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Series of Hydroecological Data to the Zoological Evaluation of the Pondweed Fields of Lake Fertő

By

S. Andrikovics*

Abstract. During the vegetation period in 1971–72, the author conducted hydrophysical and chemical researches at a monthly frequency in the frequent pondweed fields of Lake Fertő. His examinations covered the measurements of air and water temperature, of conductivity and dissolved oxygen. The circadial changes in water temperature, pH and dissolved O_2, as parameters which had the greatest influence upon the zoogenic factor, were registered in 4 characteristic types of habitats at a two hours' frequency. The author evaluates the topographically separable pondweed stands of Lake Fertő in zoological respect, and also calls attention to the intricate relations among the single Fertő habitats.

By the hydroecological examination of the pondweed fields significant in the substance- and energy transport of Lake Fertő the author intended to obtain data on the ecology of this important type of habitat. Some of the results of the physical and chemical measurements conducted parallelly with the zoological examinations support the individual characteristics of the habitats as observed in the pondweed fields of Lake Fertő.

In the open water, the most frequent species occurring in large numbers in the Fertő pondweed fields are *Myriophyllum spicatum* and *Potamogeton pectinatus*. In the reed zone mainly *Utricularia vulgaris* and *Najas marina* form stands besides *Potamogeton pectinatus*.

The environmental factors of the Fertő plant associations were investigated mainly in hydrobotanical respect up to now (1, 2, 4).

The present study is aimed at evaluating the pondweed fields of Lake Fertő in zoological respect. Out of the small number of literary references on the Hungarian part of the Lake, the author could stress, maybe, Varga's (5) often quoted study, in which the latter describes the role of the factors affecting the formation of the open-water Potamogeton pectinatus atolls.

His data can be used even today for the evaluation of the open-water pondweed fields as habitats. Founded upon a recent two-years series of examinations, the author summarizes, further, the ecological conditions of the topographically separable pondweed stands of Lake Fertő.

* *Dr. Sándor Andrikovics*, ELTE Állatrendszertani és Ökológiai Tanszék (Zoosystematical and Ecological Institute of the Eötvös Loránd University), 1088 Budapest, VIII. Puskin-u. 3.

The place, time and methods of the examinations

The measuring points were the pondweed fields of the Rákos flat in front of the reed screen, as well as the lakes Herlakni, Hidegség and Überfart. Examinations were often conducted also in the areas of the Madárvárta-, Hegykő- and Rucás-inlets. On one occasion examinations were performed in the Austrian part of the Lake (Fig. 1).

In 1971, the measurements were taken on May 27th, June 29th, July 28th, August 23rd, September 14th and October 27th; in 1972, on May 5th, June 2 nd, July 11th, August 23rd, September 19th and October 26th.

When choosing the ecological factors to be examined, the author followed a twofold principle. On the one hand he strove to select, in compliance with the special conditions of Lake Fertő, the measurable factors which had the greatest influence upon the occurrence of the invertebrate macrofauna. On the other hand, he ehdeavoured to apply simple examination methods which could be carried out on the spot.

In the author's judgment it is the measurement of the temperature of the water (of the air), the determination of pH, of conductivity and of the tendencies of the changes in O_2 dissolved in the water, which meet this twofold condition most. So that the relatively infrequent monthly measurements could be made more accurate, the author also measured the circadial fluctuation of pH, water temperature and dissolved O_2 content.

Thus, parallelly with the zoological examinations also the temperatures of the air and water were taken, pH, conductivity and the quantity of O_2 dissolved in the water were determined.

The circadial changes in temperature and O_2 dissolved in the water having taken place at the various habitats were recorded in the area of Neusiedl am See between 7 – 8. July, 1976.

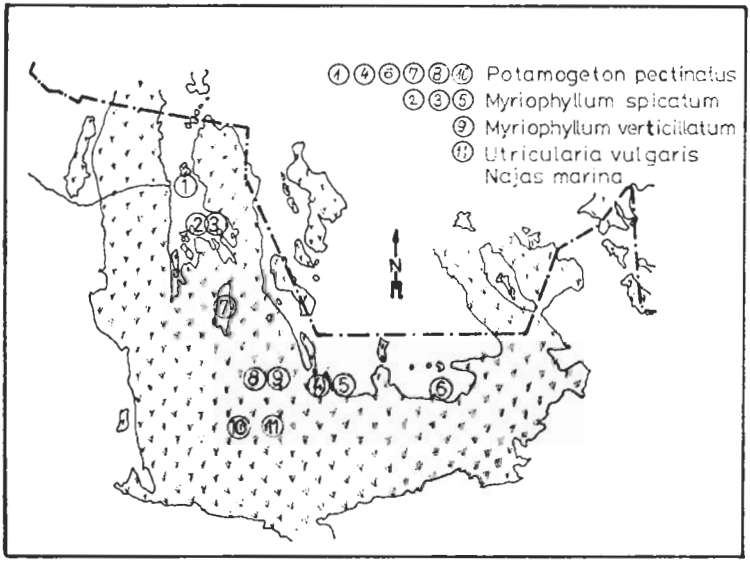

Fig. 1. Sketch map of the measuring points

Table 1. Data of air and water temperature (1971)

