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ZOOLOGICAL INVESTIGATIONS IN THE OPEN WATER *POTAMOGETON PERFOLIATUS* STANDS OF LAKE BALATON

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The striking qualitative change in the water of Lake Balaton is indicated, among others, by the numerical increase of algae, the change in the specific proportion of phytoplankton (TAMÁS, 1972), the extensive distribution of *Stratiotes aloides* and other species of reed-grass (TÓTH, 1972), and especially by the territorial extension of reed-grass stands (KÁRPÁTI and VARGA, 1972). The fauna of *Potamogeton perfoliatus* is still imperfectly known. The fauna of some reed-grass stands were investigated by ENTZ (1947) and the crustaceans living in them were investigated by PONYI (1956). This study discusses the results of zoological investigations on the open water *Potamogeton perfoliatus*. The aim of our work was to throw light in the quantitative and qualitative proportion of the fauna exclusively consisting of *P. perfoliatus*.

Places of samplings, material and methods

Our investigations were carried out in a three-year period (July, 27 Aug. 28, 1970; June 4, July 12, Aug. 4, Sept. 9, 1971; June 15, Aug. 1, Sept. 1 1972) at the following 7 points of the lake *(Fig. 1)*:

In the Keszthely Bay, 500 m off the inflow of river Zala,
1 km west of Szigliget port, 500 m off the shore,
1 km west of Révfülöp port 500 m off the shore,
1 km west of Akali port, 500 m off the shore,
in the Bozsai Bay, at Tihany, 500 m off the shore,
in the Palóznak Bay, 800 m off the shore,
in the Fűzfő Bay, 500 m off the shore.

For collecting *P. perfoliatus* and the animals living on it a bag-shaped net of 300 μ mesh (No. 6) was made *(Fig. 2)*. The opening of the net was carefully pulled over the plant and closed under the water with the help of a string, then the stem was cut. The sample obtained in this way was washed from the net into a Petri dish. Each collecting was accompanied with three parallel samples. The stem and the leaves of *P. perfoliatus* were cleaned from all living organisms and precipitations, and the volume of the plant was

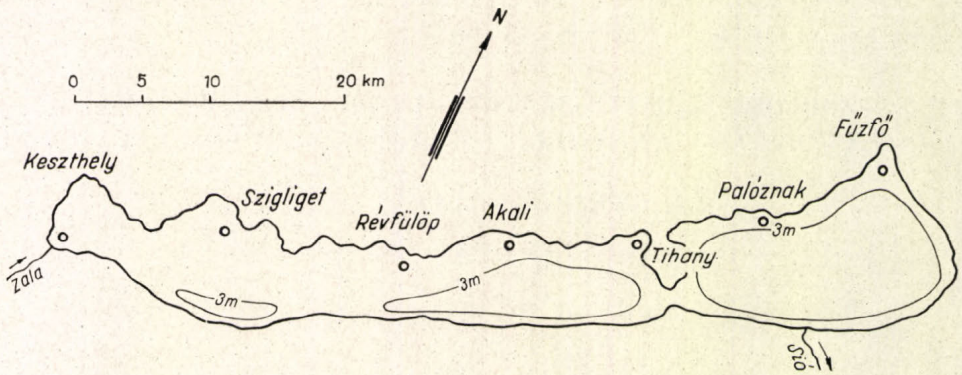

Fig. 1. Collecting sites in Lake Balaton (1970—72)

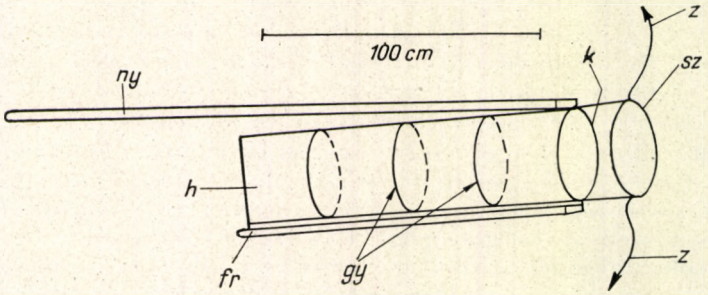

Fig. 2. Reed-grass collecting net:
ny = shaft, gy = net-tightening rings, h = bag of the net, k = frame, fr = net-tightening pole, sz = closable opening of the net, z = closing string

determined by the displacement method in a graduated cylinder. The volume of each plant varied between 50 and 260 ml. It would be more profitable to calculate the quantity of fauna to a given unit of plant surface, however, no good method for a routine-like measuring the surface of the variously developed reed-grass shoots is yet known. The animals preserved in formalin were separated from the fragments of plant origin and other detrital particles with sugar-solution of 1.12 density (Biró, 1972). The biomass of the animals was determined by measuring the volume. Their density was considered to be 1.0. The number and the biomass of animals found on the reed-grass were converted into 100 ml living reed-grass volume. The result is given in i/100 ml *P. perfoliatus* and the biomass in g/100 ml *P. perfoliatus*.

Composition of the fauna

The way of collectings clearly reveals that we aimed at collecting the mezo-fauna of the reed-grass stand. The size which can be collected with No. 6 net has practical advantages. One of the requirements of the future collecting method, in case it becomes routine-like, is that technical assistants can perform

it. With the help of a loose net pulled over the plants, the metaphytic organisms living among them in the water or the semi-sessile ones may also be collected. Owing to the nature of the method, typical plankton species drifted into the reed-grass (by the wave-action, wind etc.) may also occur in the samples. This is a particular problem of shallow waters. The reed-grass stands of real deep lakes may be found in the littoral zone and there are hardly any members of euplankton in their metaphyton stock. The open water of Lake Balaton, on the whole, is said to belong to the transitional littori-profundal zone (sublittorial, eprofundal, micro-littoral and macro-littoral), where the reed-grass may propagate far and wide. Therefore, the constant species of the fauna of the open waters of Lake Balaton comprise such true representatives of the plankton community like *Diaphanosoma brachiurum*, *Daphnia hyalina*, *D. cucullata*, *Laptodora kindtii*, etc. Apart from the great number of benthic species (Harpacticida, Oligochaeta and Nematoda species), the biotecton (coatings) is constituted by the epibenthic or epiphytic organisms living on the surface of plants. The algae, of course, also take part in forming this, besides animals fixed to the substratum *(Dreissena polymorpha)*, the Chironomida larvae, semisessile organisms *(Piscicola geometra, Stagnicola palustris)* and species hanging on the reed-grass (Holocentropus, Platycnemis) or predators, in some cases. In *Table 1* the modes of life are distinguished as follows:

p — members of plankton community: organisms of open waters without substrata (euplankton),

m — members of metaphytic community: species living in the water zone among plants but not fixed to the substratum,

b — members of benthic community: organisms originating from the fauna of the bottom-sediment. They are either plankto-benthic species (to be found in the water zone of reed-grass) or the organisms of the coatings.

e — epiphytic (epibenthic?) species: they are living on the surface of *P. perfoliatus* and are never found in the sediment.

The list of species observed in three years is given in *Table 1*. The table includes only those taxa which have been caught in the net, thus their quantitative collecting is guaranteed. The observed species of small size, since they do not affect the quantity, are the following: *Aphanolaimus aquaticus*, *Ironus tenuicaudatus*, *Mermis* sp., *Paraphanolaimus behningi*, *Theristus setosus*, *Tobrilus graculis* (Nematoda), *Brachionus quadridentatus*, *Euchlanis dilatata*, *Keratella quadrata*, *Polyarthra vulgaris* (Rotatoria). The Oligochaeta species calculated to 100 ml *P. perfoliatus* are as follows: *Limnodrilus hoffmeisteri*, *Nais communis*, *Euilyodrilus hammoniensis*, *Stylaris lacustris*. In the table they are headed under Oligochaeta.

The table contains the number of individuals calculated from the average of the three parallel samples to 100 ml *P. perfoliatus*. According to mode of life, the distribution of the species is very interesting *(Table 2)*. The percentage of epiphytic species is (13.8%), almost one-seventh of the total. At the same time, if we sum up the combined numbers of the epiphytic and other modes of life, then group "e" (e+me+eb) comprises 22 species (33.8%), group "b" (eb+mb+b) again 23 (35.4%), while group "m" (m+mb+me+mp), gives 37 species (56%). Consequently, in the water zone among the plants with respect to the number of species, not the typical planktonic, but the metaphytic elements are dominant.

TABLE 1.

