ANNAL. BIOL. TIHANY | 37 | 291—308 | HUNGARIA 1970

THE QUANTITATIVE PROPORTIONS OF ROTIFERA PLANKTON IN LAKE BALATON, IN 1967

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(Received: 28th February, 1970)

A number of papers have been published — mainly the result of occasional investigations — on the wheelanimalcules inhabiting the water of Lake Balaton, which provide valuable information on species living in various parts of the lake in different biotopes or habitats (VARGA, 1938; 1939; 1941; 1944—45; 1957). The elaboration of Rotifera plankton of the lake is given in three papers based on several years of systematic work (ENTZ et al. 1937; SEBESTYÉN et al. 1951; SEBESTYÉN, 1953), the studies make reference to the seasonal changes of species inhabiting the open water stretching before the Tihany Peninsula. Horizontal investigations carried out simultaneously for the whole area of the Lake Balaton have not yet been done up to this date, our present paper endeavours to supply data to this effect.

The rapid development of the shoreline: erections of houses, increased cultural actual activities, higher degree of water polution, shoreline arrangements all contributed to certain changes taking place in the aquaeous habitat, consequently, we may justifiably suppose, that since the last Rotifera investigations in 1951 both the number of individuals and species suffered changes. Furthermore, the question arose whether the results obtained previously for the water stretches before Tihany Peninsula also hold good for other parts of Lake Balaton.

In order to give exhaustive answers to these questions, and to see clearly the conditions issuing from the great fish stock destruction which occured in 1964 in Lake Balaton, since 1965 we have collected plankton samples both for quantitative and qualitative investigations (P.-ZÁNKAI and KERTÉSZ, 1967). In our present study, we made our quantitative analysis on Rotifera collected in 1967.

Material and method

Sample taking was done between May and October once a month at 5 places of the depth longitudinal axis of the Lake Balaton and at 3—3 places of its transversal section. The places of sample taking in each section were 2000-2500 m apart from each other *(Fig. 1)*. (For detailed description of the sections see SEBESTYÉN, 1960, p. 118.)The samples were taken by the help of FRIEDINGER apparatus from the depths of 0.3, 1, 2, 3 and when it was possible from 4 metres. The one litre water samples taken from the different depths were poured together in order to obtain better values for average,

subsequently, the mixture was preserved with formalin, after deposition the surplus water was removed by VOLK filtration (SEBESTYÉN et al. 1951). After determining the volume of the condensed sample, one third and one fourth of it were examined, of which we pipetted 1, 2 or 4 ml of sample quantity at a time into 60×30 mm counting dish, then in turn each sample was counted under a magnification of ×130. This procedure depending on the good parallels was repeated 3—6 times. The obtained results were calculated for one

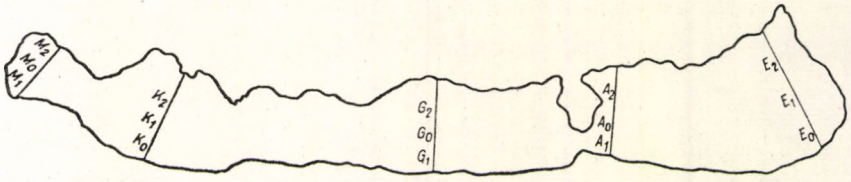

Fig. 1. Sketch of Lake Balaton showing the sites of sample taking

litre of water. Those species which were difficult to determine we cleared on separate slides during counting, of course, after sufficient preparation procedures we determined them.

At the time collecting we made ample notes as to the transparency, temperature of the water as well as to weather conditions.

Results

We found great differences between Keszthely-Bay ("M") and the other parts of Lake Balaton when taking the sum of individual numbers per litre collected at 3—3 points of the 5 sections separated from one another by different distances during the 6 months of investigation *(Table 1)*.

TABLE 1

Quantitative distribution of total Rotifera in the sections of the Lake Balaton (individual per litre)

	M	K	G	A	E
V	340	290*	711	765	1125
VI	167	330	496	163	324
VII	143	654	549	489	436
VIII	262	725	843	408	413
IX	35	139	170	219	234
X	207	169	308	215	323
	1154	2307	3077	2259	2855

* The sample taken at point marked K_0 was broken, thus, the sum is the result of 2 parallels only.

In each of the four sections twice ("K" and ' A") and three times more Rotifera plankton was present than in the water of Keszthely-Bay.

If we add up the individual numbers per litre at each point of the section referring it to the whole period of investigation then we find that between the

collecting sites near the south and north shores and those situated in the middle axis of the Lake Balaton i.e. sections "M" and "A" the difference is comparatively small, in the case of the others, i.e. sections "G" and "E" the two point near the shore show somewhat greater similarity. Generally, excepting section 'M", the central points of all others sections display higher values *(Table 2)*.

