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ZOOBENTHOS INVESTIGATIONS IN THE SALINE WATERS OF THE GREAT HUNGARIAN PLAIN

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Introduction

The investigation of the saline waters of the Great Hungarian Plain began at the end of last century but in an organized form it has only taken place since 1961, under the auspices of the Academy Committe in Szeged, led by J. MEGYERI (PÓNYI, 1961). The research of these small waters is justified, apart from faunistic points of view, by particularly interesting physical, chemical, biological connections (KREUTZER, 1940).

The most important factors that determine their state of being and character are: their small size and periodical character. The other, biotic and abiotic, effects that influence one another in a complex way and jointly induce the fauna characteristic of the saline waters, ensue from those.

The smaller a water unit is, the more determinative the s i n g l e factors (chemical, climatic, physical, biological, etc.) become. It is not our aim to force these small water units, that are so interesting owing to their variability and plasticity, into a rigorously stereotyped form; we are rather endeavouring to recognize their fundamental regularities: all the same, some degrees of the „saline" character can be recognized on the basis of the zoobenthos investigations.

Methods

The samples were taken from three „lakes", from open water, and from near the shores, from among the vegetation, in about 200 cm^3 units. They were hand-selected after being rinsed through a metal sieve of 0.25 x 0.25 mm meshes. Then the animals were fixed in 6% formalin.

Characterization of the collecting stations

They are generally shallow waters (from a few cm to a depth of 1.5 m) of lesser extent (0.5 to 1.5 sq.km), that are in the main astatic, but in winter sometimes frozen to the bottom. The pH of the water varies between 8.2 and 10.2, according to the degree of desiccation. The quantity of water depends on the precipitation and the evaporation. Cation types: Na–Mg, anion types: CO_3–HCO_3. The shores are generally overgrown in a 1–2 m broad strip with higher-order vegetation (reed, sedge, etc.) and farther in, even some submerged vegetation may be found sporadically.

We carried out seasonal collections from 1965 until 1967 in the following saline waters: „lake" at Őszeszék and Pusztaszer – on ten occasions, „lake" at Kakasszék – on nine occasions.

As regards their origin, these saline „lakes" belong to two types (ANDÓ, 1966): those developed in an ancient river bed (e.g. Kakasszék) and those originating in deflated depressions (e.g. Őszeszék, Pusztaszer).

Lake at Őszeszék

The water is a maximum of 1,5 m deep; in the places investigated it was a minimum of 2–3 cm, and a maximum of 90 cm deep. It newer dries up completely; even in warm summers without precipitation there is a water coverage of 10–20 cm. At the shores, in a 50–150 m broad strip, there was *Phragmites–Carex* association, and in the open water *Potamogeton, Ceratophyllum* and *Chara fragilis* were to be found. The substratum is sandy clay. The water is clear, and relatively well transilluminated. The sodium content of the water is moderate compared with other saline waters. Water pollution: III.

In the material of the total of 24 collections 7616 individuals were found. The percentage of the taxonomic groups is shown by Fig. 1. The guantitative and qualitative abundances of the lake are shown unequivocally. This can be explained partly by its being less polluted, partly by its rich vegetation.

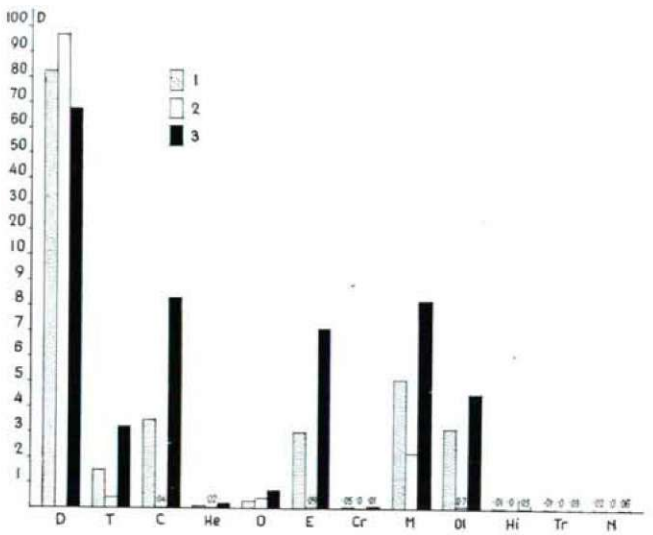

Fig. 1. Őszeszék: D values of the zoobenthos taxonomic groups

1: overall data

2: no vegetation; open water fauna

3: rich in vegetation; litoral fauna

D: Diptera, T: Trichoptera, C: Coleoptera, He: Heteroptera, O: Odonata, E: Ephemeroptera, Cr: Crustacea, M: Mollusca, Ol: Oligochaeta, Hi: Hirudinoidea, Tr: Trematoda, N: Nematoda