Species collected of Potamogeton perfoliatus

Species	Way of life	Month	Keszthely			Szigliget		
			1970	1971	1972	1970	1971	1972
1	2	3	4	5	6	7	8	9
CNIDARIA								
Hydroidea								
Pelmatohydra oligactis PALL.	e	VI	—	—	—	—	—	—
		VII	—	—	—	—	—	—
		VIII	—	9	—	15	—	6
		IX	—	—	—	—	—	—
Hydra vulgaris PALL.	e	VI	—	7	—	—	—	—
		VIII	11	7	—	—	—	—
		IX	—	—	—	—	—	—
ANNELIDA								
Oligochaeta	—	VI	—	280	70	—	14	30
		VII	1	190	—	130	100	—
		VIII	364	270	270	380	760	11
		IX	—	298	58	—	90	16
Hirudinoidea								
Piscicola geometra (L.)	e	VI	—	2	—	—	7	3
		VII	1	6	—	2	16	—
		VIII	—	—	5	—	3	—
		IX	—	1	—	—	—	—
MOLLUSCA								
Gastropoda								
Physa fontihalis L.	eb	VII	—	—	1	—	—	—
		VIII	5	4	—	—	—	—
Stagnicola palustris MÜLL.		VII	1	—	—	—	—	—
	eb	VIII	—	—	3	—	—	—
Lamellibranchiata								
Dreissena polymorpha PALL.	e	VI	—	—	5	—	14	—
		VII	—	5	—	34	27	—
		VIII	—	—	49	60	12	24
		IX	—	3	—	—	10	—
ARTHROPODA								
Crustacea								
Entomostraca								
Cladocera								
Sida crystallina (O. F. MÜLLER)	me	VI	—	4690	1468	—	630	1364
		VII	417	502	—	389	1465	—
		VIII	15	2910	856	1464	651	830
		IX	—	1831	844	—	596	21
Diaphanosoma brachyurum (LIÉVIN)	p	VI	—	—	—	—	72	15
		VII	26	18	—	68	63	—
		VIII	10	50	125	474	46	19
		IX	—	42	65	—	25	10
Daphnia hyalina LEYDIG	p	VI	—	—	45	—	43	38
		VII	—	10	—	—	—	—
		VIII	4	25	20	36	—	45
		IX	—	18	35	—	—	20
Daphnia cucullata SARS	p	VI	—	43	50	—	66	—
		VII	—	67	—	—	40	—
		VIII	4	—	137	80	52	225
		IX	—	12	97	—	32	11

in seven sites in Lake Balaton (1970—72)

Révfülöp			Akali			Bozsai Bay			Palóznak Bay			Fűzfő Bay		
1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	—	5	—	—	—	—	—	5	—	9	—	—	—	—
—	—	—	—	—	—	—	—		6	—	—	—	—	—
—	—	—	—	35	—	—	5	—	—	—	10	21	1	—
—	—	—	—	810	36	—	—	—	—	3	—	—	13	—
—	—	—	—	2	—	—	—	—	—	2	—	—	—	—
—	3	—	7	10	—	—	3	—	9	—	7	3	—	—
—	—	—	—	480	—	—	—	—	—	—	—	—	4	—
—	24	225	—	2	—	—	12	—	—	1	6	—	—	5
760	151	—	40	40	—	35	74	—	271	25	—	180	15	—
160	41	35	300	69	53	138	92	26	224	37	56	40	50	123
—	81	22	—	50	66	—	125	18	—	87	—	—	50	41
—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	3	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	17	—	—	—	—	—	6	4	—	12	9	—	21	6
850	45	—	15	58	—	19	15	—	46	7	—	2	12	—
64	19	3	129	9	15	13	10	7	21	—	—	8	6	16
—	4	2	—	5	3	—	6	17	—	—	—	—	—	4
—	545	1358	—	217	2370	—	1941	1331	—	659	1650	—	2530	1452
2153	715	—	471	1064	—	2140	1003	—	1894	2109	—	856	1113	—
1076	776	3321	1187	1896	1300	1081	2702	850	1481	2700	2010	261	3573	1172
—	540	573	—	252	460	—	119	156	—	780	—	—	170	37
—	105	26	—	32	73	—	36	82	—	—	14	—	39	82
76	30	—	49	15	—	283	21	—	131	—	—	83	—	—
153	55	30	79	54	20	100	20	57	188	—	25	57	—	72
—	22	—	—	—	—	—	—	—	—	—	—	—	18	—
—	—	42	—	18	88	—	112	76	—	—	42	—	83	43
14	—	—	11	—	—	—	—	—	12	—	—	—	—	—
20	—	—	22	—	—	20	75	—	20	—	34	15	—	58
—	—	35	—	30	—	—	—	—	—	—	—	—	—	—
—	13	26	—	17	110	—	187	69	—	7	36	—	160	75
15	64	—	5	14	—	11	—	—	—	—	—	12	—	—
31	32	27	20	30	—	78	80	—	21	—	—	—	—	—
—	38	36	—	28	—	—	—	—	—	—	—	—	18	—

Species	Way of life	Month	Keszthely			Szigliget		
			1970	1971	1972	1970	1971	1972
1	2	3	4	5	6	7	8	9
Simocephalus vetulus (O. F. MÜLLER)	m	VII	—	10	—	—	—	—
		VIII	4	—	—	—	—	—
		IX	—	—	8	—	—	—
Ceriodaphnia quadrangula (O. F. MÜLLER)	mp	VI	—	—	5	—	—	—
Macrothrix laticornis (JURINE)	mb	VI	—	—	7	—	—	—
Eurycercus lamellatus (O. F. MÜLLER)	m	VIII	—	3	5	—	—	—
		IX	—	—	—	—	—	—
Acroperus harpae (BAIRD)	m	VII	10	20	—	—	—	—
		VIII	—	—	10	—	—	—
		IX	—	—	—	—	—	—
Monospilus dispar SARS	b	IX	—	—	—	—	—	—
Graptoleberis testudinaria (FISCHER)	b	VII	—	4	—	—	—	—
Leydigia leydigii (SCHOEDLER)	b	VI	—	—	10	—	—	—
		VII	—	5	—	—	—	—
Leydigia acanthocercoides (FISCHER)	b	VI	—	—	5	—	—	—
		VII	—	5	—	—	—	—
Oxyurella tenuicaudis (SARS)	m	VII	—	4	—	—	—	—
		VIII	—	—	4	—	—	—
Alona rectangula SARS	mb	VI	—	9	8	—	—	—
		VII	—	20	—	—	—	—
Alona quadrangularis (O. F. MÜLLER)	b	VII	16	19	—	—	—	—
		VIII	6	—	7	—	—	—
Alona affinis (LEYDIG)	mb	VI	—	—	15	—	—	—
		VII	10	15	—	—	—	—
		VIII	—	10	—	—	—	—
		IX	—	—	10	—	—	—
Alonella excisa (FISCHER)	mb	VIII	—	—	—	—	27	—
Disparalona rostrata (KOCH)	mb	VI	—	—	187	—	—	—
		VII	—	9	—	—	—	—
		VIII	5	244	—	—	18	—
		IX	—	—	—	—	—	—
Pleuroxus uncinatus BAIRD	mb	VII	—	10	—	—	—	—
		VIII	—	5	—	—	—	—
Anchistropus emarginatus SARS	m	IX	—	—	—	—	—	—
Chydorus sphaericus (O. F. MÜLLER)	mp	VI	—	525	153	—	140	22
		VII	59	2541	—	36	82	—
		VIII	—	1106	52	—	65	—
		IX	—	359	—	—	—	—
Bosmina longirostris (O. F. MÜLLER)	p	VI	—	—	—	—	—	34
		VII	—	—	10	—	—	—
Leptodora kindtii (FOCKE)	p	VI	—	—	—	—	7	8
		VII	—	2	—	—	5	—
		VIII	5	2	67	38	—	—
		IX	—	—	290	—	9	—
Ostracoda Candona sp.	—	VI	—	—	—	—	—	—
		VII	4	4	—	—	—	—
		VIII	43	5	5	—	—	—