TABLE 2

Quantity of total Rotifera at the different collecting sites of the sections with reference to the whole period of examination

M_1	M_0	M_2	K_0	K_1	K_2	G_1	G_0	G_2
460	325	369	672	1061	574	957	1191	929
		A_0	A_0	A_2	E^0	E_1	E_2	
		678	814	767	728	1327	800	

The average values of individual number per litre of the total Rotifera of each section show that the populations increase twice or three (?) times *(Fig. 2)*. In May, the Rotifera plankton density is high in all the 5 sections this is the time when the highest number of individuals occur in sections "M" "A" and "E". The population greatly decreases in June, then in July, ex-

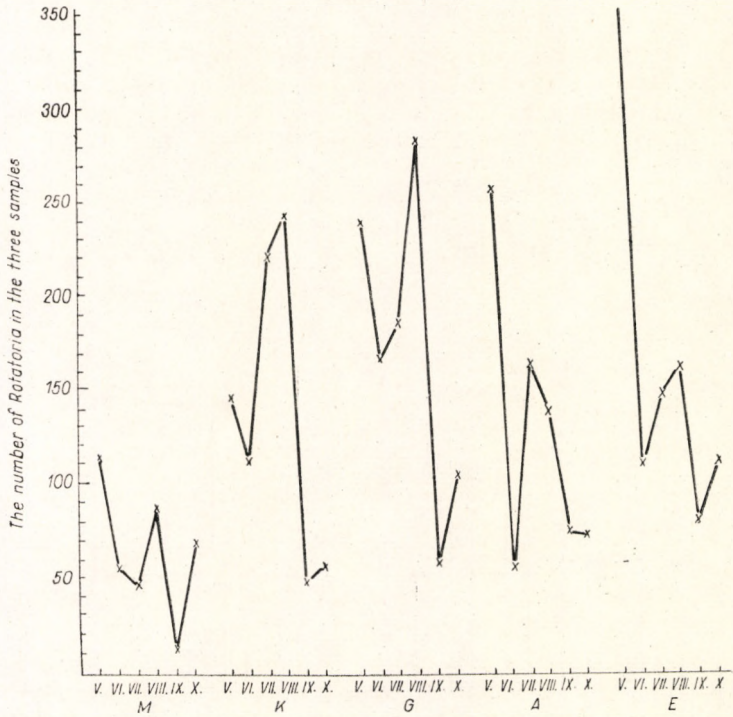

Fig. 2. Monthly change of the specimens per litre values of the total Rotifera shown in the average for the three sites of each section

cepting section "M" the population again gradually increases, and in August the late summer maximum is formed, which value is well below that of the spring results, excepting sections "K" and "G". The lowest individual number of populations was recorded in September, except in section "A", however, in October some slight or bigger increase could be observed.

During the collecting period 24 species, varieties and forms have been determined. From among them 4 species *(Keratella cochlearis, Polyarthra vulgaris, Keratella C. tecta, Keratella quadrata)* occurred in every section and during the whole period of investigation, 1 species was lacking in Keszthely-Bay during the whole period. These 5 species consequently may be regarded

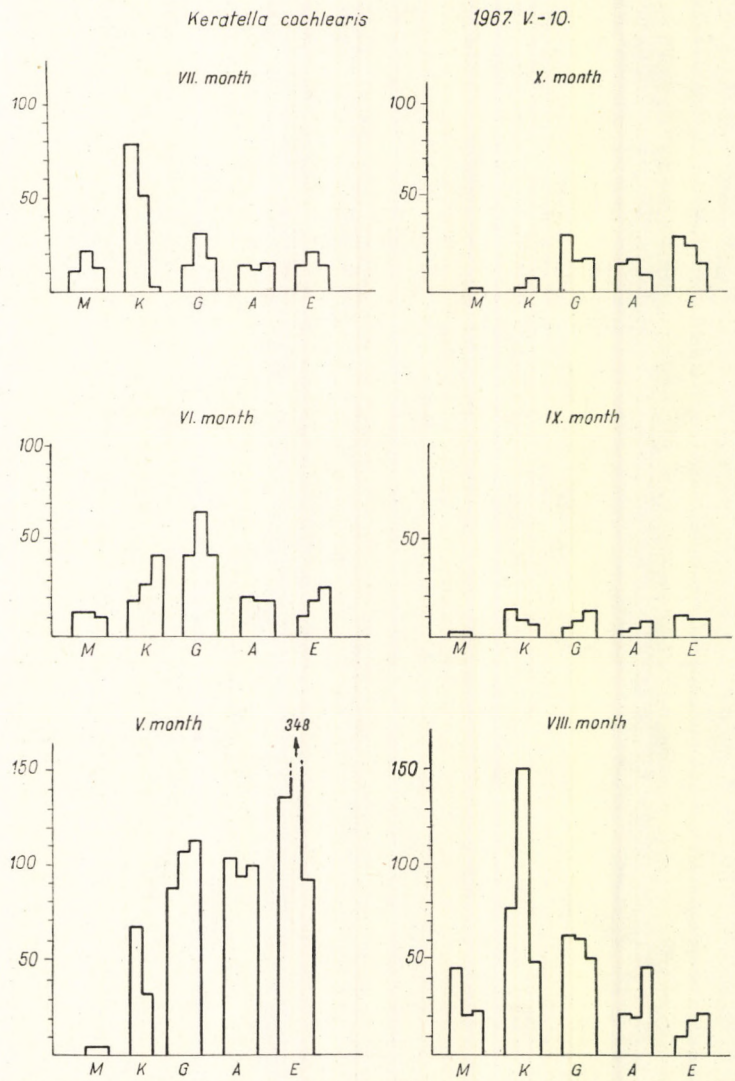

Fig. 3. Monthly change of the number of individuals per litre of *Keratella cochlearis* at 3-3 sites of each section

as the main components of the Rotifera plankton of Lake Balaton from early spring to November. Because each these species is capable for very rapid proliferation (SEBESTYÉN et al. 1951) we thought important to treat them in more detail concerning their population changes with regard to months both within each section — following the order of chronology — and their interrelationships.

