Übergangsgewässern sind diese Maxima nur weniger signifikant, die Individuenzahl ist in denen aber im Winter höher als in den grauen Gewässern. In den geschlossenen Teichen mit schwarzem Wasser ist die Individuenzahl der Algen beim intensivsten Wachstum des Schilfes am niedrigsten, in anderen Jahresperioden dagegen ziemlich hoch. In den grauen Gewässern war die Dominanz der Chlorococcales (über 90 %) im größten Teil des Jahres kennzeichnend, in den braunen Gewässern konnte die Dominanz der Chlorococcales- und Cryptophyceae-Arten (50-50%), in den schwarzen Gewässern meistens die Dominanz der Cryptophyceaen (über 80 %) festgestellt werden. Es wurden insgesamt 7 dominante Arten während der Untersuchungsperiode nachgewiesen.
Die Forschungsergebnisse weisen eindeutig darauf hin, daß die dimensionale Heterogenität des ungarischen Fertô-Teiles sich in der Struktur der Algen-Assoziationen widerspiegelt.
Nachdem die wichtigeren Wassertypen als einzelne Stufen der natürlichen Degradation des Sees betrachtet werden können, sind unsere Untersuchungen auch deswegen von großem Interesse, da die artifizielle Eutrophierung - worüber von österreichischer Seite berichtet wird - und die natürliche Degradation an ein und demselben See parallel studiert werden kann.

Table 1

a.

CYANOPHYTA	60
(Chroococcales 19)	
(Hormogonales 41)	
EUGLENOPHYTA	13
PYRROPHYTA	4
(Cryptophyceae 2)	
(Dinophyceae 2)	
CHRYSOPHYTA	84
(Xanthophyceae 2)	
(Chrysophyceae 2)	
(Bacillariophyceae 80)	
CHLOROPHYTA	85
(Volvocales 5)	
(Chlorococcales 71)	
(Desmideaceae 9)	
Total	246

b.

	LOUB (1952-1953)	RUTTNER (1956-1958)	DOKULIL (1968-1973)	PADISAK (1979-1980)
CYANOPHYTA	11	11	10	24
EUGLENOPHYTA	11	11	7	5
PYRROPHYTA	2	12	7	2
CHRYSOPHYTA	46	34	32	34
CHLOROPHYTA	30	32	44	35
	100 %	100%	100 %	100 %

Distribution of identified taxa in five taxonomical phyla (a) and its comparison to earlier studies (b).

