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DATA TO THE KNOWLEDGE OF COMPOSITION OF THE MOST FREQUENTLY OCCURRING REED-GRASS SPECIES IN LAKE BALATON

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During the synecological analyses of the reed-grass vegetation in Lake Balaton we wish to gain detailed information on the quantitative and qualitative conditions of the phytomass production. The present paper is to add data to the composition of the most frequently occurring reed-grass species in Lake Balaton. A carefully planned survey will subsequently follow our present preliminary collaction of data. We wish to gain a comprehensive picture about the organic material production of the reed-grass vegetation (Potametea) in the constant water surfaces of Lake Balaton, together with the shore-zonal reedery (Phragmition) and high sedge (Magnocarition) with respect to individual annual periods.

Material and method

The reed-grass samples used in the investigation were collected at the same time (1. X. 1968) from Lake Balaton *(Table 1)*. After washing in distilled water, the samples were dried at 60 °C, then the desiccated matter was groun to powder.

The compositional characteristics were determined by the following methods:

1. Determination of water and dry matter content was carried out in two phases:
   (a) Organic matter (after drying) = dry matter — raw ash
   (b) Extractable matter free of nitrogen = 100 — (water content + raw protein) + raw fat + raw fibre + raw ash
2. Determination of raw ash was carried out according to the pattern number MSZ6, B30.
3. Determination of raw fat by the Soxhlet method (extrahaling).
4. Determination of materials containing nitrogen:
   (a) Raw protein (total matter containing nitrogen), the determination was carried out according to the WAGNER-PARNASS microkjeldahl method
   (b) Digestible raw protein percentage was obtained by calculation.
5. Raw fibre (lignin) content was determined by the HENNEBERG—STOKMANN method.
6. Starch values were obtained by calculation.

Our investigations, in all cases, were carried out in accordance with the foraging standards in order to enable anyone to compare our data to those already published in Hungarian technical literature directly.

TABLE 1

Collecting data of read-grass samples

Serial N°	Note book N°	Species	Association	Collecting sites	Date of collecting
1	23	*Ceratophyllum submersum*	*Ceratophylletum submersi*	+ Fadd	1968. X. 1.
2	25	,, ,,	,, ,,	Balatonfüred	1968. X. 1.
3	35	,, ,,	,, ,,	Tihany	1968. X. 1.
4	38	,, ,,	,, ,,	Badacsonytomaj	1968. X. 1.
5	39	,, ,,	,, ,,	Vonyarcvashegy	1968. VIII. 30.
6	40	,, ,,	,, ,,	Badacsonytomaj	1968. X. 1.
7	63	,, ,,	,, ,,	Balatonfüred	1968. X. 1.
8	6	*Chara phoetida*	*Lemno-Utricularietum charetosum*	Tihany	1968. X. 1.
9	10	,, ,,	,, ,,	Balatonfüred	1968. X. 1.
10	14	,, ,,	,, ,,	Vonyarcvashegy	1968. X. 1.
11	19	,, ,,	,, ,,	Badacsonytomaj	1968. X. 1.
12	60	,, ,,	,, ,,	Vonyarcvashegy	1968. X. 1.
13	3	*Hydrocharis morsus-ranae*	*Hydrochari-Stratiotetum typicum*	Balatonfüred	1968. X. 1.
14	21	,, ,,	,, ,,	Balatonfüred	1968. X. 1.
15	58	,, ,,	,, ,,	Tihany	1968. X. 1.
16	17	*Lemna minor*	*Lemno-Utricularietum typicum*	Vonyarcvashegy	1968. X. 1.
17	2	*Lemna trisulca*	*Lemno-Utricularietum*	Balatonfüred	1968. X. 1.
18	37	,, ,,	lemnetosum trisulcae	Balatonfüred	1968. X. 1.
19	4	*Myriophyllum spicatum*	*Myriophyllo-Potametum*	Balatonfüred	1968. X. 1.
20	15	,, ,,	myriophylletosum spicati	Vonyarcvashegy, Kápolna	1968. X. 1.
21	16	,, ,,	,, ,,	Tihany	1968. X. 1.
22	26	,, ,,	,, ,,	Badacsonytomaj	1968. X. 1.