Keratella cochlearis GOSSE *(Fig. 3).* In section "M", after a very small individual number in May, the population increases gradually until August, reaching a value of 1 specimen per litre, and the same number may be observed in October, too. In section "K" (?) and "G" the population increases twice, once in May and once in August. In the case of section "A" but especially in

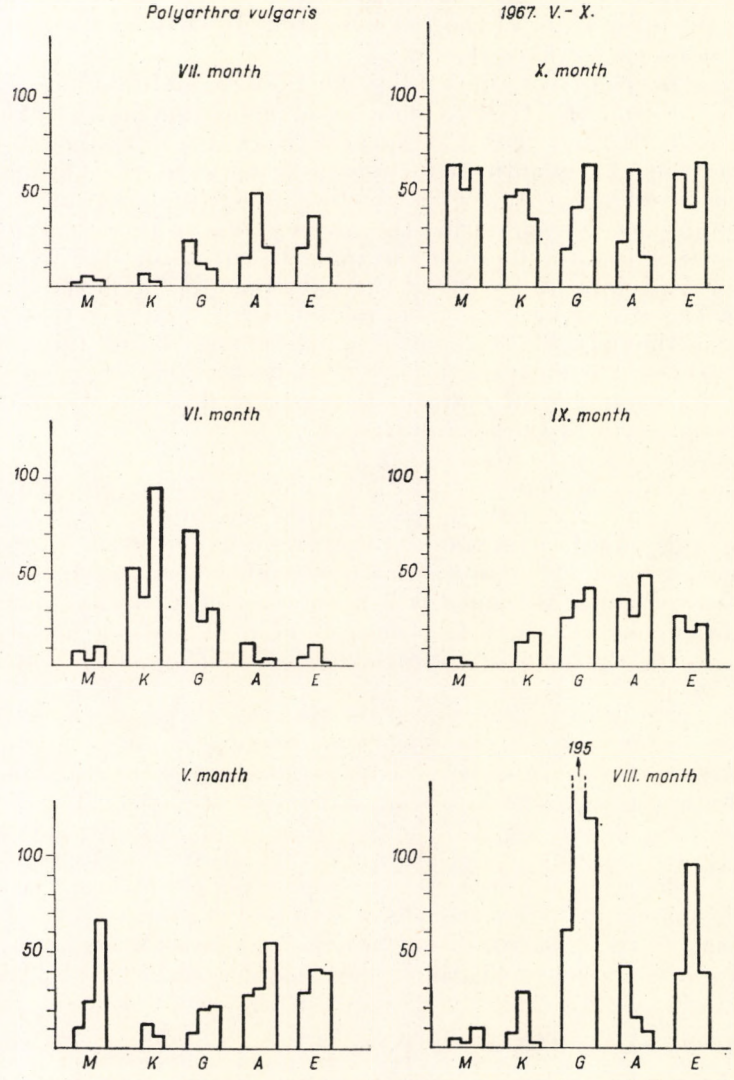

Fig. 4. Monthly change of the number of individuals per litre of *Polyarthra vulgaris* at 3-3 sites of each section

the case of section "E" after May the number of individuals suddenly drops and only a slight increase occurs in October, which cannot be called a second maximum by any rate.

Comparing the populational changes observed in all sections, it becomes clear that in May the litre density of *Kochlearis* gradually increases from sections "M" to "G", the value of "A" is identical with that of "G", while the value of section "E" is extremely high as regards number of individuals. In June, from section "G" and in July from section "K" a gradual decrease could be observed proceeding towards the two ends of Lake Balaton. In August, excepting section "E" the population density increases in all cases, in this month the highest number of individual was counted in section "K", which in September decreases suddenly and showed a well-nigh similar distribution in the open water of the Lake Balaton. In October its quantity again increases between sections "G—E".

Polyarthra vulgaris CARLIN *(Fig. 4)*. In May, and in June and October, in sections "M" and "K" the two increases in population may well be observed. In the case of "E" and "G" it so appears that three increases are present in population, but the quantitative differences between the autumnal values are not very convincing. In sectio "A" disgarding the low value in June, the population density is even during the whole period of investigation.

Comparing the results of the examined sections in May we see that as regards species the poorest parts of the Lake Balaton are in the middle ("K" and "G"). The proportions change in the following months so that the middle areas become the richest in the number of individuals. During July—September the high values of population density occur in sections "G" and "E" while in October, the number of individuals is evenly distributed at a high level over the whole area of the open water.

Keratella cochlearis tecta GOSSE *(Fig. 5)*. In sections "M" and "K", this species shows a characteristic late summer (August) development, its population density gradually increases from May until August, then subsequent to this month a pronounced drop may be observed. In section "G" the population seemingly appears with a double increase. In section "A", similarly to sections "M" and "K", it shows a characteristic maximum in August. In section "E" a distinct maximum in population density did not occur in any of the months throughout the whole period of investigation — except in May — the density is even.

With regards to its horizontal distribution this is a characteristically summer developing species, its highest individual number is found in the central parts of the southwestern basin. In the months of spring and autumn its distribution is very nearly even, excepting Keszthely-Bay.

Keratella quadrata MÜLL. *(Fig. 6)*. In section "M", it appears with an even density between May and the autumnal months, in September and October, however, its number decreases to one specimen per litre. In the other four sections the maximum of development is in May. In October, from quantitative point of view in the Rotifera plankton play an inferior role.

As regards horizontal distribution, it may be established that in May its population from section "M" to "E" gradually increases, in June—September, it plays a significant role only in the southwestern basin.