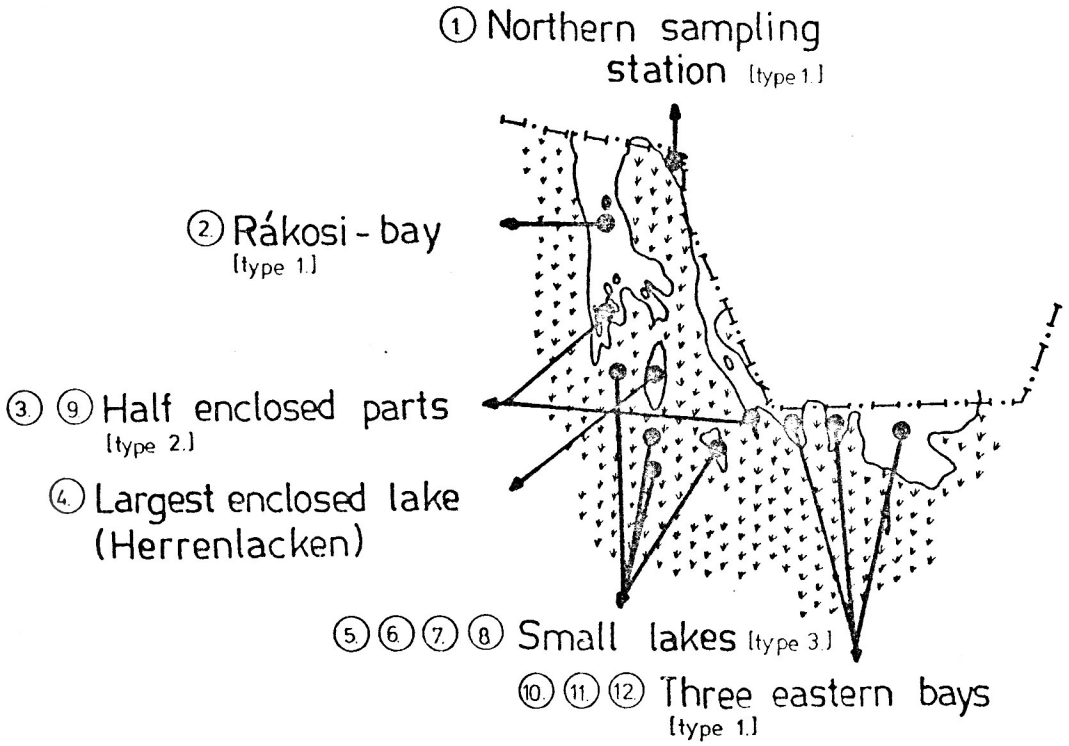

Fig.: 1 Location of sampling points

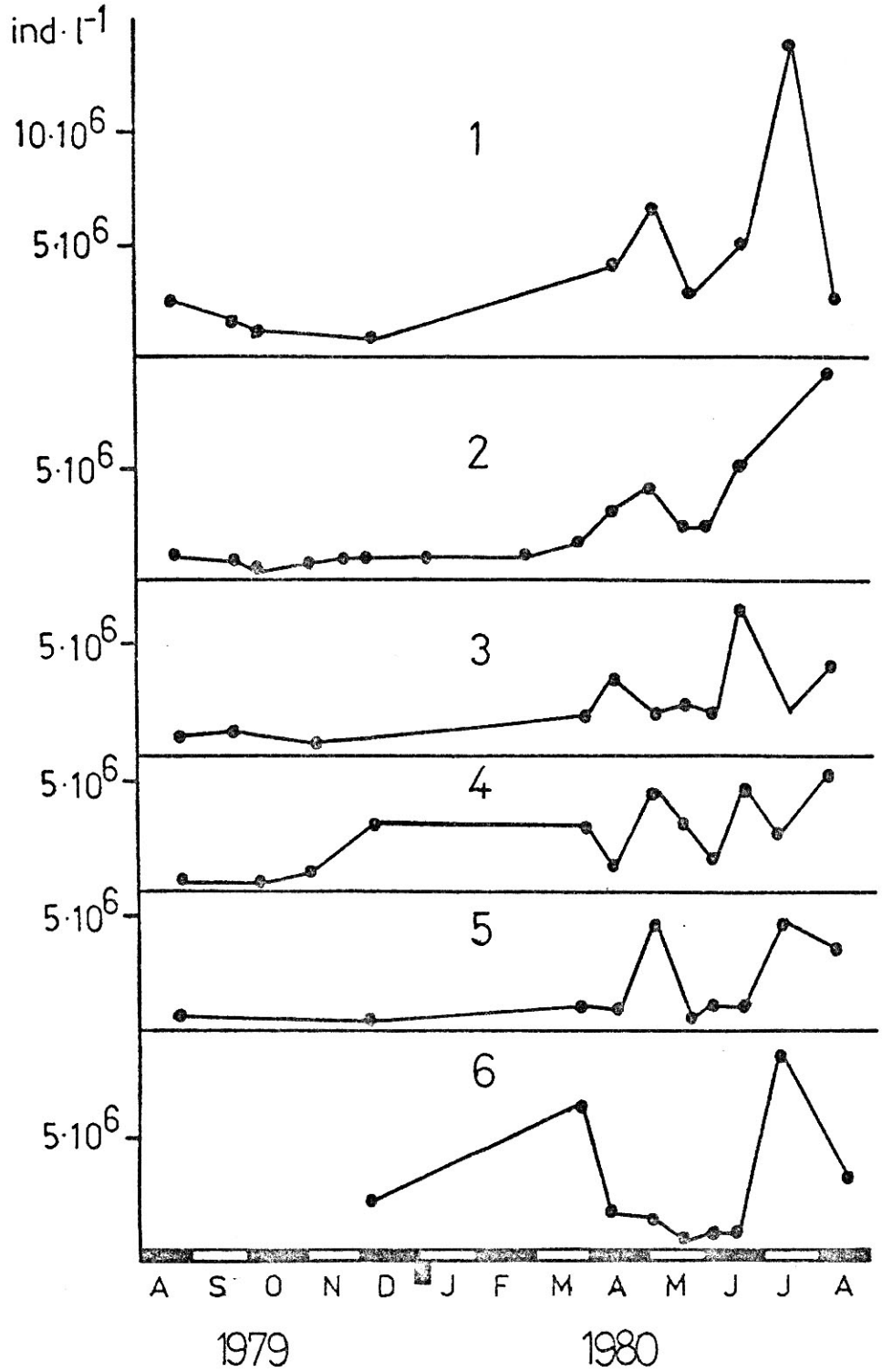

Fig.: 2 Numbers of phytoplankton in the study period

1 = northern part of the Hungarian area of Lake Fertö

2 = Rákosi-bay

3 = three eastern bays (average)