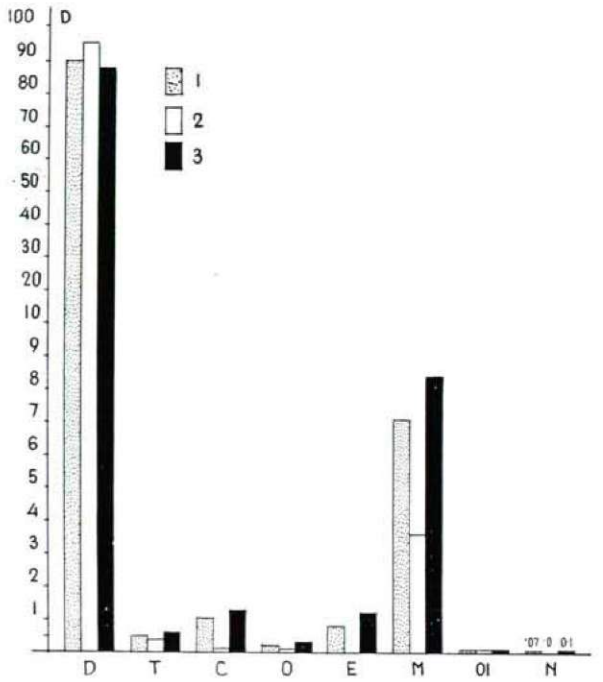

Fig. 2. Kakasszék I: D values of the zoobenthos taxonomic groups (others as in Fig. 1)

Lake at Kakasszék

Its long, narrow bed is divided by a food-path into two parts that do not communicate with each other (lake units I and II). In lake II, during the time of investigation – about half a year – a duck-farm was established, as a result of which this lake was characterized by the presence of abundant, decomposing organic matter and by sapropelic silt.

At the shore-strip of the water that dries up almost fully at intervals there are *Phragmites-Carex* associations, and only the middle of the bed is plant-free. In the parts investigated, the water depth varied between 2 and 100 cm. The substratum is sandy mud. The water is clear, limpid and comparatively well-transilluminated. The water is characterized by a very high $NaHCO_3$ content. It is extra-class IV, highly polluted.

Lake No. I: The percentage distribution of the 2769 individuals found in 28 bottom samples can be seen for the individual taxonomic groups in Fig. 2.

Lake No. II: The percentage distribution of the 3255 individuals found in 26 bottom samples can be seen for the individual taxonomic groups in Fig. 3.

The difference between the two lake units is manifested mostly in the

numerical ratio of the Oligochaeta. In lake II (as a result of the duck-manure) on the basis of the D-values of this group, this was in the second place for the four saline lakes investigated.

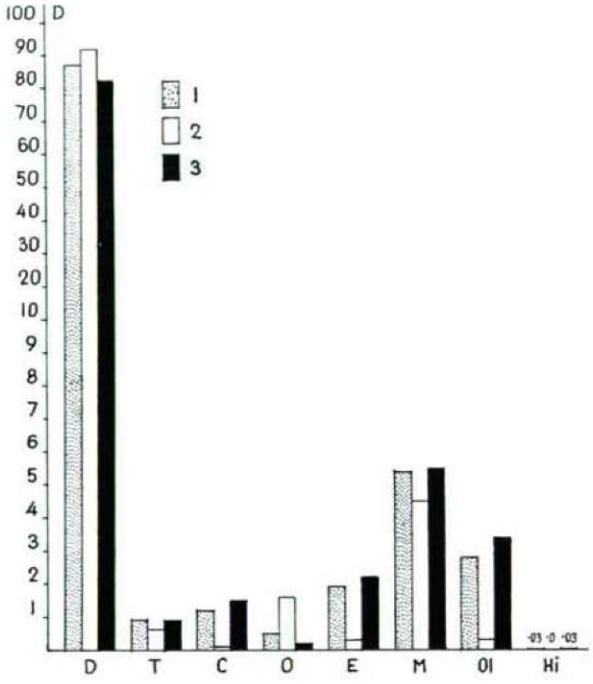

Fig. 3. Kakasszék II: Dvalues of the zoobenthos taxonomic groups (others as in Fig. 1)