Pompholyx sulcata HUDSON *(Fig. 7)*. In the northeastern basin section "A" and "E" and in section "G" its population density, from May until July, slowly increases, then in August suddenly drops. In larger number they were

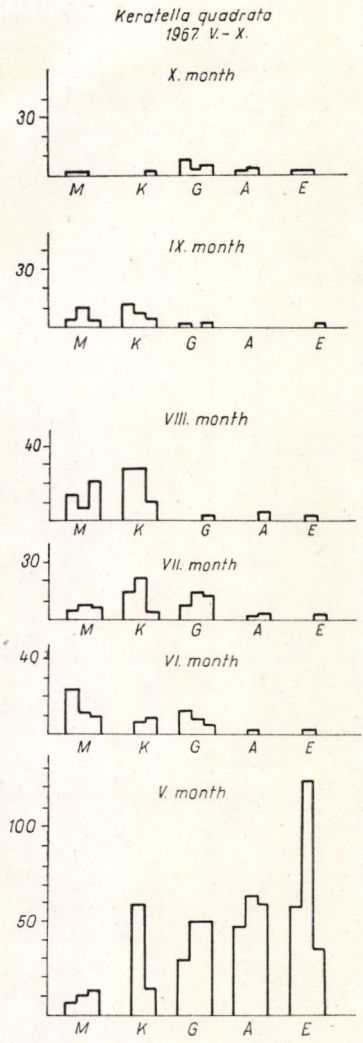

Fig. 5. Monthly change of the number of individuals per litre of *Keratella cochlearis* tecta at 3-3 sites of each section

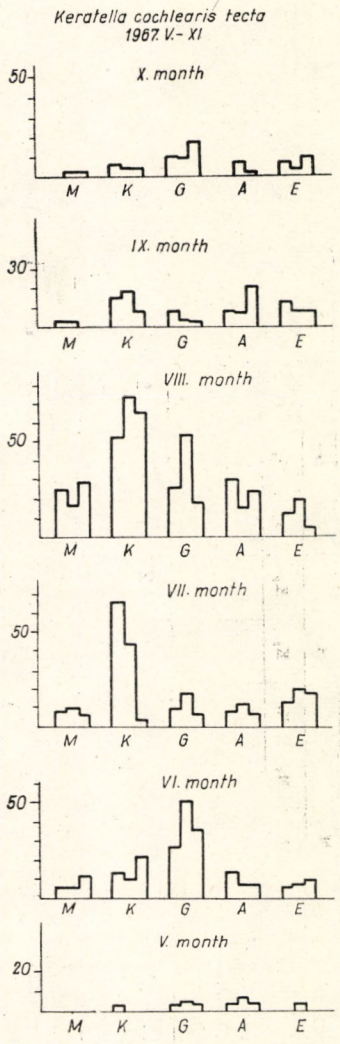

Fig. 6. Monthly change of the number of individuals per litre of *Keratella quadrata* at 3-3 sites of each section

only collected in the area limited by sections "G"—"E". As regards its distribution in the Lake Balaton, its population gradually increases from section "G" towards east, except in October, when the species is evenly distributed in all the three sections; a further exception is the collecting site marked A_0 in July where the highest value was obtained for the whole period of investigation (150 individuals per litre).

Other species. The five species discussed above occurring most frequently are accompanied by some further 19 species *(Table 3)* which, however, with

TABLE 3. QUANTITATIVE DATA OF THE NUMBER OF INDIVIDUALS PER LITRE OF INFREQUENT SPECIES

Species	Data of collection	M			K			G			A			E		
		M_1	M_0	M_2	K_0	K_1	K_2	G_1	G_0	G_2	A_1	A_0	A_2	E_0	E_1	E_2
Asplanchna girodi DE GUERNE	V. 16—18												1		2	
	VII. 19—20											1			2	1
	X. 23											3		1	1	1
Brachionus angularis GOSSE	V. 16—18						2			2			1		2	
	VI. 20			1												
	IX. 19							1								
Brachionus sessilis VARGA	V. 17												1			
	VII. 18—19	4					1	1	10	8	13	9	12	9	5	5
	VIII. 15—16		1		4	38	4	15	6	17	2	8	2	1	5	10
	IX. 19—20		1						1			2		2		
Cephalodella catellina (MÜLL.)	IX. 19							1								
Cephalodella gibba (EHRBG.)	VII. 18						2									
	VIII. 15—16			2								1				
Collotheca balatonica VARGA	V. 18														2	
	VI. 20, 26								1			1		1	8	
	VII. 19—20								6	2		4		1		
	VIII. 15—16							4	6	1	10	7	4	2	1	1
	IX. 20														1	
	X. 23													1		
Collotheca sp.	VI. 26											2	9	3		
	VII. 19—20							3	4	6	6	3		3		
	VIII. 16											6	2			
	IX. 20										1					1
	X. 23											3		4		4
Conochilus unicornis ROUSSELET	V. 16—17	157	38	4		7	6	5	1		3	1				
Filinia longiseta (EHRBG.)	V. 17												1			