4 = half-enclosed areas (average)

5 = largest enclosed lake

6 = small enclosed lakes (average)

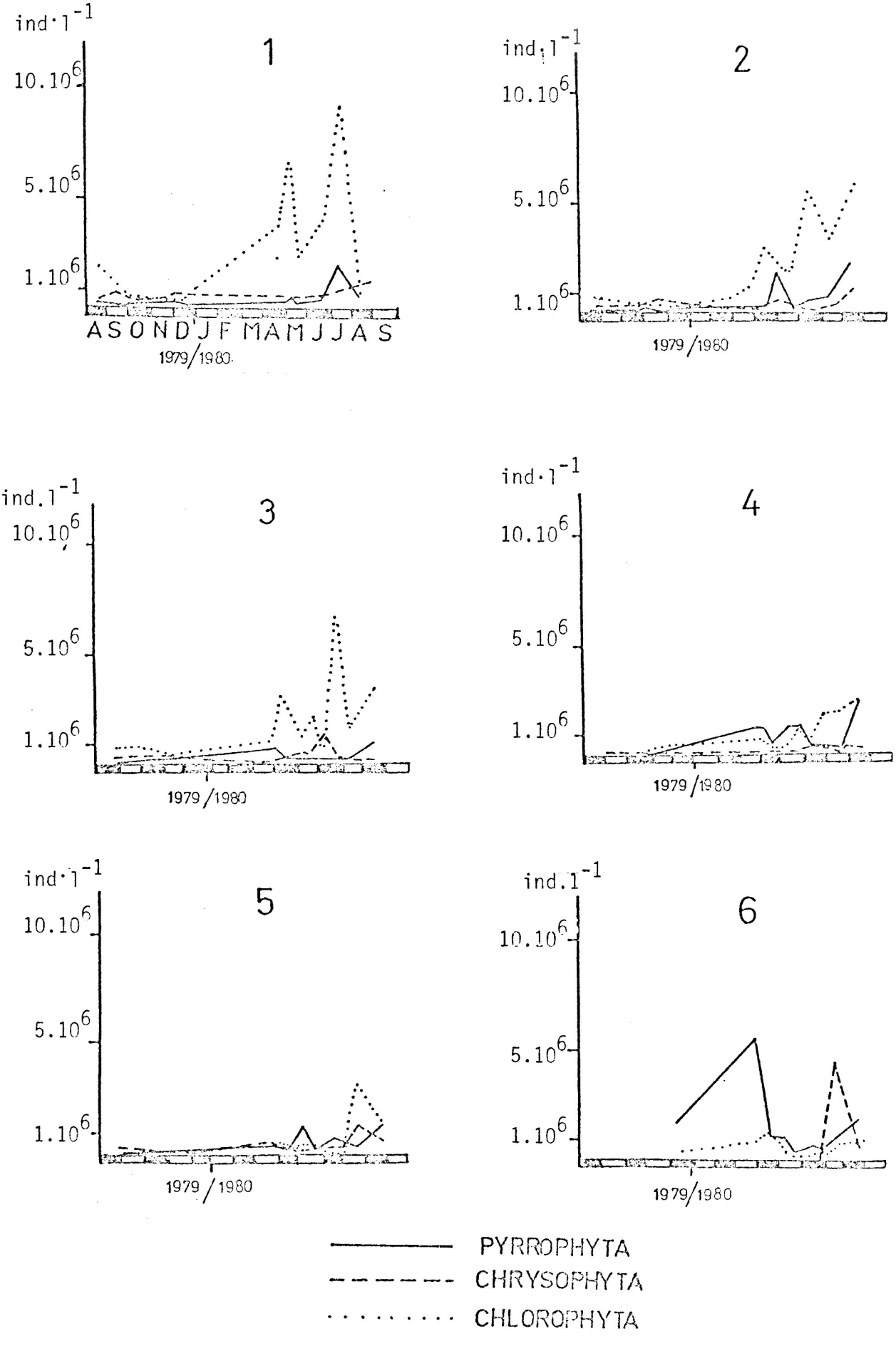

Fig.: 3 Numbers of the main phytoplankton phyla in the study period (explanation see fig.2)