Révfülöp			Akali			Bozsai Bay			Palóznak Bay			Fűzfő Bay		
1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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—	—	—	—	6	—	—	—	—	—	—	—	—	—	—
—	—	—	—	15	—	—	—	—	—	—	—	—	—	8
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	4	—	—	—	—	—	—	6	—	—	—	—
—	—	6	—	—	12	—	—	—	5	—	10	—	—	—
—	—	—	—	10	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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—	—	—	—	—	14	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	8	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	23	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	17	—	—	—	—	—	40	—
14	6	—	16	30	—	—	—	—	15	—	—	20	—	—
—	—	—	—	—	20	—	—	34	—	—	—	—	—	8
—	10	—	—	22	—	—	10	—	—	—	—	—	—	—
—	—	4	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	27	14	—	55	15	—	41	—	—	—	—	—	14	—
7	14	—	3	3	—	—	8	—	—	—	—	—	—	—
—	17	—	6	—	—	11	3	—	7	12	—	8	28	—
—	—	25	—	—	—	—	—	11	—	5	—	—	—	10
—	—	—	—	—	5	—	20	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	Way of life	Month	Keszthely			Szigliget		
			1970	1971	1972	1970	1971	1972
1	2	3	4	5	6	7	8	9
Copepoda								
Eudiaptomus gracilis (Sars)	p	VI	—	38	23	—	165	308
		VII	15	50	—	423	387	—
		VIII	25	—	42	221	129	220
		IX	—	135	259	—	140	81
Macrocyclops albidus (Jurine)	m	IX	—	—	—	—	—	—
Eucyclops macruroides (Lilljeborg)	m	IX	—	—	—	—	—	—
Eucyclops macrurus (G. O. Sars)	m	IX	—	—	—	—	—	—
Eucyclops serrulatus (Fischer)	mb	VI	—	50	15	—	20	—
		VII	20	45	—	25	—	—
		VIII	15	70	330	—	—	12
		IX	—	372	300	—	—	—
Paracyclops fimbriatus (Fischer)	mb	IX	—	—	—	—	—	—
Cyclops vicinus vicinus Ulianine	p	VI	—	25	—	—	12	—
		VIII	—	—	—	—	—	—
		IX	—	—	239	—	—	41
Cyclops strenuus strenuus Fischer	p	VI	—	—	—	—	—	—
		VII	—	—	—	18	—	—
		VIII	10	—	15	9	—	8
		IX	—	—	20	—	21	—
Acanthocyclops (A.) vernalis (Fischer)	p	VI	—	90	115	—	50	124
		VII	58	76	—	—	62	—
		VIII	140	103	175	133	—	130
		IX	—	787	2198	—	30	31
Acanthocyclops (A.) robustus (G. O. Sars)	m	VII	10	10	—	—	—	—
		VIII	—	5	15	—	—	6
		IX	—	—	20	—	17	11
Acanthocyclops (Megacyclops) viridis viridis (Jurine)	mb	VI	—	—	—	—	—	—
		VII	10	15	—	35	12	—
		VIII	—	20	10	46	—	12
		IX	—	—	12	—	—	—
Mesocyclops leuckarti (Claus)	p	VI	—	70	76		356	33
		VII	85	92	—	662	522	—
		VIII	95	20	334	261	227	65
		IX	—	331	359	—	310	42
Graeteriella sp. juv.		VIII	—	1	—	—	—	—
Ectinosoma abrau (Kritschagin)	mb	VI	—	—	—	—	—	—
		VII	—	—	—	4	—	—
		VIII	—	—	—	3	—	—
		IX	—	—	—	—	—	—
Nitocra hibernica (Brady)	mb	VI	—	—	7	—	43	—
		VII	12	—	—	20	34	—
		VIII	14	—	10	—	60	—
		IX	—	—	5	—	13	—
Canthocamptus staphylinus (Jurine)	m	VII	5	—	—	—	—	—
		VIII	13	—	—	—	—	—
		IX	—	—	—	—	—	—
Copepodit	—	VI	—	280	154	—	518	107
		VII	180	208	—	1160	693	—
		VIII	188	210	1026	675	276	172
		IX	—	1663	5520	—	380	152

Révfülöp			Akali			Bozsai Bay			Palóznak Bay			Fűzfő Bay		
1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	25	360	—	73	35	—	1286	341	—	14	170	—	1200	67
35	130	—	46	108	—	25	20	—	16	—	—	43	7	—
405	1600	88	224	1290	94	82	26	105	75	19	61	71	—	26
—	725	206	—	22	283	—	18	148	—	80	—	—	138	10
—	—	—	—	35	—	—	—	—	—	—	—	—	—	—
—	—	—	—	20	—	—	—	—	—	—	—	—	—	—
—	—	—	—	20	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	14	24	—	25	32
6	—	—	34	—	—	18	5	—	—	—	—	32	—	—
—	10	37	—	—	—	—	22	8	29	—	23	35	—	—
—	—	—	—	52	—	—	—	—	—	35	—	—	—	—
—	—	—	—	10	—	—	—	—	—	—	—	—	—	—
—	10	—	—	—	12	—	—	—	—	10	—	—	—	16
—	—	—	—	—	—	—	—	—	—	—	—	—	25	—
—	39	95	—	18	16	—	—	22	—	16	—	—	52	—
—	—	—	—	—	—	—	—	—	—	8	—	—	6	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28	—	8	16	—	—	11	—	—	122	—	—	10	—	—
—	10	32	—	12	18	—	19	—	—	—	—	—	26	32
—	—	183	—	—	—	—	—	141	—	—	95	—	—	—
41	—	—	—	—	—	28	—	—	66	10	—	19	—	—
—	12	23	62	—	24	—	35	—	—	—	53	—	46	—
—	—	55	—	—	41	—	—	32	—	—	—	—	—	19
4	3	—	—	—	—	—	—	—	14	—	—	—	5	—
—	—	6	—	—	10	3	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	35	—	—	—
6	10	—	—	—	—	6	2	—	—	12	—	25	11	—
—	—	4	85	20	12	—	—	10	65	—	20	16	—	—
—	—	—	—	—	—	—	—	16	—	—	—	—	—	32
—	75	353	—	208	37	—	828	355	—	42	145	—	2100	25
—	275	—	39	162	—	92	15	—	114	18	—	20	109	—
501	10	48	242	350	23	135	203	23	649	37	40	112	174	81
—	102	51	—	83	232	—	36	66	—	50	—	—	275	92
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	12	—	—	—	—	—	—	—	—	—	—	8	8
—	—	—	8	—	—	—	—	—	5	9	—	5	—	—
—	—	—	—	—	6	—	—	—	10	—	—	—	8	—
—	—	—	—	4	—	—	—	—	—	—	—	—	—	—
—	13	—	—	60	32	—	27	14	—	49	—	—	6	—
—	10	—	10	13	—	—	20	—	5	9	—	6	10	—
10	—	13	—	20	5	7	10	57	6	10	45	—	—	8
—	13	10	—	5	16	—	12	30	—	22	—	—	74	19
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	5	—	—	—	—	—	—	—	—	—	—
—	110	397	—	282	80	—	706	508	—	82	149	—	469	126
73	430	—	120	52	—	163	23	—	231	35	—	96	112	—
928	58	212	657	1530	104	231	283	20	1356	56	152	243	245	127
—	298	293	—	252	590	—	24	112	—	184	—	—	491	215

Species	Way of life	Month	Keszthely			Szigliget		
			1970	1971	1972	1970	1971	1972
1	2	3	4	5	6	7	8	9
Branchiura								
Argulus foliaceus (L.)	—	VI	—	—	—	—	—	—
Malacostraca								
Mysididea								
Limnomysis benedeni CZERN	me	VI	—	107	52	—	—	—
		VII	91	107	—	12	—	—
		VIII	53	38	7	14	—	30
		IX	—	23	22	—	20	18
Amphipoda								
Corophium curvispinum devium WUNDSCH	me	VI	—	36	176	—	225	76
		VII	260	84	—	663	327	—
		VIII	323	167	1294	666	651	135
		IX	—	512	774	—	2065	1063
Dicerogammarus villosus MART	b	VI	—	2	3	—	—	—
		VII	7	3	—	2	11	—
		VIII	5	—	7	3	—	—
		IX	—	8	—	—	16	17
Insecta								
Ephemeroptera								
Caenis horaria L.	mb	VI	—	9	—	—	—	—
		VII	—	8	—	—	—	—
		VIII	5	4	13	—	—	—
		IX	—	—	5	—	—	—
Cloeon dipterum L.	mb	VI	—	7	2	—	—	—
		VII	16	25	—	—	—	—
		VIII	4	13	12	—	—	—
		IX	—	2	—	—	—	—
Odonata								
Sympecma fusca (LINDEN)	e	VI	—	—	—	—	—	—
		VIII	—	—	—	—	—	—
		IX	—	—	—	—	—	—
Platycnemis pennipes (PALLAS)	e	VII	—	3	—	—	—	—
		VIII	3	2	—	—	—	—
		IX	—	—	—	—	—	—
Enallagma cyathigerum (CHARP)	e	VI	—	—	—	—	—	—
		VII	—	—	—	—	—	—
Erythromma viridulum (CHARP)	e	VIII	—	—	—	—	—	—
Gomphus vulgatissimus (L.)	e	VII	1	1	—	—	—	—
		VIII	—	2	—	—	—	—
Heteroptera								
Micronecta (Dihaetonecta) scholtzi FIEB	m	VII	—	2	—	—		—
		VIII	1	—	7	—	—	—
Naucoris cimicoides (L.)	mb	VIII	1	—	—	—	—	—
Coleoptera								
Bidessus geminus SCHM.	me	VIII	2	—	—	—	—	—
Peltoides caesus DFT.	me	VII	1	—	—	—	—	—
		VIII	—	—	2	—	—	—
		IX	—	1	—	—	—	—
Ditiscidae larva	—	VI	—	—	2	—	—	—
		VII	4	—	—	8	—	—
		VIII	11	—	—	—	—	—