Kellicottia longispina (KELLICOTT)	V. 16—18					42	26	26	51	78	27	46	24	57	34	24
	VI. 20, 26			1		1	1	3	2	7	1			3		5
	VII. 18—19	2			6	12	1	4		11			1			2
	VIII. 15	2	1		7	10	1		2	3						
	IX. 19—20	1		3	12		7	2	3	1	2			2	2	1
	X. 17, 23		1	2	2	6	1	14	4	5	2	6	1	6	3	1
Keratella cochlearis macracantha f. *micracantha* LAUTERBORN	V. 16								1							
	VI. 20, 26								1					1		
	VII. 18		1	1	6											
	VIII. 15		1													
	X. 17									5						
Notholca squamula (MÜLL.)	X. 23														1	
Polyarthra major BURCKHARDT	X. 16—17	9	5	3	2	1	1									
Synchaeta oblonga EHRBG.	VI. 20	8	16	19	3	4	1									
	VII. 18—19	5	7	6	55	56	13	2	6	3						
	VIII. 15	2		4			4									
	IX. 19		1													
	X. 23, 26	1									2					
Trichocerca pusilla (JENNINGS)	VI. 20			1												
	VII. 18	4	7		69	89	29	81	63	41	5	9	4	3	5	3
	VIII. 15	5	6	14	22	51	15	19	29	6	28	1	6		11	
	IX. 19—20						1		2		1	2		2	2	4
	X. 23											1	1		1	
Trichocerca rousseleti (VOIGT)	VI. 20, 26		1								1				2	
	VII. 18	2	7	3	6	9										
	VIII. 15		2	4	2											
	IX. 19								1							
Trichocerca stylata (GOSSE)	VII. 18	1														
Trichocerca tenuior (GOSSE)	X. 23											1				
Trichocerca tigris (MÜLL.)	V. 17											1				
	VIII. 16											3				
	X. 13												1			

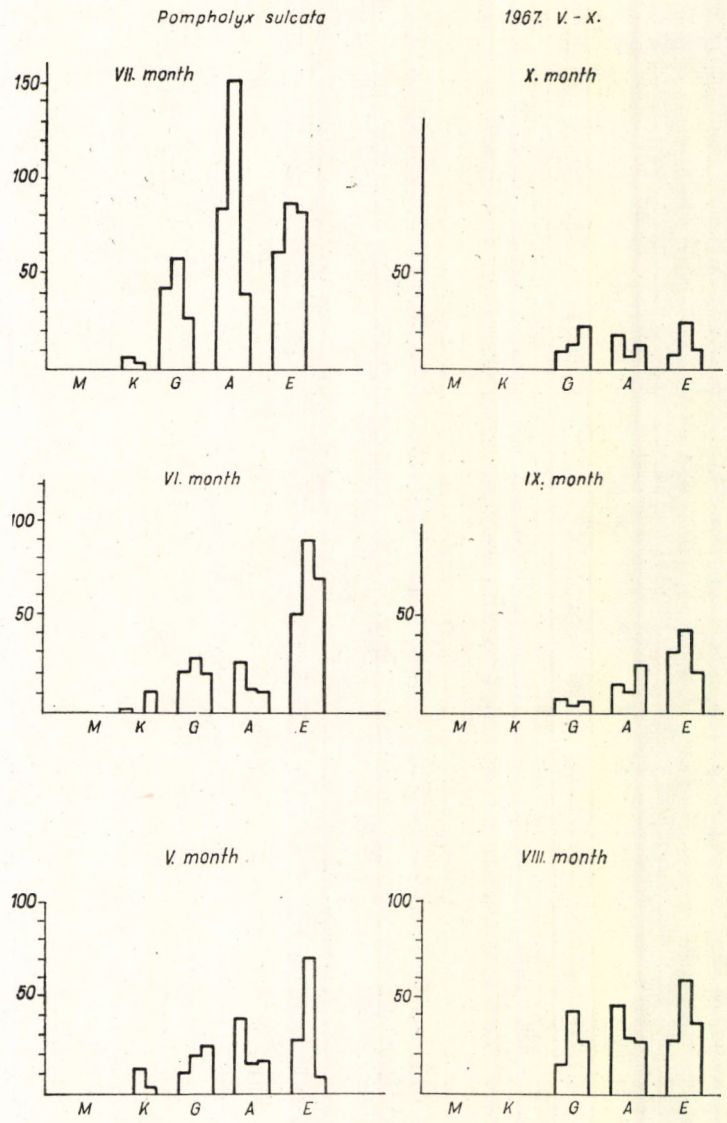

Fig. 7. Monthly change of the number of individuals per litre of *Pompholyx sulcata* at 3-3 sites of each section

regard to their number of individuals play only an inferior role in the Rotifera plankton population of Lake Balaton. The majority of these species (11 species) belongs to the plankton, some inhabits the littoral zone (4 species), others inhabit both the littoral zone and the open water, consequently, they may not be considered exclusively the inhabitants of either habitat (4 species). The appearance of a larger number of individuals in the case of a few species is rather limited to one or two months, while the others occur only sporadically.

The occurence of these species in the various parts of the Lake Balaton supposedly indicates certain changes which have taken place in the quality and composition of the water.

Discussion

On the basis of earlier investigations (SEBESTYÉN, 1953) it was expected that the Rotifera plankton of Lake Balaton for the whole area of the lake in various periods of time displays a great variability in the appearance of species, in distribution and also in the disappearance of species.

The Rotifera plankton investigations carried out from May, 1967 until October, show that as regards the total number of individuals there are two maxima being valid for the whole open water area of Lake Balaton, these maxima occur in May, July and in August. Owing to the lack of early spring samples (March and April) — whose collection due to technical difficulties were postponed — a supposition may be staged that the high number of individuals observed by us in May (first maximum) might perhaps have developed in one of the earlier months. However, quantitative investigations carried out in recent years (SEBESTYÉN et al. 1951; SEBESTYÉN, 1953) prove that neither in March nor in April occurred any high value as regards the number of individuals, furthermore, investigations carried out over a period of seven years also prove that in April of several years a very low value was yielded (15 specimens per litre). In May, on the other hand, in several years a high value for Rotifera plankton was recorded. Investigations of other lakes (KREUTZER, 1934; CARLIN, 1943; HUTCHINSON, 1967; EINSLE, 1967) also make reference that these plankton in the whole year show their highest values in spring-early summer months. Data referring to Lake Balaton show that the species giving the significant mass of Rotifera plankton, those which have been examined by us too *(Keratella cochlearis, Keratella quadrata, Polyarthra vulgaris)* occur in larger or smaller number of individuals throughout the whole year. On the basis of the above thus we may conclude that in spite of the lack of early spring collectings, the maximum occurring in May is valid for the total Rotifera plankton of Lake Balaton.