23	28	” ”	” ”	Vonyarcvashegy, Kápolna	1968. X. 1.
24	31	” ”	” ”	Vonyarcvashegy, Kápolna	1968. X. 1.
25	34	” ”	” ”	+Fadd	1968.
26	49	” ”	” ”	+Hanság	1968. XI. 13.
27	57	” ”	” ”	Tihany	1968. X. 1.
28	62	” ”	” ”	Balatonfüred	1968. X. 1.
29	29	*Najas marina*	*Myriophyllo-Potametum*	Tihany	1968. X. 1.
30	32	” ”	”	Badacsonytomaj	1968. X. 1.
31	30	*Nuphar luteum*	*Nymphaeetum albo-luteae*	Vonyarcvashegy	1968. X. 1.
32	55	*Potamogeton crispus*	*Myriophyllo-Potametum*	Tihany	1968. X. 1.
33	20	*Potamogeton pectinatus* ssp. *balatonicus*	*Myriophyllo-Potametum*	Badacsontomaj	1968. X. 1.
34	27	” ” ” ”	*potametosum balatonici*	Tihany	1968. X. 1.
35	33	” ” ” ”	” ”	Vonyarcvashegy, Kápolna	1968. X. 1.
36	36	*Potamogeton pectinatus* ssp. *balatonicus*	*Myriophyllo-Potametum potametosum balatonici*	Tihany	1968. X. 1.
37	52	” ” ” ”	” ”	Badacsonytomaj	1968. X. 1.
38	9	*Potamogeton perfoliatus*	*Myriophyllo-Potametum*	Badacsonytomaj	1968. X. 1.
39	53	” ”	*potametosum perfoliati*	Vonyarcvashegy	1968. VIII. 30.
40	54	” ”	” ”	Tihany	1968. X. 1.
41	5	*Stratiotes alloides*	*Hydrochari-Stratiotetum stratiotetosum*	Balatonfüred	1968. X. 1.
42	7	” ”	” ”	Balatonfüred	1968. X. 1.
43	11	” ”	” ”	Balatonfüred	1968. X. 1.
44	24	” ”	” ”	Balatonfüred	1968. X. 1.
45	56	*Trapa natans*	*Trapetum natantis*	Vonyarcvashegy, Kápolna	1968. X. 1.
46	1	*Utricularia vulgaris*	*Lemno-Utricularietum*	Tihany	1968. X. 1.

Coenotaxonomic survey of the reed-grass stands at the collecting sites

The coenotaxonomic conditions of the reed-grass vegetation in Lake Balaton are quite well known from the detailed works of Borbás, V (1900), Soó R. (1928, 1934, 1936, 1947, 1948), also Soó's Manual I, II and III (1964, 1966, 1968), and from the result of our investigations (Kárpáti, I. and Mrs. Kárpáti, I. 1967a, 1967b, 1967c, 1968). We have taken our material for investigation from these well defined associations. The significant associations with respect to sampling are presented with a view to coenotaxonomy:

A. Lemno-Potamea Soó, 1968

a. Hydrochari-Lemnetea
 I. Hydrocharietalia Rübel 33
 Lemnion minoris Koch et Tx. 54
 1. *Salvinio-Spirodeletum* Savnic 56
 2. *Lemnetum minoris* Rübel 12
 a) typicum
 b) lemnetosum trisulcae
 c) charetosum
 Hyrocharition (Vierhapper) Rübel 33
 3. *Lemno-utricularietum* Soó 28
 a) lemnetosum minoris
 b) charetosum
 4. *Hydrochari-Stratitetum* (Langendonck 35) Westhoff 42
b. Potametea Ty. et Prsg. 42
 II. Potametalia W. Koch 26
 Potamion eurosibiricum W. Koch 26. (p.p.) Vlieger 37
 5. *Anacharietum canadensis* (Pign.) Soó
 6. *Myriophyllo-Potametum* Soó 34
 a) potametosum perfoliati
 b) potametosum balatonici
 c) potametosum crispi
 d) myriophylletosum spicati
 e) myriophylletosum verticillatii
 Nymphaeion (Oberd. 56) Soó 64
 7. *Polygono-Potametum natantis* Soó 64
 a) polygonetosum amphibii
 b) potametosum natantis
 8. *Nymphaeetum albo-luteae* Nowinsky 28
 a) namphaeetosum
 b) nupharetosum
 9. *Trapetum natantis* Müller-Görs 60
 trapetosum natantis
 potametosum perfoliati
 10. *Ceratophylletum submersi* Kárpáti I. et V. 68
 ceratophylletosum demersi
 potametosum balatonici

B. Cypero-Phragmitea Soó 68
  c. Phragmitetea Tx. et Persg. 42

III. Phragmitetalia W. Koch 26

Phragmition communis W. Koch 26
11. *Scirpo-Phragmitetum* W. Koch 26
  a) phragmitetosum
  b) schoenoplectetosum
  c) typhetosum
  d) glycerietosum
  e) phalaridetosum

Discussion of results

a) *Nutritive value of reed-grass elements*

Tables 2 and *3 give* the composition and nutritive values of reed-grasses. The nutritive material content has been expressed by the starch value calculated by Kellner, accepted and currently in use in Hungary. The utilization coefficients of individual nutritive materials were obtained on the basis of Sudan grass *(Sorgum vulgare sudanense)* from the standard No. MSZ 6890, for no coefficient numbers have as yet been calculated for reed-grass species, and because the chemical composition of reed-grass species is very similar to this arable land foraging plant.