Révfülöp			Akali			Bozsai Bay			Palóznak Bay			Fűzfő Bay		
1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
—	7	—	—	—	—	—	—	—	—	14	7	—	—	15
10	20	—	4	6	—	—	85	—	20	45	—	25	25	—
14	70	34	19	11	11	—	22	99	10	19	6	19	18	39
—	13	—	—	8	5	—	146	—	—	—	—	—	23	8
—	650	78	—	142	65	—	50	30	—	203	16	—	109	8
563	644	—	100	611	—	693	785	—	150	347	—	719	367	—
823	956	199	688	516	380	738	929	522	606	545	151	728	1693	544
—	1464	721	—	204	998	—	2660	2616	—	1220	—	—	1800	1378
—	—	—	—	12	11	—	—	—	—	2	—	—	11	—
19	2	—	7	19	—	—	—	—	2	—	—	6	—	—
8	4	8	12	9	6	—	10	23	12	—	—	—	22	—
—	1	6	—	42	20	—	6	7	—	17	—	—	13	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	15	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	4	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	1	—	—	—	—	1	—
—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	3	—	2	—	1	—	2	1
—	—	—	—	2	—	—	—	—	—	—	—	—	—	1
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
—	—	—	—	—	—	—	—	—	—	—	—	—	2	—
—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	3	—	—	—	—	—	—	—	—	—	—	—	—

Species	Way of life	Month	Keszthely			Szigliget		
			1970	1971	1972	1970	1971	1972
1	2	3	4	5	6	7	8	9
Trichoptera								
Holocentropus dubius RAMB	me	VI	—	—	—	—	—	—
		VII	—	1	—	—	—	—
		VIII	—	3	1	—	—	—
		IX	—	—	—	—	—	—
Holocentropus stagnalis ALBDA	me	VI	—	—	—	—	—	—
		VIII	—	—	—	—	—	—
Cyrnus trimaculatus CURT.	me	VII	—	3	—	—	—	—
		VIII	—	4	—	—	—	—
		IX	—	1	—	—	—	—
Cyrnus flavidus MCL.	me	VI	—	—	—	—	—	—
		VIII	—	—	1	—	—	—
Ecnomus tenellus RAMB.	me	VII	—	—	—	—	—	—
		VIII	—	7	5	—	—	—
		IX	—	—	5	—	8	—
Lepidoptera pupa	me	VII	1	1	—	—	—	—
		VIII	1	1	1	—	—	—
		IX	—	—	3	—	—	—
Diptera								
Chironomida larva	eb	VI	—	1510	1630	—	150	460
		VII	650	4850	—	230	130	—
		VIII	1880	1730	1070	100	40	14
		IX	—	1300	650	—	290	170
Hydracarina	—	VII	4	—	—	—	—	—
		VIII	—	4	—	—	—	—
Totally:		VI	—	7780	4283	—	2532	2622
i/100 ml P. p.		VII	1973	9050	—	3921	3976	—
		VIII	3265	7054	5992	4682	3023	1964
		IX	—	7699	11798	—	4072	1704
Biomass		VI	—	3.1	1.7	—	2.1	0.95
g/100 ml P. p.		VII	1.1	2.4	—	1.15	1.0	—
		VIII	1.0	2.6	1.9	1.75	1.5	0.7
		IX	—	2.05	2.4	—	2.3	1.7

Faunistically, the appearance of a Cladocera: *Anchistropus emarginatus* SARS is most interesting *(Fig. 3)*, (GULYÁS and TYAHUN, 1974), since it is new to the fauna of Lake Balaton and Hungary.

The commonest species are *Sida crystallina* and *Corophium curvispinum*. The small-sized *Sida crystallina* occurs far and wide in Lake Balaton, while *Diaphanosoma brachiurum* rather in the middle of the lake. The distribution of some cladocerans is definitely restricted to the reed-grass stand of the Keszthely Bay district *(Alona rectangula, Disparalona rostrata, Macrothrix laticornis)* or at least the majority is found there *(Alona affinis, Chydorus sphaericus)*. The species of Cladocera are generally dominant in the fauna of the reed-grass in early summer, but late in the season, Corophium takes over. In the district of Keszthely, off the inflow of river Zala, the species of Cladocera are followed by the crowds of mid-summer Chironomida larvae. By the end of summer, a large population of copepods develops.

Révfülöp			Akali			Bozsai Bay			Palóznak Bay			Füzfő Bay		
1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972	1970	1971	1972
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
—	—	3	—	—	2	—	—	—	—	1	—	—	—	—
—	—	—	—	2	—	—	2	—	2	—	—	—	—	—
—	2	1	—	—	3	—	—	—	—	2	1	—	—	—
—	—	2	—	—	2	—	—	—	—	2	—	—	—	1
—	—	—	—	—	—	—	—	—	—	2	—	—	—	—
—	3	—	—	2	—	—	2	—	—	—	—	—	3	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
—	—	—	—	—	—	—	—	2	—	—	—	—	1	—
—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
—	2	1	—	—	6	—	5	4	—	4	1	—	3	2
—	—	—	—	—	—	—	—	2	—	—	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	—	1	—	—
3	—	—	2	—	—	1	—	—	4	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	80	138	—	153	120	—	135	91	—	91	392	—	151	460
270	130	—	72	98	—	126	160	—	480	133	—	354	58	—
170	190	150	290	280	420	68	340	960	260	190	910	293	230	750
—	160	365	—	660	370	—	350	140	—	568	—	—	350	240
2	—	—	—	—	—	—	—	—	—	1	—	—	—	—
—	—	—	—	—	—	—	—	—	—	3	—	—	—	—
—	1701	3224	—	1218	3055	—	5405	3051	—	1538	2689	—	6974	2422
4929	2679	—	1055	2300	—	3639	2236	—	3482	2786	—	2514	1846	—
4400	3860	4257	4048	6358	2518	2706	4877	2809	5061	3669	3808	1940	6131	3026
—	3520	2322	—	3204	3135	—	3531	3393	—	3069	—	—	3515	2114
—	1.9	0.6	—	1.7	1.55	—	2.1	0.45	—	1.4	1.65	—	1.9	0.65
2.1	1.4	—	0.45	1.1	—	1.2	2.75	—	0.75	1.6	—	0.85	1.4	—
1.85	1.6	0.75	1.25	1.5	0.9	1.25	1.9	1.4	1.65	2.05	0.9	1.05	2.15	0.95
—	1.9	1.3	—	1.1	1.6	—	2.55	3.3	—	1.2	—	—	2.15	2.2

TABLE 2

Distribution of species observed on Potamogeton perfoliatus according to their mode of life

Mode of life	No. of species	%
p	10	15.4
e	9	13.8
m	11	16.9
me	10	15.4
mp	2	3.1
eb	3	4.6
mb	14	21.6
b	6	9.2
Total:	65	100.0