Lake at Pusztaszer (Dongér)

In contrast to the above, the water of this lake is troubled, and greyish-white owing to the large mass of floating matter; it is less transilluminated. From time to time it dries up fully (summer drought). It is markedly of astatic type. It is the shallowest of the four lakes, its maximum depth being 50 cm. Its shore is sporadically dotted with a thin vegetation *(Carex, Elocharis),* with much *Nostoc* among the plants and farther in. The substratum of the open water is naked, consisting of clayey sand. It is a typcila saline water, characterized by a high soda content. It is extra-class IV, highly polluted.

In the material of the 26 collections the percentage distribution of the 5433 individuals according to taxonomic groups is shown in Fig. 4. The dominance of Diptera is the highest here; the D-values of the other taxons, however, are very low (being in this respect similar to the lake I, Kakasszék), except for Nematoda, found only here in larger numbers.

Evaluation of results

The very high D-value of Diptera agrees in all the four lake units investigated, and this in valid generally for the saline waters in this country, e.g.: Kunfehértó 78.3, Kardoskút 72.3 (FERENCZ, 1965; 1967).

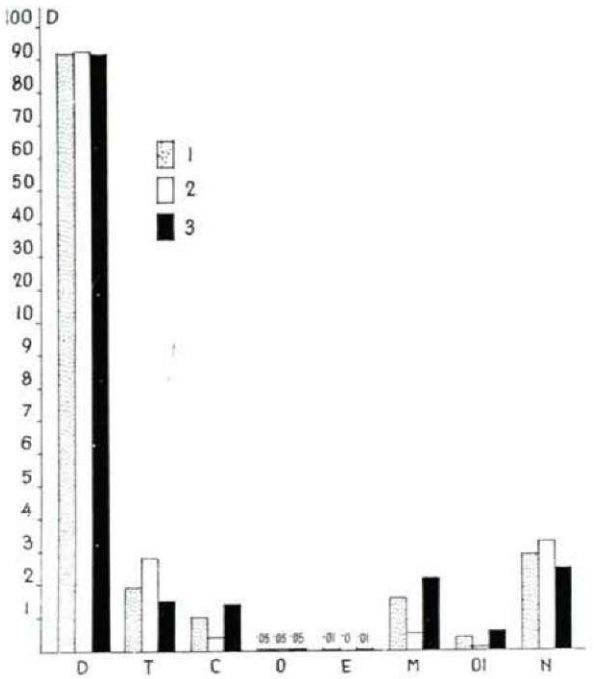

Fig. 4. Pusztaszer: D values of the zoobenthos taxonomical groups (others as in Fig. 1)

Considering the shore strip that is very rich in vegetation and the generally naked substratum of the open water (according to the fact and degree of their being stocked), we see that, on the one hand, in the fauna of the substratum in the open water the dominance of Diptera is still more marked; on the other hand, the members of more taxonomical groups live among the plants (Figs. 1–4, and Table). Where the higher-order vegetation is negligible (Pusztaszer), there is, of course, no considerable difference in the fauna of the middle water and that close to the shores.

The qualitative and quantitative seasonal change in the zoobenthos fauna is indicated by the autecology of the species. In the case of a larger water of permanent character the change in seasons makes its influence felt in only a roundabout way, but for small waters it can have a direct and fundamental effect upon the life of the species living there (e.g. if the water has dried up completely or frozen solid). Only species showing great adaptability can survive