The dry matter content of the reed-grass species fluctuated between 7.94 and 12.33%. The lowest dry matter content was measured (7.94—8.22%) in *Ceratphyllum submersum* samples, while the highest values were obtained for *Lemna trisulca* (11.98—12.33%) and *Lemna minor* (12.16%).

With respect to organic matter content the most favourable result was obtained with *Nuphar luteum* (9.17%), while the lowest value was shown in *Chara phoetida* (4.38%). The highest and lowest amount of ash residue (5.05% and 1.14%) were gained with *Myriophyllum spicatum.* Concerning raw protein content the lowest and the peak values were between 0.53 and 2.38%. The highest protein content was shown by *Myriophyllum spicatum,* while the lowest values were obtained with *Potamogeton pectinatus* ssp. *balatonicus.*

Among the nutritive materials the lowest values were displayed by raw fats (0.03—0.15%). The raw fibre content of reed-grass species fluctuated between 0.66—3.96%. The quantity of the extractable matter free of nitrogen varied between 0.58 and 5.24%.

The nutritive material quantity expressed in starch values fluctuated between 3.18 and 7.90 kg/g. The lowest nutritive values were displayed by *Chara phoetida,* while the highest values were shown by *Myriophyllum spicatum.* With respect to digestible raw protein the smallest value was yielded by *Potamogeton perfoliatus* (0.47%), while the highest value was given by *Myriophyllum spicatum* (1.83%) *(Table 1).*

In summarizing the results we established that both in chemical composition and nutritive values great variations are perceiveable between species and even within the individuals of the same species. The most favourable nutritive material content (expressed in starch values) is shown in *Lemna minor*

TABLE 2

1000 g analised material contains

Serial N	Note-book	Species	Dry matter %	Organic matter %
1	23	*Ceratophyllum submersum*	8.19	5.06
2	25	,, ,,	8.07	6.49
3	35	,, ,,	8.16	5.29
4	38	,, ,,	8.22	5.90
5	39	,, ,,	8.00	6.26
6	40	,, ,,	8.15	5.52
7	63	,, ,,	7.94	6.03
		average	8.10	5.79
8	6	*Chara phoetida*	8.50	4.43
9	10	,, ,,	8.54	4.39
10	14	,, ,,	8.52	4.59
11	19	,, ,,	8.49	4.38
12	60	,, ,,	8.50	4.61
		average	8.51	4.48
13	3	*Hydroharis morsus-ranae*	8.17	5.34
14	21	,, ,,	8.03	5.42
		average	8.10	5.38
15	17	*Lemna minor*	12.16	8.94
16	2	*Lemna trisulca*	11.98	8.40
17	37	,, ,,	12.33	7.94
		average	12.15	8.17
18	15	*Myriophyllum spicatum*	10.77	6.50
19	16	,, ,,	10.65	5.85
20	26	,, ,,	10.64	6.58
21	31	,, ,,	10.86	6.48
22	34	,, ,,	9.91	8.77
23	49	,, ,,	10.53	8.25
24	57	,, ,,	10.73	5.68
		average	10.58	6.87
25	29	*Najas marina*	10.56	7.64
26	32	,, ,, average	10.55	8.12
		average	10.55	7.88
27	30	*Nuphar luteum*	10.71	9.17
28	55	*Potamogeton crispus*	10.65	6.94
29	20	*Potamogeton pectinatus* ssp. *balatonicus*	10.41	7.14
30	27	,, ,, ,, ,,	10.39	7.65
31	33	,, ,, ,, ,,	10.49	7.56
32	36	,, ,, ,, ,,	10.19	7.56
33	52	,, ,, ,, ,,	10.30	7.48
		average	10.35	7.47
34	9	*Potamogeton perfoliatus*	10.28	6.84
35	53	,, ,,	10.09	8.02
36	54	,, ,,	10.49	6.46
		average	10.28	7.10
37	5	*Stratiotes aloides*	10.62	6.96
38	17	,, ,,	10.24	7.93
39	11	,, ,,	10.63	6.34
40	24	,, ,,	10.55	6.89
		average	10.51	7.03
41	56	*Trapa natans*	10.21	7.70