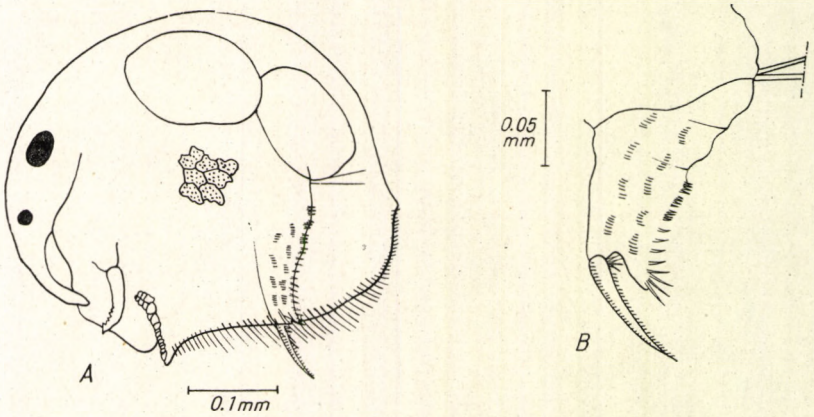


Fig. 3. Anchistropus emarginatus SARS:
A = female B = female postabdomen

In the Keszthely Bay and in the northeastern bay of the lake Chironomida larvae may be found in the greatest numbers. Odonata and Trichoptera larvae were found everywhere except at the collecting place in the Bay of Szigliget. Their population density is low and does not fluctuate. Some Oligochaeta and Nematoda species, *Limnomysis benedeni*, *Dreissena polymorpha* and *Leptodora kindtii* occur in low numbers, but are permanent among *Potamogeton perfoliatus*.

The distribution of species

The faunistic description of each reed-grass stand is not given here, since the quantity of species is shown in *Table 1*, graduated into collecting places and time. After surveying up the results of this three-year investigation we wish to emphasize only the dominant species and the characteristics of each collecting site.

The reed-grass vegetation of the Keszthely Bay at the inflow of river Zala is characterized by the higher number of species. From the cladocerans, *Sida crystallina* is the most frequent, its individual number high early in summer, decreases to its one-third by September. *Daphnia hyalina*, *D. cucullata* and *Chydorus sphaericus*, although low in number were always present and in 1972 even a number of *Leptodora kindtii* was found. This was the only place where a large number of metaphytic, benthic and epiphytic species of Cladocera and Copepoda was captured in the samples. Of the latter *Acanthocyclops vernalis* and *Mesocyclops leuckarti* yielded the highest ratio amounting to 50—75% of the fauna of reed-grass vegetation. *Corophium curvispinum* — contrary to the other collecting places — did not increase to such an extent even by the end of summer, so it does not play an important role in the fauna of *Potamogeton perfoliatus*. Comparing this to the other collecting places, the number of *Limnomysis benedeni* was higher. The relatively high percentage of Chironomida larvae may be explained with the "hiding-place" offered by the Cladophora often coating the reed-grass. Odonata and Trichoptera larvae, the

predators of the waters are also frequent. In the aquatic vegetations, off the inflow of river Zala, the effect of the river is strongly felt. It is manifested not only in the physical and chemical attributes of the water but in the fauna and flora, too. The occurrence of Ephemeroptera larvae, *Peltoides caesus*, *Bidessus geminus*, *Micronecta (Dihaetonecta) scholtzi*, *Naucoris cimicoides* and *Stagnicola palustris* may be ascribed to this fact. The large number of Oligochaeta living on the submerged vegetation indicate the presence of a great quantity of organic matter *(Figs 4, 5, 6)*.

In summer, in the Bay of Szigliget, *Sida crystallina* was the most frequent species, while early in autumn *Corophium curvispinum*. Of the copepods the occurrence of *Eudiaptomus gracilis*, *Acanthocyclops vernalis*, *A. viridis* and

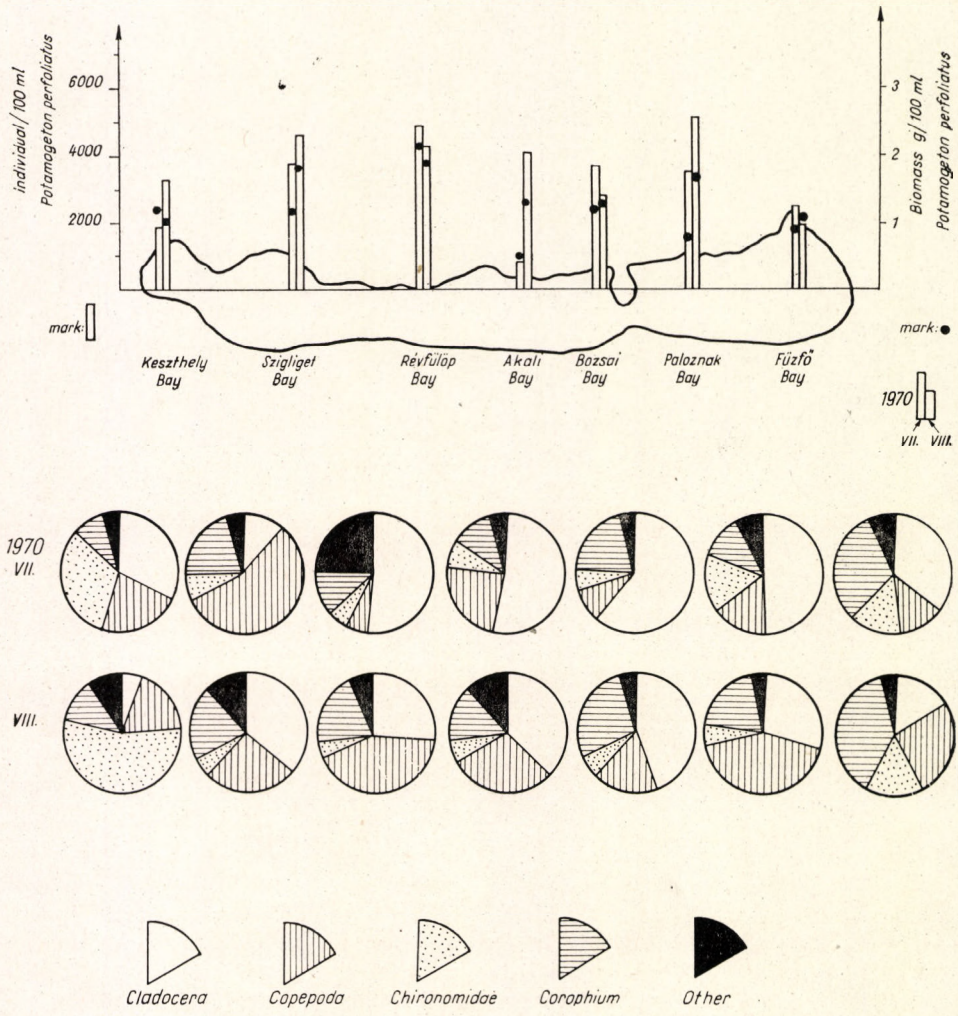
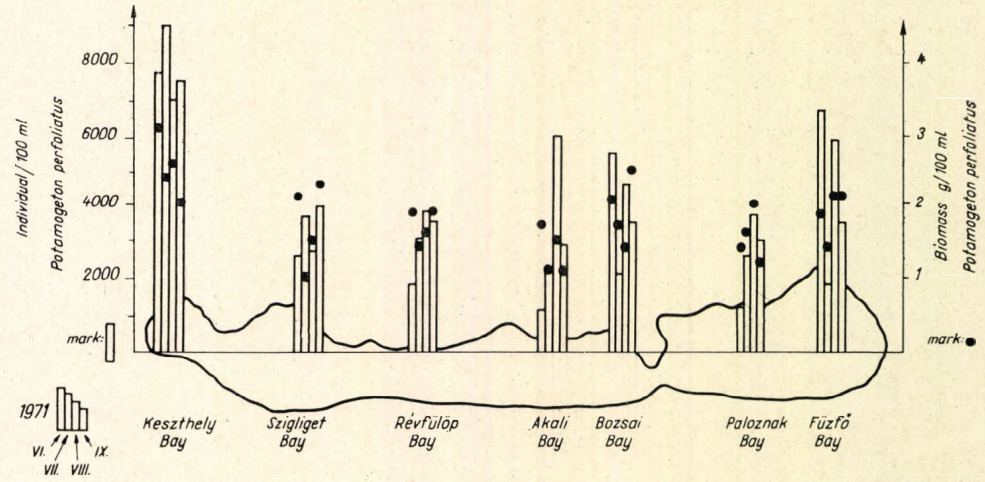


Fig. 4. The fluctuation in the quantity of animals living on *P. perfoliatus* and collected in the different regions of Lake Balaton (1970)