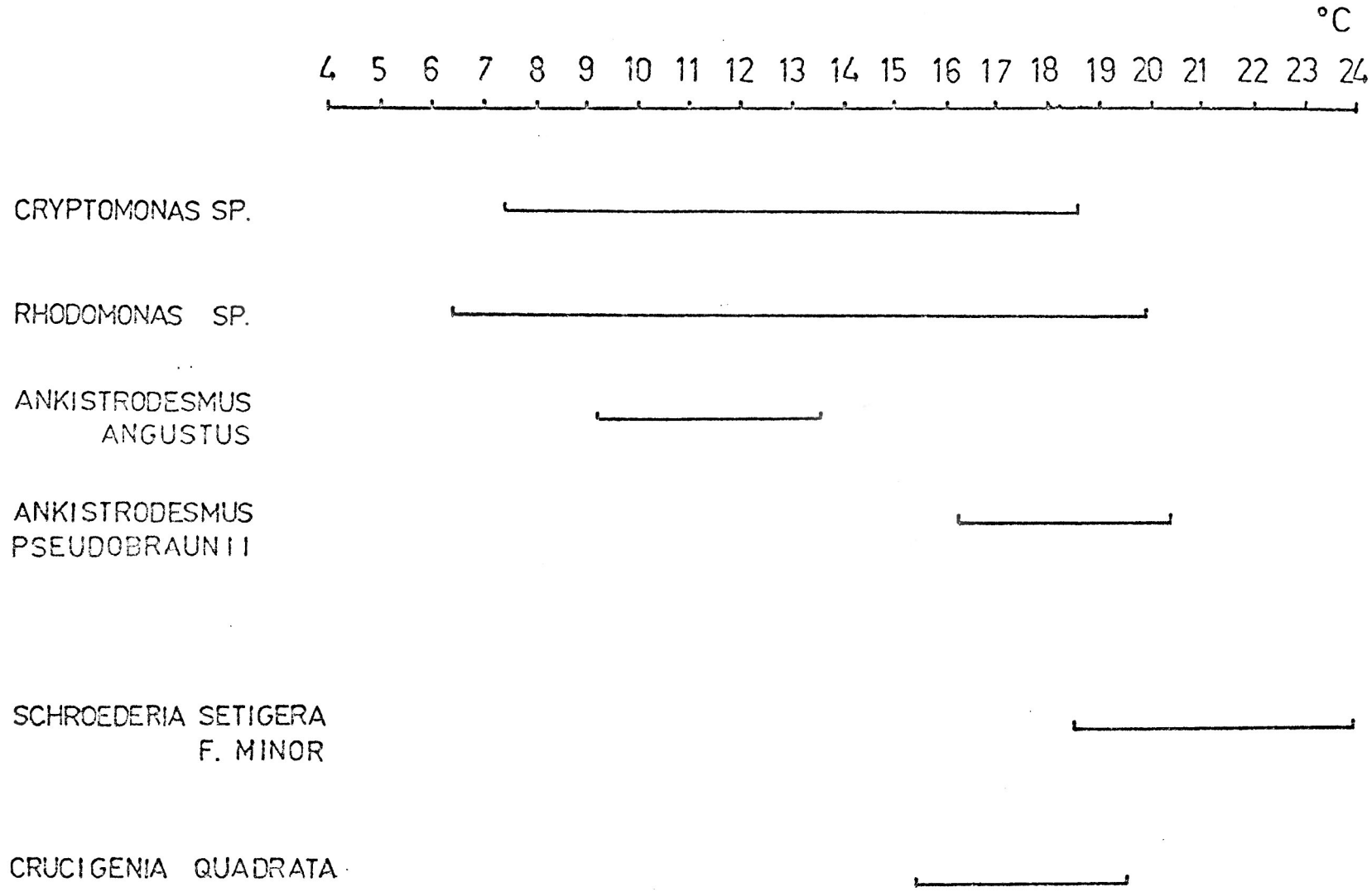
°C
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
CRYPTOMONAS SP.
RHODOMONAS SP.
ANKISTRODESMUS ANGUSTUS
ANKISTRODESMUS PSEUDOBRAUNII
SCHROEDERIA SETIGERA F. MINOR
CRUCIGENIA QUADRATA

Abb. 4