calculated for original dry matter

Ash %	Raw protein %	Raw fat %	Raw firre %	NMK %	Starch value %	Digestible raw protein, %
3.13	2.09	0.06	2.33	0.58	3.70	1.61
1.58	1.97	0.08	1.52	2.92	4.72	1.51
2.93	1.02	0.06	1.88	2.33	3.84	0.79
2.32	0.59	0.06	1.88	3.37	4.27	0.45
1.74	1.12	0.07	1.49	3.58	3.63	0.86
2.63	0.74	0.05	1.47	3.26	3.98	0.57
1.91	1.52	0.06	2.34	2.11	4.39	1.17
2.32	1.29	0.06	1.84	2.59	4.07	0.99
4.07	0.90	0.06	1.89	1.58	3.23	0.69
4.15	0.74	0.03	0.66	2.96	3.18	0.50
3.93	0.80	0.03	1.72	2.04	3.32	0.62
4.10	0.75	0.04	2.61	0.98	3.20	0.58
3.89	0.78	0.03	2.96	0.84	2.82	0.60
4.02	0.79	0.03	1.96	1.68	3.15	0.59
2.83	1.07	0.05	1.54	2.68	3.86	0.82
2.61	0.99	0.08	1.17	3.18	3.94	0.76
2.72	1.03	0.06	1.35	2.93	3.90	0.79
3.22	1.55	0.09	2.90	4.40	7.55	1.19
3.58	1.65	0.15	2.75	3.85	7.90	1.27
4.39	1.78	0.08	3.32	2.76	5.78	1.37
3.98	1.71	0.11	3.03	3.30	6.84	1.32
4.27	1.10	0.05	2.87	2.48	4.68	0.85
4.80	2.38	0.07	1.53	1.87	5.13	1.83
4.06	0.84	0.08	2.41	3.25	4.78	0.65
4.38	1.14	0.05	3.65	1.64	4.72	0.88
1.14	1.91	0.13	1.55	5.18	7.90	1.47
2.28	1.44	0.08	1.49	5.24	5.95	1.10
5.05	1.07	0.06	2.67	1.88	4.13	0.82
3.71	1.27	0.07	2.31	3.07	5.32	1.08
2.92	1.17	0.09	3.15	3.24	5.56	0.90
2.43	1.20	0.10	2.77	4.05	5.90	0.92
2.67	1.18	0.09	2.96	3.64	5.73	0.91
1.54	1.14	0.10	2.68	5.25	6.65	0.88
3.71	1.13	0.08	2.76	2.97	3.25	0.87
3.27	0.84	0.08	2.80	3.42	5.19	0.65
2.74	1.27	0.11	3.04	3.23	5.56	0.98
2.93	0.82	0.07	2.77	3.90	5.47	0.63
2.63	1.02	0.08	2.54	3.92	5.62	0.92
2.82	1.36	0.08	3.00	3.04	5.44	1.04
2.87	1.06	0.08	2.83	3.50	5.45	0.84
3.44	0.53	0.07	3.96	2.27	4.97	0.41
2.07	1.01	0.11	3.60	3.30	5.84	0.78
4.03	1.34	0.08	1.45	3.59	4.69	1.03
3.18	0.96	0.08	3.00	3.05	5.16	0.74
3.66	2.23	0.07	2.49	2.17	5.10	1.71
2.31	1.39	0.08	2.75	3.71	5.76	1.07
4.29	1.00	0.07	2.68	2.59	4.61	0.77
3.66	1.20	0.07	2.95	2.68	5.00	0.92
3.48	1.45	0.07	2.71	2.78	5.11	1.11
2.51	1.15	0.09	1.70	4.76	5.56	0.89

TABLE 3

1000 g analysed material contains

Serial No	Note-book	Species		Dry matter %	Organic matter %
1	23	*Ceratophyllum submersum*		100.00	61.78
2	25	,, ,,		100.00	40.43
3	35	,, ,,		100.00	64.10
4	38	,, ,,		100.00	71.78
5	39	,, ,,		100.00	78.25
6	40	,, ,,		100.00	67.74
7	63	,, ,,		100.00	75.95
			average	100.00	71.43
8	6	*Chara phoetida*		100.00	52.11
9	10	,, ,,		100.00	51.40
10	14	,, ,,		100.00	53.87
11	19	,, ,,		100.00	51.59
12	60	,, ,,		100.00	54.24
			average	100.00	52.64
13	3	*Hydrocharis morsus-ranae*		100.00	65.36
14	21	,, ,,		100.00	67.49
		,, ,,	average	100.00	66.42
15	17	*Lemna minor*		100.00	73.51
16	2	*Lemna trisulca*		100.00	70.12
17	37	,, ,,		100.00	57.51
			average	100.00	63.81
18	15	*Myriophyllum spicatum*		100.00	60.35
19	16	,, ,,		100.00	54.92
20	26	,, ,,		100.00	61.85
21	31	,, ,,		100.00	59.67
22	34	,, ,,		100.00	88.38
23	49	,, ,,		100.00	78.35
24	57	,, ,,		100.00	52.94
			average	100.00	65.20
25	29	*Najas marina*		100.00	72.35
26	32	,, ,,		100.00	76.97
			average	100.00	74.66
27	30	*Nuphar luteum*		100.00	85.63
28	55	*Potamogeton crispus*		100.00	65.17
29	20	*Potamogeton pectinatus* ssp. *balatonicus*		100.00	68.58
30	27	,, ,, ,, ,,		100.00	73.63
31	33	,, ,, ,, ,,		100.00	72.07
32	36	,, ,, ,, ,,		100.00	74.20
33	52	,, ,, ,, ,,		100.00	72.63
			average	100.00	72.22
34	9	*Potamogeton perfoliatus*		100.00	66.53
35	53	,, ,,		100.00	79.49
36	54	,, ,,		100.00	61.59
			average	100.00	69.20
37	5	*Stratiotes aloides*		100.00	65.53
38	7	,, ,,		100.00	77.44
39	11	,, ,,		100.00	59.64
40	24	,, ,,		100.00	66.97
			average	100.00	65.30
41	56	*Trapa natans*		100.00	75.42