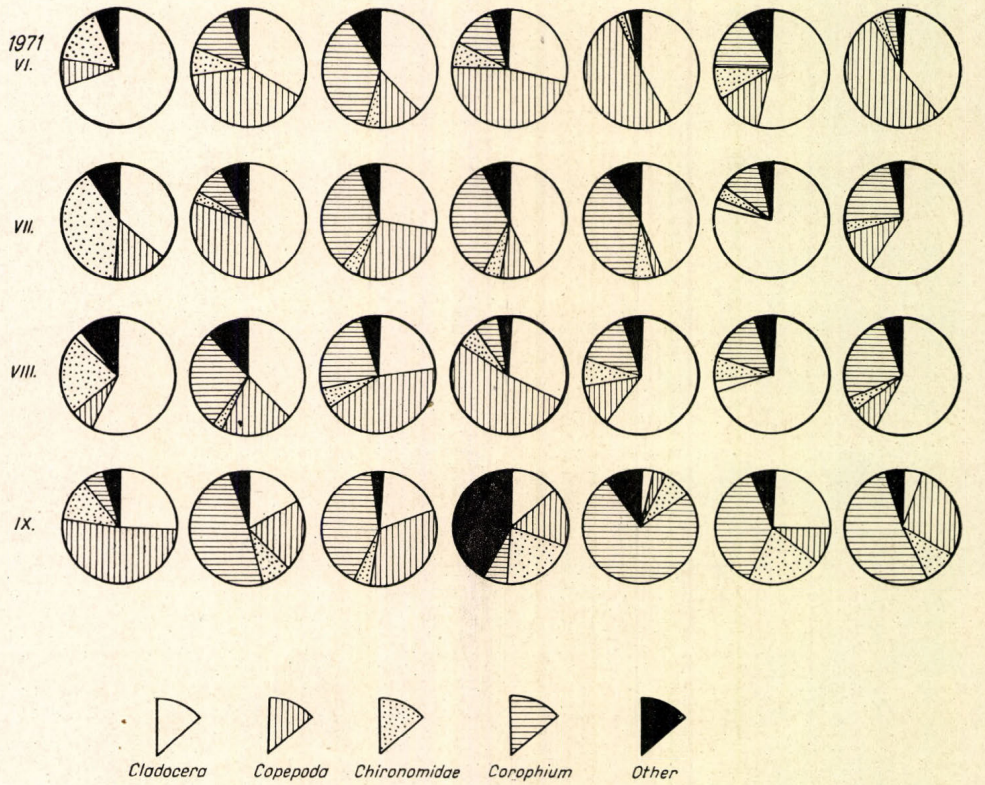


Fig. 5. The fluctuation in the quantity of animals living on *P. perfoliatus* and collected in the different regions of Lake Balaton (1971)

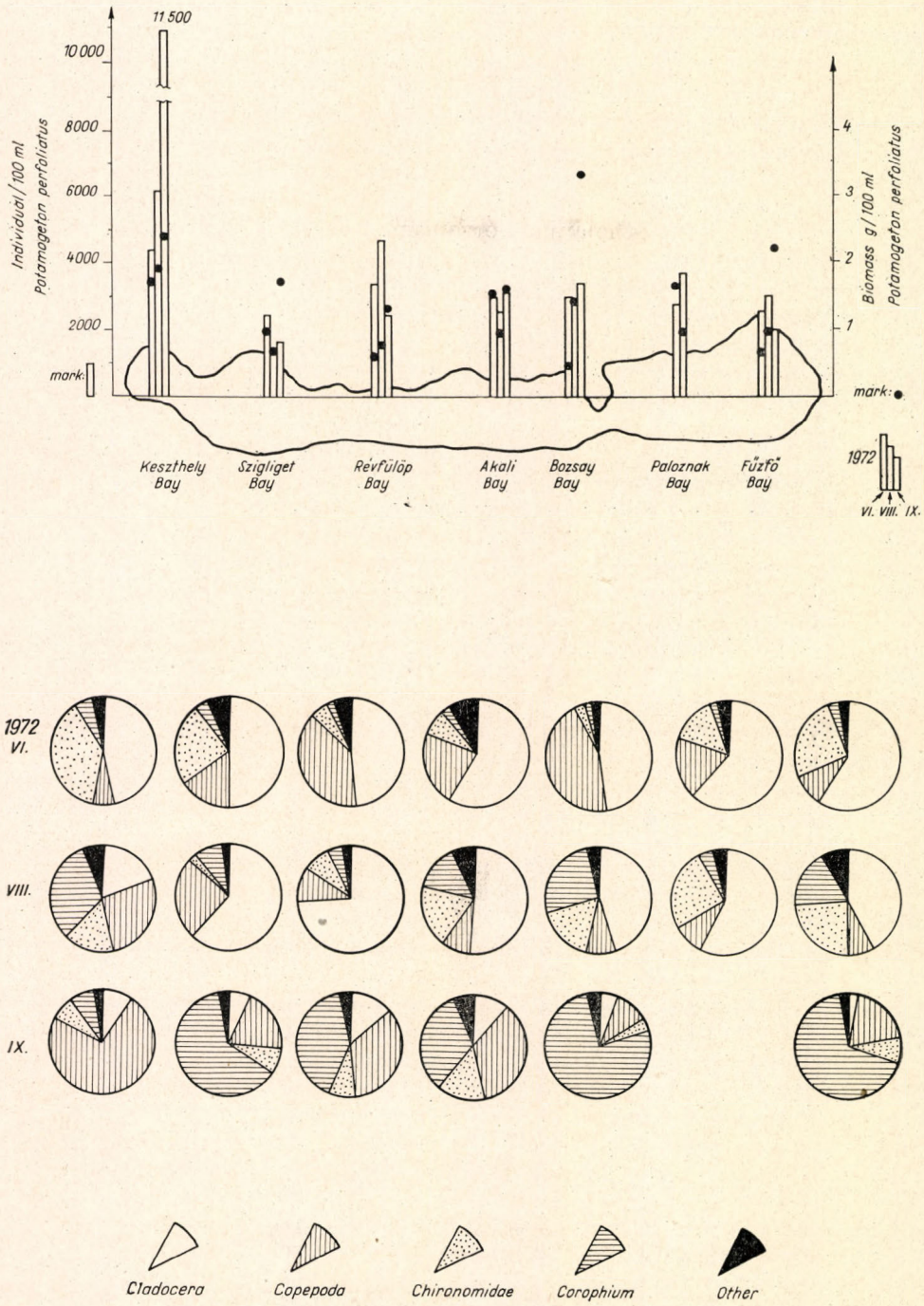


Fig. 6. The fluctuation in the quantity of animals living on *P. perfoliatus* and collected in the different regions of Lake Balaton (1972)

Mesocyclops leuckarti well characterizes the reed-grass stands. Their number generally increased from the middle of summer, only. At the beginning of this season, Chironomida larvae played an important role, after a few weeks, however, their quantity considerably diminished.

During the investigations Trichoptera larvae were found only once, while Ephemeroptera and Odonata larvae not at all. At the end of summer, the shoots of *Potamogeton perfoliatus* at some places were covered with a 10 mm thick coat of bacteria and diatoms which meant a local pollution, but at the same time, it prevented the animal organisms from attaching immediately to the water plants. This phenomenon was especially remarkable in 1972. In the submerged reed-grass stand, west to the mole of Révfülöp, *Sida crystallina*, *Diaphanosoma brachyurum* and *Mesocyclops leuckarti* were predominant at the beginning of summer. During the middle of the season, the number of *Eudiaptomus gracilis* also increased. At the end of summer, *Sida crystallina*, *Eudiaptomus gracilis* and *Corophium curvispinum* were further on predominant. Apart from the low number of Chironomida larvae, some *Dicerogammarus villosus*, *Limnomysis benedeni*, *Dreissena polymorpha* and Trichoptera larvae were recorded.