Place	Months											
	M		J		J		A		S		O	
	a	w	a	w	a	w	a	w	a	w	a	w
1	28,2	20,4	18,6	17,0	26,2	24,1	26,8	23,4	15,1	13,5	8,8	8,8
2	28,0	20,2	19,2	18,6	25,5	24,8	25,2	23,0	14,8	13,9	8,4	8,1
3	27,0	20,8	20,0	19,2	25,5	25,2	25,6	23,0	14,6	13,5	9,3	8,4
4	27,0	20,8	19,2	19,8	27,2	25,1	25,1	23,9	15,0	13,8	9,4	8,3
5	28,5	20,9	19,9	20,0	28,9	25,2	26,0	24,0	16,0	13,8	10,6	9,0
6	28,0	20,6	19,2	20,8	28,2	24,9	24,0	23,2	16,1	14,8	9,9	9,2
7	28,0	20,6	21,1	18,8	29,4	26,2	24,0	22,8	17,1	15,8	10,6	9,0
8	28,6	20,9	18,6	19,2	31,2	26,9	25,5	24,8	17,1	15 8	9,1	8,8
9	28,8	20,1	20,0	19,2	30,6	26,2	19,2	19,8	17,0	15,9	10,3	8,1
10	29,0	20,4	–	–	–	–	19,8	19.2	17,0	16,9	10,3	8,3
11	–	–	–	–	–	–	19,9	19,8	17,5	17,1	11,3	8,0

The temperatures of the air and water were measured with a 0.2 °C-scale thermometer; pH, conductivity and the circadial fluctuations of O_2 dissolved in the water were determined by electrometry, the seasonal changes in dissolved O_2 content with WINKLER's method.

Examination results and their evaluation

The pondweed fields of Lake Fertő are of intermediate character between the open water and the reed fields. The most important form in which this intermediate character is expressed is that these fields do not form habitats of stable climates like the former.

In weedy habitats the temperature of the water follows the changes in air temperature differently from the open water and reed fields (Tables 1 and 2). On the other hand, as shown by the measurements conducted at identical dates, in calm weather there are significant differences to be found between the microclimates of the pondweed fields of various situation and composition as to species (Table 3.). Similarly to the other habitats, the values of pH and conductivity are rising in the course of the vegetation period (Tables 4 and 5).

In the pondweed fields of the clearings in the reeds and in those situated on the borderline of reeds and open water the aquatic climate is determined, besides the dominant species and density of the stand of plants, by the reeds, and in the open-water pondweed fields basically by the physical and chemical characteristic of the Fertő "flat water".

As to location, the pondweed fields at the border of reeds and open water can be ranked with a special group. In case of a bay-like situation, they rather involve the possibility of an isolated, at a straight-line reed screen, on the other hand, that of an unstable water climate changing with the action of the wind.

Still, the basic characteristics brought on by the topographic conditions are considerably modified also by the composition as to species, by the extension and density of the stands of plants.

Table 2. Data of air and water temperature (1972)

Place	Months											
	M		J		J		A		S		O	
	a	w	a	w	a	w	a	w	a	w	a	w
1	17,0	15,0	17,4	16,5	15,0	19,4	18,2	14,4	17,7	15,8	9,2	7,2
2	17,0	14,8	17,5	16,8	15,2	20,0	20,4	14,8	18,4	14,8	12,5	8,0
3	21,1	16,8	20,0	16,4	15,0	19,6	20,4	14,6	18,4	16,5	12,5	8,4
4	19,1	16,2	24,0	17,4	15,2	19,6	22,2	14,8	18,4	16,5	14,3	8,3
5	18,1	15,8	19,2	17,9	15,2	19,6	20,3	14,0	18,4	16,8	13,5	8,5
6	19,1	16,2	20,4	17,8	15,2	19,8	18,4	16,5	18,4	16,5	13,9	8,7
7	18,1	16,8	19,0	18,9	14,9	19,8	19,1	14,9	17,4	16,6	14,5	9,0
8	18,2	15,5	21,0	19,2	–	–	21,9	15,2	17,4	16,6	14,5	12,4
9	18,1	17,8	19,2	18,0	–	–	18,0	13,7	–	–	–	–
10	18,8	18,2	–	–	–	–	–	–	–	–	–	–

Even at similar location e.g., stands of *Myriophyllum spicatum* or *Potamogeton pectinatus* give rise to sharply contrasting water climates. According to data in the pertinent literature, the animal population in the fields of *Potamogeton pectinatus* is rather scanty.