calculated for absolute dry matter

Ash %	Raw protein %	Raw fat %	Raw fibre %	NMK	Strach value kg/g	Digestible protein, %
38.22	25.51	0.73	28.45	7.08	45.17	19.65
19.57	24.41	0.99	18.87	36.10	58.48	18.71
35.90	12.50	0.73	23.03	28.55	47.05	9.68
28.22	7.17	0.73	22.87	40.99	51.94	5.47
21.75	14.00	0.87	18.62	44.75	45.37	10.75
32.26	9.07	0.61	18.03	40.00	48.83	6.99
24.05	19.14	0.76	29.47	26.57	55.28	14.73
28.56	15.97	0.77	22.76	32.00	50.30	12.28
47.89	10.58	0.71	22.23	18.58	38.00	8.11
48.60	8.66	0.39	7.73	34.66	37.23	6.55
46.13	9.38	0.37	20.18	23.94	38.96	7.27
48.41	8.83	0.47	30.74	11.54	37.69	6.83
45.76	9.17	0.35	34.82	9.88	33.17	7.05
47.35	9.32	0.45	23.14	19.72	37.01	7.16
34.64	13.09	0.67	18.84	32.80	47.24	10.03
32.51	12.32	0.99	14.57	39.60	49.06	9.46
33.57	12.70	0.83	16.70	36.20	48.15	9.74
26.49	12.14	0.74	23.84	36.18	62.08	9.78
29.88	13.77	1.25	22.95	32.14	65.94	10.60
42.49	14.44	0.65	26.93	22.38	46.88	11.11
36.18	14.10	0.95	24.94	27.26	56.41	10.85
39.65	10.21	0.46	26.64	23.02	43.45	7.89
45.08	22.35	0.66	14.36	17.55	48.16	17.18
38.15	7.89	0.75	22.65	30.54	44.92	6.11
40.33	10.49	0.46	33.61	15.10	43.46	8.10
11.62	19.27	1.32	15.80	52.80	79.71	14.83
21.65	13.67	0.76	14.14	49.76	56.50	10.44
47.06	9.97	0.56	24.88	17.52	38.48	7.64
34.79	13.40	0.71	21.72	29.47	50.66	10.31
27.65	11.07	0.84	29.83	30.68	52.65	8.52
23.03	11.37	0.95	26.26	38.39	55.92	8.72
25.34	11.22	0.89	28.04	34.53	54.28	8.62
14.37	10.64	0.93	25.02	49.01	62.09	8.22
34.83	10.61	0.75	25.91	27.88	30.51	8.17
31.42	8.06	0.76	26.89	32.85	49.85	6.24
26.37	12.22	1.06	29.26	31.09	53.51	9.43
27.93	7.81	0.67	26.41	37.18	52.14	6.00
25.80	10.00	0.78	24.93	38.47	55.15	9.03
27.37	13.20	0.78	29.12	29.51	52.81	10.09
27.77	10.25	0.88	27.32	33.82	52.69	8.15
33.67	5.15	0.68	38.52	22.08	48.35	3.98
20.51	10.01	1.09	35.67	32.70	57.87	7.73
38.41	12.77	7.62	13.82	34.22	44.71	9.82
30.86	9.31	3.13	29.33	29.66	50.38	7.17
34.47	20.99	0.65	23.44	20.43	48.02	16.10
22.56	13.57	0.78	26.85	36.23	56.25	10.44
40.36	9.40	0.66	25.21	24.36	43.37	7.24
34.70	11.37	0.69	27.96	25.40	47.39	8.72
33.02	13.83	0.69	25.86	26.60	48.75	10.62
24.58	11.26	0.88	16.65	46.03	54.45	8.72

(7.55 kg/g), followed in order of sequence by *Lemna trisulca* (6.84 kg/g), *Nuphar luteum* (6.65 kg/g). The nutritive values of the rest of the reed-grass species was below 6.0 kg/g calculated for starch values. The highest value for the digestible raw protein content was found in *Lemna trisulca* (1.32%),while therest followed in order of sequence *Lemna minor* (1.19%), *Stratoides aloides)* (1.11%), *Myriophyllum spicatum* (1.08%). The digestible raw protein content of the rest of the species never reached 1.0% *(Table 2)*.