Among the submerged plants, next to the mole of Akali, *Sida crystallina* was predominant and other cladocerans were scarce. During summer, the population of *Corophium curvispinum* and some other Copepoda species *(Eudiaptomus gracilis, Mesocyclops leuckarti)* increased. By the end of the season, the number of specimens of *Corophium curvispinum*, *Eudiaptomus gracilis*, *Mesocyclops leuckarti* and *Dicerogammarus villosus* grew high. In September, 1971 the samples were not taken from the open water vegetations but from wind-protected ones, behind the moles. The metaphytic and benthic species found here were not observed elsewhere, except in the Keszthely Bay. The species of *Anchistropus emarginatus*, *Macrocyclops albidus*, *Eucyclops macruroides*, *E. macrurus* and *Paracyclops fimbriatus* living on the ectoderm of *Hydra vulgaris* and *Pelmatohydra oligactis* were recovered, which proves that the fauna of the open water is unlike that of the littoral zones, therefore it would also be worth while to investigate the rich vegetation of the protected bays. This idea is supported by ENTZ's (1947) and PONYI's results (1956).

In June, the proportion of Cladocerans (predominantly *Sida crystallina*) and copepods *(Eudiaptomus gracilis, Mesocyclops leuckarti)* is nearly equal in the Bozsai Bay. In July and August, the number of copepods diminishes and that of *Limnomysis benedeni*, *Corophium curvispinum* and Chironomida larvae increases. At the end of summer, the latter amounted to 75% of the fauna *(Figs 4, 5, 6)*. At the same time even Ephemeroptera, Odonata and Trichoptera larvae were occasionally found.

In the *Potamogeton perfoliatus* vegetation, in the Paloznak Bay, during summer, *Sida crystallina*, *Mesocyclops leuckarti* and Chironomida larvae were in the largest number. By the end of the season, *Corophium curvispinum* and *Chironomida* larvae were predominant. At this time, the other species were already in very low numbers in the stands of *P. perfoliatus*. At the beginning of September, 1972, the reed-grass stand, at this part of the lake, was totally devastated by a storm, thus at the everyday collecting sites, even at that district, no *Potamogeton perfoliatus* was found. Instead, luxuriant colonies of *Stratiotes aloides* were discovered.

In the first part of summer, in the Füzfő, *Sida crystallina* Bay, *Eudiaptomus gracilis*, *Mesocyclops leuckarti* and Chironomida larvae were dominant.

From the middle of the season, the number of copepods decreased, while that of *Corophium curvispinum* and Chironomida larvae increased. By the end of summer, *Sida crystallina* almost entirely disappeared from the fauna: but its place was taken by *Corophium curvispinum*, Chironomida larvae and *Mesocyclops leuckarti*.

The quantity of fauna

The quantity of fauna living among *Potamogeton perfoliatus* ranged from 1.055 to 11.798 i/100 ml *P. perfoliatus (Table 1)*, on an average, it was 3.800 i/100 ml *P. perfoliatus*. In front of the mouth of river Zala, in the Keszthely Bay, the average number of water organisms was 2.500, while in 1971—72 it was 7.700 i/100 ml *P. perfoliatus*. It is almost twice as much as the values recovered at the other collecting places. From Szigliget to Füzfő, the average number of organisms was 3.300 i/100 ml *P. perfoliatus*. A remarkable fluctuation in numbers within a year was noted only at Akali and Füzfő. From the beginning of summer till early autumn, the total number of the animals did not change, but in the species the change was conspicuous.

The biomass of the fauna in *Potamogeton perfoliatus*

The biomass of the fauna in reed-grass stands was determined by measuring the volume of the animals. This varied between 0.4 and 3.3 g/100 ml *P. perfoliatus (Table 1)*. As for the average of the three years, the biomass value was 2.0 g/100 ml *P. perfoliatus* in the Keszthely Bay; between Szigliget and Füzfő it was 1.5, and the lowest at Akali was 1.2 g/100 ml *P. perfoliatus*. By the end of summer, the biomass generally increased. Although, it was not the result of an increase in the number of the animals, but the dominance of large-sized species. The biomass value was mostly influenced by *Corophium curvispinum*. In the vicinity of the mouth of river Zala together with Corophium the Chironomida, Ephemeroptera and Trichoptera larvae, and some large-sized Coleoptera increased the biomass *(Figs 4, 5, 6)*.

Results

The open water reed-grass stands decisively consist of *Potamogeton perfoliatus*. Near these stands, the species of *Acroperus harpae*, *Camptocercus rectirostris*, *Chydorus globosus*, *C. ovalis*, *Moina brachiata*, *Peracantha truncata*, *Pleuroxus trigonellus*, *Scapholeberis mucronata* and *Sida crystallina* were observed by Entz et al. (1937). According to the investigation of Entz and Sebestyén (1940), *Sida crystallina*, *Asellus aquaticus* and *Corophium curvispinum* f. *devium* are the most common organisms of the submerged vegetations. During our sampling in 1970—72 only the species of *Sida crystallina*, *Corophium curvispinum* and *Acroperus harpae* were observed. In the past 30 years, one of the dominant species, *Asellus aquaticus*, has disappeared from the reed-grass stands, and instead the rare species which inhabited these regions other Cladocera species populate the stands. The fauna of *Potamogeton perfoliatus*

some 100 m off the shore of Tihany peninsula was investigated by ENTZ at the end of summer. In addition to the large number of nematods (36%), he noted specimens of *Corophium curvispinum*, *Sida crystallina*, *Nitocra hybernica* and *Dreissena polymorpha* in the company of some larvae (Chironomida, Trichoptera and Ephemeroptera, 10—10%) which almost equalled in numbers. Of the cladocerans, besides *Sida crystallina*, he found only *Acroperus harpae* and *Daphnia cucullata* in the samples. In addition to *Nitocra hybernica* and *Ectinosoma abrau* (Harpacticida), he also observed *Eucyclops serrulatus* and *Eudiaptomus gracilis* (Copepoda), but they were very low in number. Comparing the data of ENTZ to those of our investigations, there are differences in the proportions of the species. This may be attributed to the collecting method.

Entz grouped the fauna of submerged water plants according to their activities. He considered *Sida crystallina*, Acroperus and Alona species to be 'very active', and the larvae of Cyclops, Corophium and Ephemeroptera to be 'active' organisms. The Chironomida, Trichoptera larvae, Nitocra, nematods and Oligochaeta were considered to be 'less active'. The Dreissena and Helobdella kokon were classified as sessile organisms. With the help of our well-closing net we collected and registered several 'very active' and 'active' specimens. This fact, of course, modified the quantitative proportion of the fauna. The animals found on *Potamogeton perfoliatus* and separated according to their activities, on the basis of ENTZ's and our data are as follows:

	ENTZ (1947)	VITUKI (1971)
Cladocera	9.3%	25%
Copepoda	15.2%	12%
Corophium curvispinum	13.6%	35%
Chironomida larvae	13.1%	22%
Other animals	48.8%	6%

The difference between the data of ENTZ and ours may also be attributed to the different collecting places. ENTZ worked near to the shore, while we investigated the open water vegetations. It has also been emphasized by PONYI (1956) that the fauna of crustaceans near to the shore does not equal that in the open water. This statement is strengthened by the results of our collectings made at Akali. During the past two decades a change occurred in the life of the lake which is indicated by the modification of the submerged vegetations.

In the course of our investigations carried out at the end of summer, contrary to ENTZ's data, *Corophium curvispinum* and *Sida crystallina* were found in higher percentage, while the number of Trichoptera larvae, *Nitocra hybernica* and *Dreissena polymorpha* were smaller.

At three points in the open water and at one point near to the shore (at Tihany, where, the investigations were also carried out by ENTZ in 1947) the crustaceans living among *Potamogeton perfoliatus* were investigated by PONYI (1956). A comparison can be made between his results obtained at Örvényes (July 27) and the reed-grass stands in the vicinity of Akali. PONYI recorded the proportion of *Sida crystallina* and *Eudiaptomus gracilis* to be 5 : 1; while the ratio for *Dicerogammarus villosus* and *Corophium curvispinum* was 2 : 1. These values differ from our results, although the percentages of *Sida crystallina* and *Eudiaptomus gracilis* were similar. In every case, however, we found a greater proportion of *Corophium curvispinum* than *Dicerogammarus villosus*. PONYI took the samples in the northeastern basin of the lake, near

to the Tihany peninsula, and in reed-grass stands at Füzfő (August 13), where he caught only *Sida crystallina*, some specimens of *Mesocyclops leuckarti*, and *Dicerogammarus villosus* and *Corophium curvispinum* in a ratio of 5 : 1. In addition ot the high number of *Sida crystallina*, in our sample series collected at Füzfő (in August) we also found copepods *(Eudiaptomus gracilis, Mesocyclops leuckarti)*, but the ratio between *Dicerogammarus* and *Corophium* never reached 5 : 1. The percentages of Cladocera *(Sida crystallina, Diaphanosoma brachiurum)* and Copepoda *(Eudiaptomus gracilis, Mesocyclops leuckarti)*, furthermore, *Corophium* large in numbers observed at Tihany were similar to the results of PONYI. It was only at Tihany where more *Corophium* than *Dicerogammarus* was collected by PONYI, while we always found more of the former.