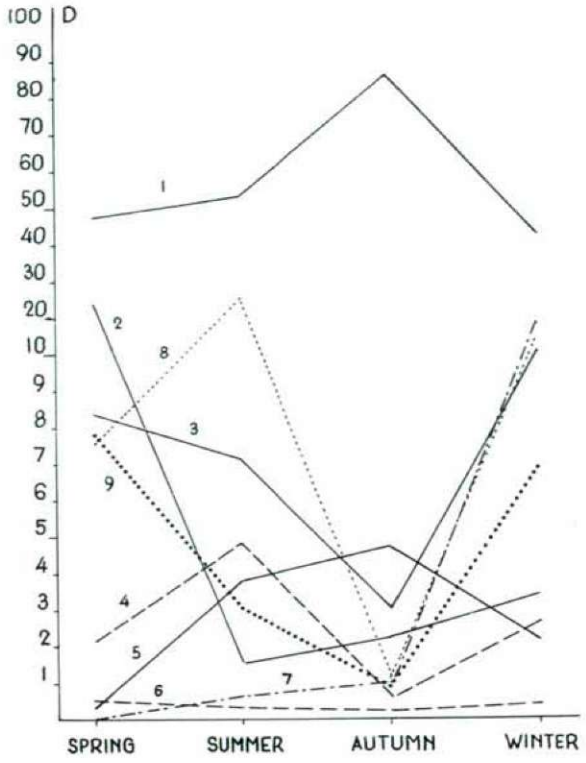

Fig. 5. Seasonal variations in the important taxonomic groups at Őszeszék
1: Chironomidae, 2: Ceratopogonidae, 3: other Diptera, 4: Trichoptera, 5: Coleoptera, 6: Odonata, 7: Ephemeroptera, 8: Mollusca, 9: Oligochaeta

under extreme conditions like these. In addition, we must consider some other abiotic factors, too, given by the shallowness and relatively small extent of the saline waters, which exert a stronger effect on their life, e.g. the great annual and daily fluctuations in temperature, the relatively larger amount of the mass of deposits as compared to the mass of water, the precipitation and evaporation, as well as the more immediate influence of the terrestrial environment, etc.

The seasonal changes in the zoobenthos populations do not show an unequivocal picture about the character of saline waters, or the water type itself. A cause of this may possibly be the unsatisfactory number of samples, and their disproportionate distribution according to the seasons, too. It must be mentioned, however, that the results of investigations of a similar character in rice-fields (KOWALSKI, 1964) were similar and that these biotops provide in many respects similar conditions for the benthos fauna, reminiscent of saline waters.

The desiccation and drying up in late summer and early autumn results in the decrease of the individual number of taxonomic groups, except for

Diptera. The prominence of the D-value of Ceratopogonidae (except in Őszeszék) in this period, when they gave for instance about 95 per cent of the total individual number in the samples got from the wet mud, is particularly striking.

The results of the zoobenthos investigations of saline waters in the Hungarian Plain therefore indicate that the major part of the species living here (Ceratopogonidae, Chironomidae) show a preference for these water types, being able to accommodate themselves in a high degree to the astatic conditions that are characteristic of these waters.

The dominant group of the saline water at Kunfehértó, that is similar to the salt lake at Őszeszék, is the Chironomidae; and in the saline water at

D-values of Diptera groups in the individual saline waters:

	Őszeszék	Kakasszék I.	Kakasszék II.	Pusztaszer
Chironomidae	85.8	78.7	78.1	59.0
Ceratopogonidae	7.7	17.1	20.0	39.5
other Diptera	6.4	4.1	1.8	1.4

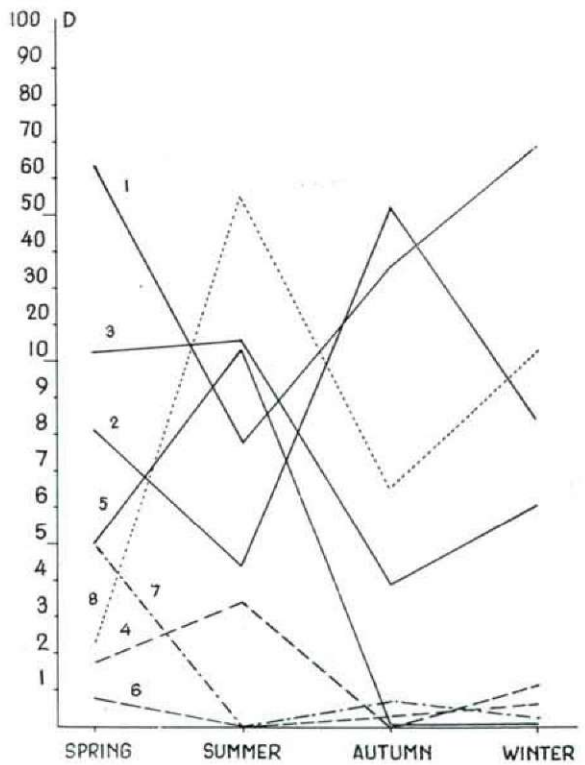

Fig. 6. Seasonal variations in the important taxonomical groups at Kakasszék I (others as in Fig. 5)