The chemical composition and nutritive material values of reed-grass species were calculated for absolute (100%) dry matter in order to eliminate the differences caused by dry matter content and to obtain more favourable basis for comparison. The absolute dry matter included 52.64—85.63% organic matter. The lowest values were displayed by *Chara phoetida,* while the highest ones by *Nuphar luteum.* Concerning ash content, the lowest yield was given by *Nuphar luteum* (14.37%), while highest yield was obtained with *Chara phoetida* (47—37%). The most favourable result with respect to raw protein was obtained with *Ceratophyllum submersum* (15.97%), while *Pomatogeton perfoliatus* showed a mere 9.31% of raw protein. The highest raw fibre content was yielded in *Naja marina* (28.04%), while the lowest value was shown by *Trapa natans* (16.65%). The extractable matter free of nitrogen fluctuated between 19—72 and 49.01%. With respect to nutritive material content we found the following two limiting values 30.51 and 62.09 kg/g; at the same time the digestible raw protein content fluctuated between 6.00 and 19.65%. Considering the mean values of nutritive material content in eight species we found a value more than 50.0 kg/g for starch value *(Lemna minor, Trapa natans, Potamogeton perfoliatus, Nuphar luteum, Najas marina, Ceratophyllum submersum, Lemna trisulca, Potamogeton pectinatus)*.

Only in four species have we found a value above 10.0% for digestible raw protein content *(Myriophyllum spicatus, Stratiotes aloides, Ceratophyllm submersum, Lemna trisulca)*.

On the basis of our investigations we came to the conclusion that the nutritive value of reed-grass species is favourable, and under appropriate and economic exploitation suitable for foraging of domestic animals. However, we must point out that our data as yet are informatory in nature, for the exact determination of nutritive material content as now expressed in starch value will need extensive investigations in the future. That will render possible that the nutritive value of reed-g species be comparable to arable land fodder plants, in order to decide the bes method of utilization.

b) *Mineral material content of reed-grass elements*

During the evaluation of phytomass production of reed-grass species we endeavoured to obtain data throwing light on the mineral material conten too. We wrote a comprehensive study on the manganese content of *Potametea* elements (KÁRPÁTI I., KÁRPÁTI V. and TÖLGYESI, 1967), but we also have useful data at our disposal concerning the characteristics of macro- and microelement conditions of individual plant families (MODOR and TÖLGYESI, 1964; MÓCSY and TÖLGYESI, 1960; TÖLGYESI, 1962, 1963, 1965a, b, c, 1968). As it has been indicated in our paper, the well-nigh 5,000 data of the 44 profoundly investigated plant families unanimously support that the taxa included in Potamion associations have a very high Mn content *(Table 5)*. At

TABLE 4

Mineral material content of some reed-grass species compared with that of fodder plants
(After: TÖLGYESI GY. 1965)

Species	CaO	Na	P_2O_5	Fe	Mn	Zn	Cu
	g/kg				mg/kg		
Potamogeton natans	37	11	7	690	1400	81	5
Potamogeton pectinatus	26	10	6	880	1800	47	6
Ceratophyllum demersum	36	7	9	1400	5000	140	8
Myriophyllum spicatum	62	12	4	1300	2400	65	5
Trapa natans	35	5	4	450	700	68	6
Hydrocharis morsus-ranae	12	9	8	1300	4000	100	7
Lemna minor	58	7	12	440	3100	110	16
Lemna trisulca	30	7	6	3000	7000	50	9
Hordeum vulgare (grain)	1	0.2	6	80	20	16	5
Zea mays (grain)	1	0.1	5	60	15	16	3
Medicago sativa (hay)	20	0.4	6	240	50	30	10
Meadow-hay	10	0.5	5	160	80	25	8

TABLE 5

Mineral material content of some plant families
After: TÖLGYESI GY. — *Acta Agr. Hung.* (1965) 287—301.