The results obtained by hydrobiological investigations on several lake in Denmark by NYGAARD (1938) prove conclusively, that in a moderately eutrophic lake the absolute plankton maximum is under normal circumstances in August—October, while the second maximum occurs either in April or in May. The absolute plankton minimum occurs in May—June, rarely at the end of August. The total Rotifera plankton of Lake Balaton also has two maxima, accordingly, our lake also belongs to the group of moderately eutrophic waters. The composition of Chrustaceous plankton as well as the dynamics of population refer to the fact that Lake Balaton, which in 1951 was regarded to be on the borderline of oligo and eutrophic lakes on the basis of investigations carried out that time (SEBESTYÉN, 1953) today, we consider it moderately eutrophic in character.

The peak values of Rotifera plankton appearing in great masses in May and in August can be brought into connection with two ecological factors:

1. The rise in temperature brings about the disappearance of cold stenotherm species *(Filinia longiseta, Notholca squamula)*, and the proliferation of

eurytherm species which until that time occured only in small numbers, and also the appearance of warm stenotherm species *(Pompholyx, Trichocerca, Brachionus sessilis)*. These observations conform to the opinions of other authors who examined the relationship existing between the increase in population and temperature.

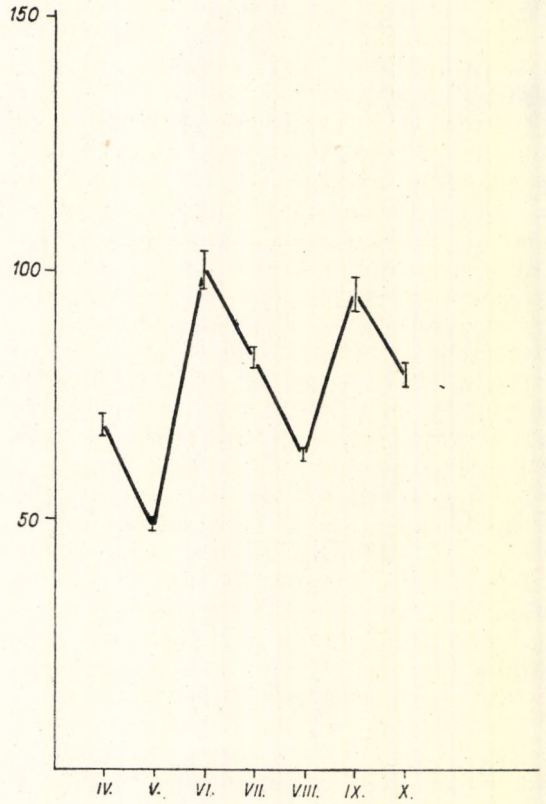

Fig. 8. Monthly change of transparency measured by a Secchi disc in the average of the sample taking places of each section. The scattering of points are shown by the standard divergence from average

2. The bulk of foodstuff of Rotifera consists mainly of algae, bacteria and detritus fragments of about 10 μ in size. Comparing the quantitative increase of bacterial plankton taken at the same time when our collectings were done, with the seasonal changes of total Rotifera individuals we could establish relationships as regards individual sections. Thus, in the case of section "M", Oláh (1969) has shown that parallel with the Rotifera maximum an increase in bacterioplankton was present. Similar foodstuff enrichment could be established both in the case of section "A" and "E" in the maxima occurring in May. In other cases, a quantitative increase of bacterioplankton was closely followed in the next month by an increase in Rotifera population (in the case of sections "G" and "E" in July).

Comparing the maximal density of the population with the transparency data measured at the same time *(Fig. 8)* — which, in fact, are nothing else

than floating seston being proportional to their quantity and refer to the accessible food supply changes for Rotifera — relationships can be established between them. In May and in August, when transparency is very small for all the section in other word, the foodstuff concentration was high, the Rotifera population showed a spring maximum. In June and in September, we observed the exact reverse of the above. Numerous literary data (NÁDAY, 1914; SEBESTYÉN et al. 1951; EDMONDSON, 1960, 1965; HUTCHINSON, 1967) put forth the supposition of existing relationship between the magnitude of Rotifera population and the quantity of foodstuff.

Species occurring in the biggest number of individuals of the Rotifera plankton in Lake Balaton also occur in the majority of European freshwaters, therefore, they are regarded less sensible to the chemical and other conditions of the water. The seasonal changes in their population in the various waters are frequently diverging, so much so, that they may even display differences in the same lake year after year.