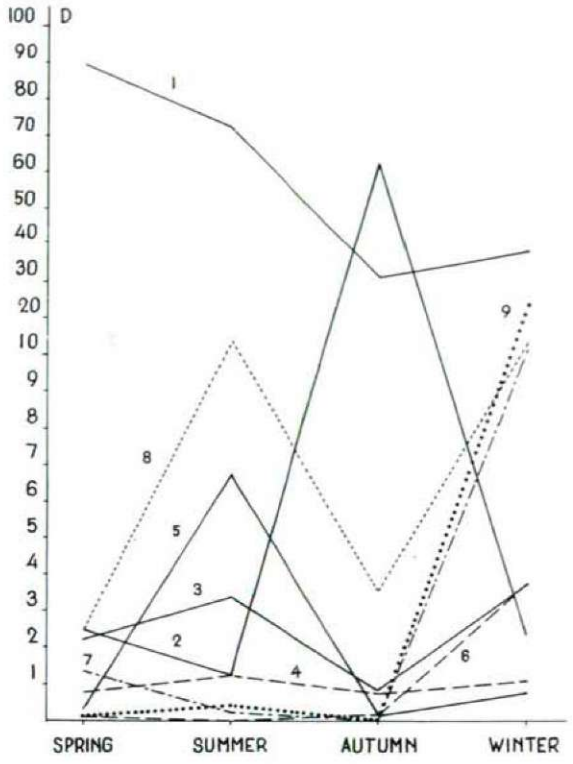

Fig. 7. Seasonal variations in the important taxonomical groups at Kakasszék II (others as in Fig. 5)

Kardoskút that, similarly to the water at Pusztaszer, has a more saline character, the dominant group is the Ceratopogonidae.

It seems that in the majority of cases the members of the groups Ceratopogonidae and Chironomidae complement one another in respect of amount. The maximum of the Ceratopogonidae is usually in autumn, in the case of decreased water and high pH (10–10,2). The maximum of the Chironomidae falls in spring (Kakasszék, Pusztaszer), or in autumn (Őszeszék).

In samples collected from below the ice, the richness in fauna of the biotops lying close to the shores and abundant in plants does not differ considerably from the others (Őszeszék). The plant-free substratum of the frozen lake at Pusztaszer, on the other hand, showed under similar conditions low quantitative and qualitative results of the zoobenthos.

The Oligochaeta, that are generally one of the most populous groups of the bottom fauna of the rivers, form only a very low percentage of the substratum fauna of saline lakes:

Kakasszék I.:	0.1	(Tubificidae:	100 %)
Kakasszék II.:	2.8	(Tubificidae:	97.87 %,
		Naididae:	2.12 %)
Pusztaszer:	0.4	(Enchytraeidae:	100 %)
Őszeszék:	3.1	(Tubificidae:	90.87 %
		Naididae:	1.24 %
		Enchytraeidae:	6.22 %
		Lumbricidae:	1.65 %)

The distribution of Oligochaeta in the three saline waters is as follows:

Őszeszék:	66.02 %
Kakasszék	26.57 %
Pusztaszer:	7.39 %

Their distribution (abundance and dominance) according to the seasons is as follows:

	A	D
spring	140	38
summer	16	4.38
autumn	46	12.60
winter	163	44.65

Taking in to consideration both the individual and the species numbers, the characteristically sodic Pusztaszer lake is conspicuous with its low values. Comparing this facts with the Ceratopogonidae group, showing a maximum D-value at the same place, the change in the ratio of the two taxonomic groups brings about the order of sequence of the saline lakes. This sequence, in the proportion of increasing sodification is: I. Őszeszék, II. Kakasszék, III. Pusztaszer.