Pant family	No. of species	Sample No.	CaO	P_2O_5	Fe	Mn	Zn	Su
			g/kg		ppm			
Gramineae	98	466	3.7	4.2	179	71	28	5.6
Compositae	74	243	14.2	5.9	329	57	31	11.4
Papilionaceae	49	194	15.6	4.7	196	50	25	9.1
Salicaceae	18	117	17.0	4.8	149	103	85	7.7
Cyperaceae	41	109	4.8	4.9	273	199	24	2.0
Rosaceae	24	105	15.8	4.3	201	69	28	7.7
Labiatae	27	72	15.3	5.8	439	50	33	11.2
Cruciferae	27	71	14.0	6.4	270	46	27	5.3
Fagaceae	7	65	13.6	3.7	162	454	25	7.7
Ranunculaceae	19	64	15.5	6.2	176	51	35	9.8
Betulaceae	4	58	19.5	3.1	218	432	32	8.1
Scrophulariaceae	28	53	11.8	5.0	323	60	28	7.7
Caryophilaceae	18	49	11.7	5.7	281	128	32	6.7
Polygonaceae	14	48	10.2	5.4	277	81	28	6.6
Boraginaceae	18	46	20.6	6.1	372	66	27	11.7
Oleaceae	7	46	14.5	3.2	140	46	24	6.5
Rubiaceae	12	44	15.4	5.5	293	52	27	7.5
Aceraceae	6	44	15.0	5.1	181	94	27	7.0
Liliaceae	16	40	10.2	5.8	143	46	32	7.2
Juncaceae	13	32	3.0	3.6	210	141	24	6.6
Euphorbiaceae	8	25	16.9	6.1	183	109	32	8.4
Umbelliferae	14	24	17.4	5.9	196	47	29	8.9
Solanaceae	6	23	15.7	7.7	299	57	25	14.0
Plantaginaceae	5	22	15.2	5.4	261	38	31	9.4
Chenopodiaceae	9	20	12.7	5.5	270	55	46	7.1
Hydrochariaceae	3	20	15.7	7.2	1300	496	108	5.3
Zosteraceae	7	20	35.6	6.0	875	1160	80	5.6

TABLE 6

Manganese content of some reed-grass species

(After KÁRPÁTI I.—KÁRPÁTI V.—TÖLGYESI GY. 1967)

Species	Collecting site	Depth of water	Association	Mn mg/kg
CHAROPHYTA				
Chara phoetida	Tatai-tó, Réti	60	Homogen-cous stand	1 320
NYMPHACEAE				
Nuphar luteum	Ludányhalászi, Ipoly	80—100	Nymphaeetum albo-luteae	2 760
N. luteum	Drégelypalánk, Ipoly	80—100	Nymphaeetum albo-luteae	1 960
N. luteum	Sérfenyősziget, Duna-holtág	100—150	Nymphaeetum albo-luteae	300
N. luteum	Sérfenyősziget, Kis-Duna	50—80	Nymphaeetum albo-luteae	420
CERATOPHYLLACEAE				
Ceratophyllum demersum .	Mosonmagyaróvár, Fekete-erdő, Duna-holtág	50—150	Myriophyllo-Potametum	10 600
C. demersum	Dunaharaszti	100—120	Myriophyllo-Pot2metum	3 000
C. demersum	Tatai-tó, Réti	60—80	Myriophyllo-Potametum	2 160
C. demersum	Velencei-tó	200—300	Myriophyllo-Potametum	450
HALORAGACEAE				
Myriophyllum spicatum .	Velencei-tó	200—300	Myriophyllo-Potametum	480
M. spicatum	Dunaharaszti	100—120	Myriophyllo-Potametum	2 470
M. spicatum	Tatai-tó, Cseke	100	Myriophyllo-Potametum	980
M. spicatum	Drégelypalánk, Ipoly	40—60	Myriophyllo-Potametum	8 400
M. spicatum	Öskü-Séd		Myriophyllo-Potametum	405
TRAPACEAE				
Trapa natans	Dunaharaszti	200—250	Trapetum natantis	1 100
T. natans	Szarvas, Bikazug	200—300	Trapetum natantis	620
T. natans	Taksony	180—190	Trapetum natantis	360
T. natans	Hercegszántó	200—300	Trapetum natantis	305
LENTIBULARIACEAE				
Utricularia vulgaris	Karapancsa, Ferenc-csatorna	200—300	Lemno-Utricularietum	1 090
U. vulgaris	Veresegyház	70	Lemno-Utricularietum	2 040
U. vulgaris	Karapancsa, Duna-holtág	100	Lemno-Utricularietum	4 580
U. vulgaris	Velencei-tó	50—150	Lemno-Utricularietum	303
HYDROCHARITACEAE				
Hydrocharis morsus-ranae	Kiskunlacháza	60—70	Hydrochari-Stratiotetum	1 100
H. morsus-ranae	Szarvas, Bikazug	200—300	Hydrochari-Stratiotetum	895
H. morsus-ranae	Ipolyszög	150—180	Hydrochari-Stratiotetum	5 200
H. morsus-ranae	Velencei-tó	50—100	Lemno-Utricularietum	625