We may conclude that in the past 30 years the fauna of *Potamogeton perfoliatus* has undergone a change. We were unsuccessful in catching one of its dominant species, *Asellus aquaticus*. In the 1920s, the species of *Corophium* and *Dreissena*, formerly unknown from the lake, having found a good biotope increased so rapidly that today they may comprise 75% of the fauna (especially *Corophium curvispinum*). Some scarce species recovered earlier, we could not find at all, like *Moina brachiata, Chydorus glubosus* and *Camptocercus rectirostris*, on the other hand, the introduced species *Limnomysis benedeni*, was distributed far and wide in the lake. In addition to these the following species were encountered in the stands of *Potamogeton perfoliatus: Leydigia leydigii, Oxyurella tenuicaudis, Alonella excisa, Pleuroxus uncinatus, Anchistropus emarginatus, Macrocyclops albidus, Eucyclops macruroides, Cyclops vicinus, C. strenuus, Acanthocyclops vernalis* and *A. robustus*. The wide distribution of filtering-type species draws the attention to the rich, floating detritus of the lake.

Summary

With a well-closing reed-grass collecting net *(Fig. 2)* we collected the fauna of *Potamogeton perfoliatus* at seven points of Lake Balaton *(Fig. 1)* in 1970—72. The most frequent species in these submerged vegetations were *Sida crystallina, Corophium curvispinum, Eudiaptomus gracilis* and *Mesocyclops leuckarti*. Apart from the frequently collected Chironomida larvae, the rarer *Dicerogammarus villosus, Limnomysis benedeni* and Trichoptera larvae may also be regarded as constant inhabitants of the reed-grass stands *(Table 1)*.

More than half of the species are metaphytic *(Table 2)*. There is also a difference between the submerged vegetations in the different areas of Lake Balaton. The formation of the openwater fauna at the two ends of the lake is different from that found at the other collecting sites.

In the reed-grass vegetation, in front of the mouth of river Zala, at the beginning and middle of summer the Chironomida larvae and cladocerans *(Sida crystallina, Chydorus sphaericus)*, while at the end of the season the copepods *(Eudiaptomus gracilis, Eucyclops serrulatus, Mesocyclops leuckarti, Acanthocyclops vernalis)* were dominant. Also in the Bay of Füzfő, at the beginning of summer, the Chironomida larvae and *Sida crystallina* were predominant. Sometimes the number of *Eudiaptomus gracilis* and *Mesocyclops leuckarti* was also high. At the end of the season, however, in addition to the copepods the *Corophium curvispinum* and Chironomida larvae were the most frequent.

For the other vegetations of the lake *Sida cyrstallina* might also be regarded as the most common species at the beginning of summer, but it was replaced by *Corophium curvispinum* and some copepods *(Eudiaptomus gracilis, Eucyclops serrulatus, Mesocyclops leuckarti)*.

In the last 30 years, the fauna in *P. perfoliatus* has undergone a change. We were not able to collect *Asellus aquaticus*, but some cladocerans and copepods, formerly unknown in the fauna of the lake, were found.

Anchistropus emarginatus new to the fauna of Lake Balaton was collected *(Fig. 3)*.

Since ENTZ's investigations (1947) and those of PONYI (1956), *Sida crystallina* and *Corophium curvispinum* have been dominant species in the *P. perfoliatus* stands of Lake Balaton.

The quantity of fauna ranged from 1.055 to 11.798 i/100 ml P. perfoliatus. At the mouth of river Zala, in the Keszthely Bay, the number of animals was 2.500 i/100 ml *P. perfoliatus* in 1970, while in 1971—72 it was 7.700 i/100 ml *P. perfoliatus*. From Szigliget to Füzfő this average was 3.300 i/100 ml *P. perfoliatus* during the three years.

The biomass value of the fauna, determined with measuring the volume, ranged from 0.4 to 3.3 g/100 ml *P. perfoliatus*. In the Keszthely Bay the average value was 2.0 g/100 ml *P. perfoliatus*, while in the other regions, it was 1.5 g/100 ml *P. perfoliatus* during the three-year period. The quantity of the biomass mostly depended on the number of *Corophium curvispinum (Table 1,* and *Figs. 4, 5, 6)*.

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ZOOLÓGIAI VIZSGÁLATOK A BALATON NYILTVIZI *POTAMOGETON PERFOLIATUS* HINARASAIBAN

Biró Kálmán és *Gulyás Pál*

Összefoglalás

A jól bezárható hínárgyűjtő hálóval *(2. ábra)* 1970—72-ben a *Potamogeton perfoliatus* hinarasok faunáját gyűjtöttük a Balaton hét pontján *(1. ábra)*. A hinarasban a legelterjedtebb faj a *Sida crystallina*, a *Corophium curvispinum*, az *Eudiaptomus gracilis* és a *Mesocyclops leuckarti* volt. A gyakran gyűjtött Chironomida lárvák mellett ritkábban a *Limnomysis benedeni*, a *Dicerogammarus villosus* és a *Trichoptera* lárvák is a hínáros állandó tagjainak tekinthetők *(1. táblázat)*.

A fajok több mint fele metafitikus *(2. táblázat)*. A Balaton különböző helyein levő hínárosok között is különbség figyelhető meg. A tó két végében, a Keszthelyi és a Fűzfői-öblökben a nyíltvízi hínarasok faunájának alakulása eltér a többi gyűjtőhelyétől.

A Zala folyó torkolata előtti hínárosban nyár elején és közepén elsősorban a Chironomida lárvák és a Cladocera rákok *(Sida crystallina, Chydorus sphaericus)*, míg nyár végén a Copepoda rákok *(Eudiaptomus gracilis, Eucyclops serrulatus, Mesocyclops leuckarti, Acanthocyclops vernalis)* éltek zömmel.

A Fűzfői-öbölben nyár elején szintén a Chironomida lárvák és a *Sida crystallina* uralkodott. Egy-egy alkalommal az *Eudiaptomus gracilis* és a *Mesocyclops leuckarti* egyedszáma is magas volt. Nyár végén a Copepoda rákok mellett azonban már a Corophium curvispinum és a Chironomida lárvák voltak a leggyakoribbak.

A tó általunk vizsgált többi hínármezőjét általánosságban az jellemezte, hogy nyár elején a *Sida crystallina* volt a leggyakoribb, mondhatni uralkodó faj, ami a nyár közepére és végére a *Corophium curvispinum*-nak, valamint egyes evezőlábú rákoknak *(Eudiaptomus gracilis, Eucyclops serrulatus, Mesocyclops leuckarti)* adta át a helyét.

A *Potamogeton perfoliatus* hínaras faunája az elmúlt 30 év alatt kissé átalakult. Nem sikerült gyűjtenünk *Asellus aquaticus*-t, míg néhány kis számban előforduló, a hínáros faunájából eddig nem ismert Cladocera és Copepoda rákot jegyeztünk fel.

Megfigyeltük a Balaton faunájában új *Anchistropus emarginatus* Sars Cladocera-t *(3. ábra)*.

A Balatoni *Potamogeton perfoliatus* hínárosára a *Sida crystallina* és a *Corophium curvispinum* — Entz (1947) és Ponyi (1956) vizsgálatai óta is — jellemző fajok.

A hínáros állatvilágának mennyisége 1055 és 11798 i/100 ml *P. perfoliatus* között változott. A Keszthelyi öböl Zala torkolat előtti hínárosában 1970-ben 2500 i/100 ml *P.p.*, míg 1971—72-ben 7700 i/100 ml *P.p.* volt az állatok száma. Szigligettől Fűzfőig a három év alatt átlagosan 3300 i/100 ml *P.p.* volt.

A hínáros faunájának biomasszája — térfogatméréssel meghatározva — 0,4 és 3,3 g/100 ml *P.p.* között változott. A három évben a Keszthelyi öbölben átlagosan 2,0 g/100 ml *P.p.*, míg a tó más részein 1,5 g/100 ml *P.p.* volt. A biomassza mennyiségét a *Corophium curvispinum* befolyásolta a legjobban. *(1. táblázat* és *4., 5., 6. ábra)*.