The species of the Tubificidae familia, with the highest individual number, are distributed in the following manner:

	Őszeszék		Kakasszék	
	A	D	A	D
Limnodrilus udekemianus CLAP.	158	72.14	75	78.94
Limnodrilus claparedeanus RAT.	—	—	8	8.42
Tubifex tubifex MÜLL.	40	18.26	—	—
Psammoryctes moravicus HRABE	18	8.21	—	—
indet. Tubificidae	3	1.36	12	12.63
	219		95	

Limnodrilus udekemianus, that gave 63.83% of all the Oligochaeta, is doubtless the leading species of the saline-dwelling Annelida. Studying its autecology (KENNEDY, 1966; SZCZEPANSKI, 1953), it can be established that the limit of its tolerance towards the different kinds of water and substrata is very broad – euryvalent. According to the data of the literature and to my own observations, as well, however, the substrata of the waters that are richer in organic matter are preferred by the individuals of this species. For instance,

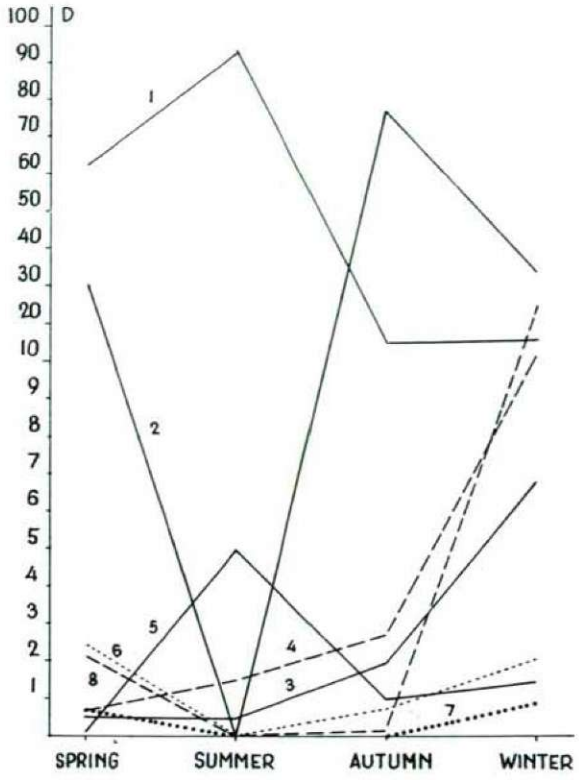

Fig. 8. Seasonal variations in the important taxonomical groups at Pusztaszer
1: Chironomidae, 2: Ceratopogonidae, 3: other Diptera, 4: Trichoptera, 5: Coleoptera, 6: Mollusca, 7: Oligochaeta, 8: Nematoda

at Szarvas (Institute of Fishculture) in the water of a shallow drainage ditch coming from a duck-pond (brought about in connection with duck breeding) they showed maximum D-values, too. It must be noted that in lake II at Kakasszék the individuals of this species were again dominant, giving about 80 % of all the Oligochaeta individulas there. And 72 % of the otherwise rich and variegated Oligochaeta population at Őszeszék belonged, to this species too. At the same place, individuals of this species were collected during the whole year, and there were even 61 individuals in a sample from the bottom of the frozen lake.

It is noted here that the individuals of *Limnodrilus udekemianus* in this water were infected in 20–25 % by a Sporozoa species: *Haplosporidium limnodrilii* GRANATA whose individuals, that were in various phases of development, frequently completely filled the cavity of the posterior body of the infected worms.

Summary

Evaluation of the results of 3 years' zoobenthos investigations in the saline „lakes" of the Great Hungarian Plain has established that in these shallow, partly astatic waters the Diptera taxonomic group is unequivocally dominant. The species of the Ceratopogonidae and Chironomidae appear generally to complement one another quantitatively. The most extreme, plantless, typical saline (natron) waters are characterized by the dominance of Ceratopogonidae, and the subdominance of Nematoda instead of Mollusca. At the same place, the Oligochaeta are represented exclusively by the Enchytraeidae family. The saline waters containing higher organic-matter pollution, and those richer in vegetation, on the other hand, are characterized by Tubificidae, and within these the *Limnodrilus udekemianus* CLAP. The seasonal changes of the zoobenthos are not characteristic and not unequivocal. The fauna of the beds rich in vegetation, however, is always more abundant.