Species	Collecting site	Depth of water	Association	Mn mg/kg
ZOSTERACEAE incl. POTAMOGETONACEAE				
Potamogeton pectinatus ..	Tata, Fényesfürdő	60—80	Myriophyllo-Potametum	840
P. pectinatus	Drégelypalánk	60	Myriophyllo-Potametum	2 350
P. pectinatus	Tatai-tó, Réti	60—80	Myriophyllo-Potametum	276
P. pectinatus	Soroksár, Duna-holtág	50	Myriophyllo-Potametum	1 320
P. pectinatus	Velencei-tó	100—200	Myriophyllo-Potametum	240
Potamogeton perfoliatus ..	Keszthely		Myriophyllo-Potametum	600
P. perfoliatus	Magyaróvár, Fekete-erdő	50—100	Myriophyllo-Potametum	336
P. perfoliatus	Bankháza	100—150	Myriophyllo-Potametum	385
Potamogeton crispus	Veresegyház	200	Myriophyllo-Potametum	1 510
P. crispus	Dunaharaszti	100—120	Myriophyllo-Potametum	1 150
P. crispus	Ludányhalászi, Ipoly	80—100	Myriophyllo-Potametum	1 200
NAJADACEAE				
Najas minor	Szarvas, Káka	30—50	Myriophyllo-Potametum	1 100
Najas marina	Velencei-tó	200—300	Myriophyllo-Potametum	285
N. marina	Hercegszántó, Ferenc-csatorna	200—300	Myriophyllo-Potametum	620
LEMNACEAE				
Lemna triculca	Veresegy á hz	70	Lemno-Utricularietum	16 100
L. trisulca	Drégelyplánk	40—50	Lemno-Utricularietum	9 680
L. trisulca	Ipolyszög, Ipoly	80—100	Lemno-Utricularietum	34 600
Lemna minor	Tatai-tγ, Réti	30	Lemno-Utricularietum	1 190
L. minor	Karapancsa, Duna-holtág	200—280	Lemno-Utricularietum	9 000

the same time, in the specific elements of Rosaceaea, Fabaceae, Umbelliferae, Runiaceae, Labiatae, Solanaceae, etc. reealy acclimatized to dry land habitats manganese occur as an average between 50 and 70 mg/kg. The problem is discussed in more detail in our previously mentioned paper (KÁRPÁTI, I., KÁRPÁTI, V. and TÖLGYESI, 1967) providing ample space both for ecological and phylogenetical references.

The principle just indicated does not only appear in the relation of Mn content but we can also see from the comparison of systematical taxa (TÖLGYESI, 1965 b, c) that both the macro- and microelements occur in greater quantities in the reed-grass elements in plant species living under dry land conditions.

Especially their manganese, sodium, iron, and zinc contents are greater than many of the plant species living on the dry land. The calcium oxide content is equivalent to the highest limit of known dry land fodder plants In phosphorus and copper content no significant difference may be observed between them and that of the plants living on dry land *(Tables 4* and *5)*.

The data on hand reveal that this is not the outcome of macro- and microelement quantity of habitats. It can rather be explained by the better absorbing and concentrating capacity of aqueous plants although, we must bear in mind that given habitats with prevailing conditions play a sgnifican role in the accumulation of mineral material of the individual plant species.

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ADATOK A BALATONBAN ELTERJEDTEBB HÍNÁRFAJOK BELTARTALMÁNAK ISMERETÉHEZ

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A balatoni hínárvegetáció fitobiomassza-produkciójának vizsgálata során szükségessé vált a termelt zöld- és száraz növénytömeg kémiai jellemzőinek megismerése. Elemzéseinket a takarmányozástani gyakorlatban elterjedt módszerekkel végeztük el, a tóban legnagyobb tömeget adó fajok vonatkozásában.

Elemeztük a következő jellemzőket:

a) *hínárelemek táplálóértéke:* nyersfehérje, nyerszsír, keményítőérték.

b) *hínárelemek ásványanyagtartalma:* különösképpen a mangán, nátrium, vas, cinktartalom vonatkozásában állapítható meg, hogy az lényegesen nagyobb mennyiségben fordul elő, mint a szárazföldi növényekben.

A vizsgálati eredmények *elméleti szempontból* hasznos támpontot nyújtanak a balatoni táplálékláncban lényeges jelentőségükre vonatkozóan.

Gyakorlati vetületében pedig a hazai nagy tömegű hínárprodukció esetleges takarmányozási hasznosításához nyújtanak vizsgálataink támpontot, adatokat.

ДАННЫЕ О ХИМИЧЕСКОМ СОСТАВЕ НАИБОЛЕЕ РАСПРОСТРАНЕННЫХ ВИДОВ ВОДОРОСЛЕЙ БАЛАТОНА

Карпати Иштванне и *Бедѐ Шандорне*

Знание химических характеристик зеленой и сухой массы водорослей необходимо для исследований фитобиопродукции Балатона. В данной работе наиболее рапространенные водоросли Балатона характеризировались методами, принятыми в кормоводстве. Определялись следующие показатели:

а) питательность водорослей (сырые белки, сырые жиры, крахмал),

б) содержание минералов. Установлено, что содержание в первую очередь, марганца, натрия, железа и цинка гораздо выше в водорослях, чем в наземных растениях. С теоретической точки зрения, данные полезны для понимания места растений в пищевой цепи Балатона. С точки зрения практики, полученные результаты дают информацию о возможностях испльзования богатых запасов водорослей в качестве кормов.