In examining the seasonal changes of the *Keratella cochlearis* population certain authors found two maxima. Thus, for example, EINSLE (1967) in Mindelsee, where the summer temperature of the water does not exceed 20 °C, recorded one maximum in the middle of April, and another one at the end of September. On the other hand, RUTTNER (1930) could not establish a regular periodicity in the seasonal changes of population. KREUTNER (1934) from Lake Sulan in Silezia for two years secured samples every 14 days, and making analysis he found that in both years the maximum occurred in May. In the summer-autumn period one or two population increase may also occur. In Lake Balaton, in the years of 1936—1937 no spring maximum could be shown, while in 1938 definite maxima occurred in May and in September. In later years, the maximum number of individuals appeared in January, February and in September (SEBESTYÉN, 1953). Comparing our results with the most recent data of investigations (number of individual layers per litre, taken as mean values) it appears that the result obtained for section "A" in the examined six months decreased in the light of values received in 1951 (in 1951: 58 specimens per litre; in 1967: 16 specimens per litre).

Polyarthra vulgaris like in other water often comes second after *K. cochlearis* (KOCH ALTHAUS, 1963; EINSLE, 1967; NIPKOW, 1952). In the lakes of Switzerland two cycles of proliferation have been observed one in the beginning of July and the other one in October (NIPKOW, 1952). In Lake Balaton, in 1967 the population of *P. vulgaris* increased in spring and autumn only in sections "M" and "K", which may perhaps conform to two cycles of proliferation. The unequivocal increase in population occurred only in October in every section. However, recent investigations embracing a number of years (SEBESTYÉN, 1953) show that there is a slow population increase in summer (July and August), and one in late autumn. Certain modifications taking place in the population dynamics of the species (maximum divergencies) can supposedly be explained by the changes occurring in the food supply of the lake. Paying due attention to the changes in the number of individuals per litre, and comparing them to the results obtained in the years of 1947 and 1951 we find a thinning in population in the case of this species.

Species *Keratella cochlearis tecta* was regarded on the basis of earlier investigations (SEBESTYÉN, 1958) carried out in the lake stretching before Tihany Peninsula, to be an autumnal form, for the biggest number of individ-

uals was found between August and October. However, in 1967 the highest number of individuals was observed in the months of June—August. Further investigations are needed to decide whether it is a characteristic summer or autumn developing species. Comparing the population data with that of years 1947 and 1951 we find a decrease.

Species *Keratella quadrata* on the basis of literary data (SEBESTYÉN et al. 1951; HUTCHINSON, 1967; EINSLE, 1967) during the whole year may sporadically occur, still it is characteristically a species developing in spring. In Lake Balaton, taking into consideration earlier results generally it yields a maximum in May. Investigations carried out in deep lakes (KOCH ALTHAUS, 1963) point out that simultaneously with a rise in temperature the specimens of the species retreat into deep water layers. In Lake Balaton, it seems to bear up well to the higher temperature (19 °C) of the water.

Species *Pompholyx sulcata* in the literature is generally mentioned as a summer species, in Lake Balaton, too, it yields its maximum in July, August (SEBESTYÉN, 1953). In 1967, the biggest population density was in July, whose values for the number of individuals well surpassed the data of earlier years.

Comparing the results of 1930s and 1940s it appears (SEBESTYÉN, 1953) that the population of the species *Keratella cochlearis, K. c. tecta* and *Polyarthra* in the recent years increased in Lake Balaton. Our present investigations in connection with these species ascertained a decrease in the population. In order to decide whether the population of these three species really shows a decreasing tendency or the values obtained were characteristic only for 1967, further investigations are needed covering the whole area of the lake. About the probable cause of this change and about the phenomenon itself we must say a few words because the great decrease observed in section "A" in 1967 compared to the data of 1951 is very significant.

	1951, SEBESTYÉN	1967, P.-ZÁNKAI—PONYI	Decrease
Keratella cochlearis	58 sp/l	16 sp/l	3.6×
Keratella cochlearis tecta	53 sp/l	13 sp/l	4.0×
Polyarthra vulgaris	46 sp/l	23 sp/l	2.0×

sp = number of specimens.

The numerical data are the calculated mean values from 4—4 sections of the identical four months.

Comparing the average values of other sections e.g. "K" for the very same species of period of time with the data obtained by Sebestyén in front of Tihany we can see that the decrease of *K. cochlearis* and *K. c. tecta* is only 1.6×, while the same for *Polyarthra* the values for specimens per litre are the same. The example described above and the previously presented data suggest two conclusions.

1. The changes and dynamics in the zooplankton conditions of Lake Balaton can hardly be elucidated on the basis of even detailed and regular investigations carried out in one section, because at the same time, in the different water areas the population of Rotifera and Crustacea (PONYI, 1968) also differ from each other.

2. Certain Rotifera species — if not to such a great extent as in section "A" — decreased in some degree in every section when compared to the values of 1951. Perhaps one of the causes may be attributed to the wide-scale application of DDT from years 1957—58 in the lake and its environment (cf. PONYI et al. 1968).

The role of Rotifera in saprob-system is not great (LIEBMANN, 1962), still it appears that certain species groups with regard to trophism may be significant (KOCH ALTHAUS, 1963; BERZINS, 1949; LILIEROTH, 1950). Many of these species also occur in Lake Balaton, some of them in small *(Brachionus angularis)*, others in large population density *(Pompholyx sulcata)*. *Trichocerca pusilla* which is regarded to indicate the onset of eutrophic processes by many authors, in the central sections of the lake its population is also very high. These facts also refer (cf. also p. 301) to the moderately eutrophic condition of the lake.

Summary

1. With regard to the quantity of the total Rotifera significant difference occurred between Keszthely-Bay and the open water areas of the lake. The average values per section during the whole period of investigation in Keszthely-Bay yielded 64 sp/l, while for the other sections ("K"—"E") this value fluctuated between 125 and 171.