Table

Taxonomic groups	Őszeszék		Kakasszék I.		Kakasszék II.		Pusztaszer	
	a.	b.	a.	b.	a.	b.	a.	b.
D.	+	+	+	+	+	+	+	+
T.	+	+	+	+	+	+	+	+
C.	+	+	+	+	+	+	+	+
He.	+	+						
O.	+	+	+	+	+	+	+	+
E.	+	+		+	+	+		+
Cr.		+						
M.	+	+	+	+	+	+	+	+
Ol.	+	+	+	+	+	+	+	+
Hi.		+				+		
Tr.		+						
N.		+		+			+	+

a. = open water, no vegetation; b. = litoral, with vegetation;

D. = Diptera; T. = Trichoptera; C. = Coleoptera; He. = Heteroptera; O. = Odonata; E. = Ephemeroptera; Cr = Crustacea; M = Mollusca; Ol. = Oligochaeta; Hi. = Hirudinoidea; Tr. = Trematoda; N. = Nematoda.

Species:	Őszeszék	Kakasszék	Pusztaszer
Diptera:			
Corethra plumicornis FAB.		+	
Culex hortensis FIC.	+		
Culex pipiens L.	+		
Dolichopus sp.			+
Eristalis tenax L.	+		
Stratiomyida sp.			+
Tabanida sp.			+
Tipulida sp.			+

Species:	Őszeszék	Kakasszék	Pusztaszer
Trichoptera			
Athripsodes aterrimus STEPH.	+		
Limnephilus lunatus CURT.	+	+	
Limnephilus incisus CURT.			+
Limnephilus xanthodes MCLACH.	+		+
Oecetis furva RAMB.	+		
Oecetis lacustris PICT.	+	+	+
		+	
Coleoptera			
Agabus biguttatus OLIV.	+		
Berosus spinosus STEV.	+		+
Bidessus geminus FABR.	+	+	
Coelambus parallelogrammus AHR.	+		
Colymbetes fuscus L.	+	+	
Cybister laterimarginalis DEG.	+		
Cyphon variabilis THUN.			
Dytiscus marginalis L.		+	+
Enochrus melanocephalus OL.	+		
Haliplus fulvus FABR.	+		+
Haliplus confinis STEPH.	+	-	
Hyphydrus ovatus L.			
Hybius subaeneus ERICHS.			
Laccophylus obscurus PANZ.	+		
Limnius troglodytes GYLL.	+	+	
Noterus clavicornis DEG.	+		+
Noterus crassicornis MÜLL.	+	+	
Octhebius impressus MARSH.	+		+
Peltodytes caesus DUFT.	+		
Heteroptera		+	
Corixida sp.			+
Ephemeroptera			
Cloeon dipterum L.			
Crustacea			
Asellus aquaticus L.	+		
Mollusca (+)			
Anisus spirorbis L.			+
Chondrula tridens O.F.M.	+	+	
Helicopsis striata O.F.M.		+	
Planorbis spirorbis L.		+	
Pupilla loessica LOZ.		+	
Segmentina nitida O.F.M.	+	+	
Succinea oblonga DRAP.	+		
Truncatellina cylindrica FÉR.		+	
Vallonia costata M.		+	
Vallonia enniensis GREDL.	+	+	
Vallonia pulchella M.		+	
Vertigo pygmaea DRAP.		+	
Hirudinoidea		+	
Helobdella stagnalis L.			
		+	

(+) det.: Dr. A. RICHNOVSZKY.

References

ANDÓ, M. (1966): Mikroklimaverhältnisse der sodahaltigen Teiche im sündlichen Teil der Grossen Tiefebene. — Acta Georg. *6*, 23—53.

FERENCZ, M. (1965): Beiträge zum Zoobenthos des Weissen-Teiches (Fehértó) bei Kardoskút. — Acta Biol. *11*, 265—269.

FERENCZ, M. (1967): Beiträge zur Zoobenthos-Untersuchungen des Kunfehértó. — Acta Biol. *13*, 63—70.

KENNEDY, C. R. (1966): The life history of *Limnodrilus udekemianus* CLAP. (Oligochaeta: Tubificidae). — Oikos *17*, 10—18.

KOWALSKI, H. (1964): Untersuchungen über die Bodentierwelt eines Reisefeldes. — Zschr. angew. Zool. *51*, 49—106.

KREUTZER, R. (1940): Limnologisch-ökologische Untersuchungen an holsteinischen Kleingewässern. — Arch. für Hydrobiol. *10*, 359—572.

PÓNYI, J. (1961): Zoologische Erforschung der Natrongewässer der grossen ungarischen Tiefebene. — Áll. Közl. *48*, 117—124.

SZCZEPANSKI, A. (1953): Variations of the population of the bottom living Oligochaeta in the Vistula. — Polskie Arch. Hydrob. *14*, 227—250.

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