Similarly, the microclimate, and consequently also the flora and fauna of the plant populations *Utricularia vulgaris* and *Najas marina* are different in many respects.

In the open water of the Hungarian pant of the Lake *Myriophyllum spicatum* and *Potamogeton pectinatus* are the most frequent types of pondweed, and it is in the first place *Utricularia vulgaris* and Najas *marina*, which form stands in the reed zone.

For the decomposing organisms of the pondweed fields (also including the invertebrate macrofauna), the content in dissolved oxygen of the water, as well as the circadial and seasonal changes thereof are outstandingly important factors of the water climate.

It appears from the results of the measurements of dissolved O_2 content conducted in pondweed fields with monthly frequency, that during the vegetation period the values of O_2 were generally rather high, and – in spite of the differences found in the single habitats – they did not point to a possibility of lack in O_2 (Table 6).

However, the observation of the circadial dynamism of dissolved O_2 in various Fertő habitats convinces one of the very opposite of this statement. For observing the circadial changes in dissolved O_2 content the author chose 4 characteristic habitats of Lake Fertő (Neusiedl am See, 7–8th June, 1976).

These were: *a)* reeds; *b)* open water (at about 50 m. from the reed screen); *c)* decaying stand of *Utricularia vulgaris; d)* green field of *Utricularia vulgaris.*

In so to say each part of the day a low value of disselved oxygen (practically zero) was characteristic of the reed zone. In the decaying stand of *Utricularia vulgaris* similarly a slight fluctuation of the low oxygen level could be observed. On the other hand, a water climate of slight fluctuation, of a more even character at high oxygen content was found to be characteristic of the open water. The intensive oxygen production of the green stand of *Utricularia vulgaris* is shown by the fact that the values of dissolved oxygen measured here in the late morming hours far surpass the results obtained in the open water (Table 7).

Table 3. Hydroecological data of open-water pondweed fields and isolated pondweed stands (16, 9, 1971)

Compounds	Places										
	Open-water pondweed fields						Isolated pondweed stands				
	1	2	3	4	5	6	7	8	9	10	11
Water temperature C°	13.5	13.9	13.5	13.8	13.8	14.8	15.8	15.8	15.9	16.95	17.11
pH	8.40	8.40	8.4	8.45	8.5	8.55	8.85	8.45	8.50	8.50	8.40
Conductivity (μS)	2240	2240	2240	2312	2256	2232	2304	2240	2400	2256	2384
Disolved oxigen (mg/l)	10.47	12.18	9.98	12.11	10.89	11.35	13.17	9.14	8.53	10.96	8.76

Table 4. PH data (1971–72)

Place	Months											
	M	J	J	A	S	O	M	J	J	A	S	O
1	8.50	8.25	8.80	8.55	8.40	8.65	8.30	8.00	8.39	8.10	8.30	8.42
2	8.70	8.25	8.90	8.60	8.40	8.60	8.30	8.00	8.39	7.7	8.30	8.30
3	8.40	8.65	8.90	8.60	8.40	8.65	8.55	8.00	8.89	7.95	8.10	8.45
4	8.30	8.60	8.91	8.47	8.45	8.80	8.21	8.19	8.80	7.88	8.05	7.90
5	8.50	8.60	8.70	8.30	8.50	8.65	8.45	8.45	9.10	7.90	8.10	8.05
6	8.55	8.25	8.37	8.20	8.55	8.70	8.40	8.10	8.65	8.00	8.69	8.07
7	8.60	8.80	8.55	8.50	8.85	8.70	8.60	8.75	8.79	8.80	8.85	8.70
8	8.50	–	8.43	8.49	8.45	8.65	8.48	8.50	–	8.07	8.60	8.25
9	8.45	–	8.46	9.18	8.50	8.65	–	8.45	–	8.40	8.40	–
10	–	–	8.50	9.10	8.50	8.65	–	–	–	–	8.65	–
11	–	–	9.05	8.68	8.40	–	–	–	–	–	8.15	–

of conductivity (1971–72)