2. The number of individuals of the total Rotifera plankton in every section increase twice (perhaps three times?).

3. The 24 species determined during the investigations, including varietas and forms too, five species *(Keratella cochlearis, K. c. tecta, K. quadrata, Polyarthra vulgaris* and *Pompholyx sulcata)* can be regarded as the main components of Rotifera plankton in Lake Balaton. From among these species the population of *K. quadrata* and *P. sulcata* increases once in the whole area of the lake. *K. cochlearis* and *K. c. tecta* show two maxima in the middle part of the lake ("K"—"G"), while towards the two ends of Lake Balaton they show only one maximum. *Polyarthra* shows clear population increase twice only in Keszthely-Bay, while in the other parts of the lake apparently it shows three maxima. The development of maxima generally may be placed in the month of May, and in August and October.

4. The quantitative change of the Rotifera plankton is inversely proportional with Secchi (transparency); i.e. apparently it is directly proportional with the concentration of the formed foodstuff.

5. The population changes and dynamics of Rotifera plankton cannot be elucidated even by detailed and regular investigations if it is restricted to only one section, because investigating the different areas of the lake in the same time, the development of Rotifera population may differ from one another.

6. The double population increase of the total Rotifera plankton and the proliferation of species indicating eutrophic processes apparently prove that Lake Balaton may be ranged among the moderately eutrophic waters.

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A BALATON ROTATÓRIA PLANKTONJÁNAK MENNYISÉGI VISZONYAI 1967-ES ÉVBEN

P.-Zánkai Nóra és *Ponyi Jenő*

Összefoglalás

1. Az összes Rotatória mennyisége szempontjából, jelentős különbség mutatkozott a Keszthelyi-öböl és a tó nyíltvízi területei között. Az egész vizsgálati időszak szelvényenként átlagértékei db/lit.-ben kifejezve a Keszthelyi-öbölben 64, a többi szelvényben („K"–„E") 125–171 között változtak.

2. A teljes Rotatória plankton egyedszáma az összes szelvényeken kétszer (esetleg háromszor?) emelkedik.

3. A vizsgálatok alkalmával talált 24 faj, varietas és forma közül 5 faj *(Keratella cochlearis, K. c. tecta, K. quadrata, Polyarthra vulgaris* és *Pompholyx sulcata)* tekinthető a Balaton plankton Rotatóriai fő alkotóelemeinek. E fajok közül a *K. quadrata* és a *P. sulcata* népessége a tó egész területén egyszer emelkedik. A *K. cochlearis* és *K. c. tecta* a tó középső tájain („K"–„G") kettő, míg a Balaton két vége felé egy maximumot mutat. A *Polyartha* csak a Keszthelyi-öböl és környékén mutat határozottan 2 népességemelkedést, míg a tó többi területein úgy tűnik, hármat. A maximumok kifejlődése általában május, ill. augusztus és október hónapokra tehető.

4. A Rotatória plankton mennyiségének változása fordítottan arányos a Secchi-átlátszósággal, azaz úgy látszik, egyenesen arányos a formált táplálék koncentrációjával.

5. A Balaton Rotatória népességének változása és dinamizmusa egyetlen szelvény részletes és rendszeres kutatása alapján nem ismerhető meg, mivel közel azonos időben vizsgálva a tó különböző területeit, a Rotatóriák népességének kifejlődése egymástól eltérhet.

6. Az össz-Rotatória plankton népességének kétszeri emelkedése, valamint az eutrófizációt jelölő fajok elszaporodása alapján feltételezhetően tavunkat a mérsékelten eutróf jellegű vizekhez kell sorolni.

КОЛИЧЕСТВЕННОЕ ИССЛЕДОВАНИЕ ПЛАНКТОННЫХ КОЛОВРАТОК В ОЗЕРЕ БАЛАТОН В 1970 ГОДУ

П.-Занкаи Нора и *Е. Пони*

1. В отношении общего числа коловраток отмечены значительные различия между Кестхейскими заливом и открытой частью озера. Средние для всего периода исследования значения на разрез соответствуют в Кестхейском заливе 64 вида/л, тогда как в других разрезах («К» — «Е») значения колеблются между 125 и 171.

2. Число особей общего планктона коловраток в каждом разрезе увеличивается в 2, а возможно и в 3 раза.

3. Определяющими в течение периода исследований являлись 24 вида, включая разновидности и формы; из них пять видов *(Keratella cochlearis, K. c. tecta, K. quadrata, Polyarthra vulgaris, Pompholyx sulcata)* можно считать главными компонентами планктона коловраток Балатона. Из них по всей области озера однажды увеличивается популяция *K. quadrata* и *P. sulcata*. *K. cochlearis* и *K. c. tecta* проявляют два максимума в средней части озера («К» — «G»), а в направлении к двум концам озера они проявляют только один максимум. *Polyartha* проявляет чёткий рост популяции дважды только в

Кестхейском заливе, тогда как в других частях озера этот вид как будто имеет 3 максимума. Их развитие обычно происходит в мае, в августе и в октябре.

4. Количественные изменения планктона коловраток находятся в обратной зависимости от изменений показателя прозрачности по Secchi, то есть по-видимому в прямой зависимости от концентрации образующихся кормовых веществ.

5. Изменения популяции и динамика планктонных коловраток не могут быть выяснены на основе даже детальных и регулярных исследований, если они ограничены только одним разрезом, потому что в разных частях озера развитие популяции протекает различным обрезом.

6. Двойное увеличение популяции общего планктона коловраток и пролиферация видов, характерных для эутрофических процессов, вероятно свидетельствуют о том что Балатон может быть отнесен к разряду умеренно эутрофных озер.