Place	Months											
	M	J	J	A	S	O	M	J	J	A	S	O
1	2096	2040	2399	2104	2240	2336	1755	1747	1763	1540	1896	1808
2	2088	2020	2328	2144	2240	2384	1755	1678	1878	1578	1992	2000
3	2200	2160	2248	2152	2240	2240	1808	1747	1855	1524	2008	1984
4	2064	2248	2344	2242	2312	2112	1816	1809	1863	1501	1992	1968
5	2088	2160	2368	2304	2256	2112	1656	1801	1955	1378	1992	1912
6	2144	2160	2568	2336	2232	2291	1679	1863	1886	1386	1936	1880
7	2064	2096	2552	2288	2304	2240	1884	1832	1963	1455	1936	1960
8	2128	2160	2328	2224	2240	2110	1786	1701	1940	1463	1944	–
9	2064	2176	2360	2320	2256	2110	1748	1617	–	1455	1928	–
10	2152	–	2520	2128	2384	2370	1824	1863	–	1439	1968	–
11	2048	–	2400	2144	2256	2240	1831	1832	–	–	1944	–

Table 6. Result of the measurement of dissolved oxigen (mg/l) (1971–72)

Place	Months											
	M	J	J	A	S	O	M	J	J	A	S	O
1	5.84	8.58	8.55	11.44	10.74	3.02	2.54	9.09	1.42	6.25	5.74	11.03
2	8.96	4.71	10.34	17.16	12.18	6.72	3.59	8.92	1.74	0.62	6.45	9.94
3	11.92	5.80	10.91	9.18	9.98	2.57	11.29	7.24	6.66	5.35	5.11	16.87
4	14.56	5.87	11.16	6.77	12.11	9.07	8.52	6.06	5.07	1.18	5.43	4.72
5	16.40	2.39	7.57	4.96	10.89	7.93	5.83	4.10	1.20	2.83	4.80	7.61
6	8.48	6.24	8.30	2.00	11.35	7.25	4.48	2.77	7.14	3.14	11.41	5.59
7	6.96	8.43	4.88	6.99	13.17	8.24	7.48	2.94	2.69	10.15	11.49	10.02
8	6.32	9.90	5.86	6.54	9.14	9.52	7.63	2.18	2.69	1.33	9.29	13.99
9	6.32	8.66	4.64	7.37	8.53	4.00	7.85	3.19	–	6.61	9.44	–
10	8.16	–	6.92	2.41	10.96	3.40	7.70	6.73	–	9.29	14.95	–
11	9.20	–	17.27	6.47	8.76	9.82	8.6	5.89	–	8.50	3.49	–

Table 7. The daily fluctuacion of water temperature and of dissolved oxigen in the various habitats of Lake Fertő

Hours	Place							
	A		B		C		D	
	°C	mg/l	°C	mg/l	°C	mg/l	°C	mg/l
06	16,0	0,4	19,9	4,3	17,6	5,6	18,0	2,0
08	16,2	0,6	20,0	5,0	18,5	6,8	18,2	3,0
10	17,0	1,2	21,0	5,0	20,0	11,0	20,0	3,8
12	18,5	2,0	22,3	5,3	22,0	13,2	20,5	2,6
14	20,5	2,0	24,0	6,4	24,5	15,4	24,3	4,6
16	20,0	1,8	25,0	7,6	24,0	15,6	26,5	2,9
18	19,7	1,7	24,0	7,0	23,5	16,2	22,5	3,0
20	20,0	1,0	23,0	7,0	22,5	12,3	21,0	3,0
22	18,0	0,5	22,5	6,4	19,6	11,0	20,0	2,7
24	17,5	0,2	20,0	6,0	18,0	9,0	20,0	0,3
02	17,2	0,2	18,5	5,0	17,6	5,8	19,0	0,4
04	17,0	0,4	20,0	3,4	17,0	6,0	18,8	0,5

A = reed; B = bay without pond weeds; C = izolated green *Utriculaira vulgaris* stand; D = deading *Utricularia vulgaris* stand

Still, in accordance with exactly the speciality of Lake Fertő, the ecological conditions of the single habitats are modified by the characteristic flows of substances and energy connecting the biotopes. The most important agent of this intensive connection between the biotopes is wind action.

The fundamental relationship between the chemism of the water and wind action is discussed in the study of E. Szabó (3). From it is known that in windy weather an intensive flow of substances ensues between the open water and the extensive reed stands.

Bearing the above in mind, the rapid changes frequent in the various Fertő habitats and the periodic anaerobic conditions meaning an efficient ecological factor of selection can fairly well be explained. This astatic character often calls forth considerable destruction in the fauna and also decisively determines the fundamental aspect of the invertebrate macrofauna.

Apart from all these, summarizing ecological information on pondweed fields can be considered especially justified, since both in the Hungarian and in the Austrian parts of Lake Fertő, in recent years a recession of the continuous pondweed fields can be observed.

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