STUDIES ON THE SHORE VEGETATION OF LAKE* BELSŐ-TÓ AT TIHANY

BY

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INTRODUCTION.

In the course of some work with Hungarian weed vegetation, my attention was drawn for the first time to the *Nanocyperion* type of low-growing weed societies. These communities are always found in silt or muddy places (FELFÖLDY, 1942:99—102, 1947:105—106, etc.). During my researches on vegetation on the Tihany peninsula I came upon societes of *Nanocyperetum* in the inundation area of Lake Belső-tó which reccured regularly each year, research into the environment, composition and occurrence of which led me to interesting results meriting publication.

The area surveyed was the S and SW shore of Lake Belső-tó in the Tihany peninsula. The whole southern shore is pasture, there are even wells there for herds, and consequently cattle, geese and rooting pigs exert a destructive effect upon the vegetation. The SW shore was planted with maize, owing to which the shore vegetation was protected from the land side, from the destructiveness of animals. Three zones are formed on this protected side up to October. There is a bare strip directly by the water without vegetation, where only little sprouting plants and young shoots can be found. These species are the most vigorous, the most resistant, the hardy species of the next vegetative zone. After this bare strip, a low-growing *Nanocyperion* type of plant community forms, which, from its dominant species, can be called *Pycreetum flavescentis.* Beyond it, on the furthermost borders of the inundation area grows the *Bidens tripartita* association, which is sharply distinguished from the *Pycreetum* by its high growth and characteristic floral composition (See Figure 1).

On the trampled grazed area, conditions are quite different. On the strip beside the water the animals have entirely destroyed the vegetation. But beyond it is a richly growing, fresh green, short turf almost entirely composed of *Pycreus flavescens* with a very few accidental species. The *Bidentetum* above the *Pycreetum* cannot develop because of the animals, in its stead the low-cropped *Pycreetum* grows, in which, however, many sorts of weeds have taken up habitation. The

* Through the „Belső-tó" is called a lake (tó = lake), in the limnological sense it is a pond. (VARGA, 1937: 155 and 195; JACZÓ —MANN, 1940.).

tall, prickly stalks of the *Xanthium spinosum* are typical for this part (*Pycreetum Xanthiosum).* (Fig. 2).

The inundation area comes to an end, both in the pasture and the maize field, with a low, 20—60 cm shelf on which *Lolietum*, a permanent, characteristically dry-land plant society grows. The pasture itself is also composed of a *Lolium perenne-Poa angustifolia* association (See Figure 1—2).

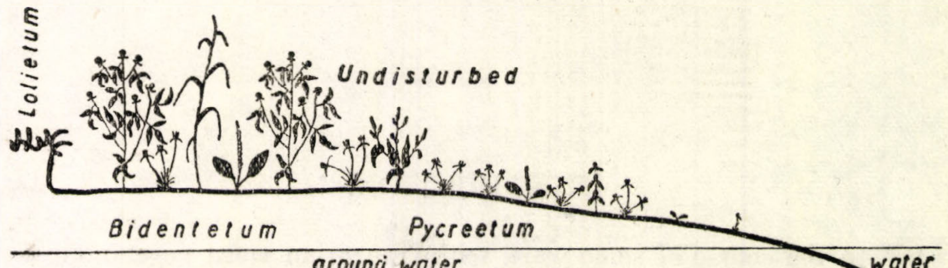

Fig. 1. Plant societies on the undisturbed parts of the shore investigated. (For explanation see the text, p. 135—136.)

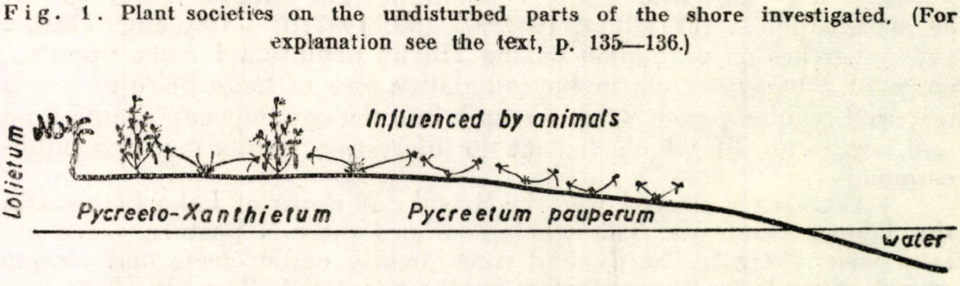

Fig. 2. Plant societies of the shore vegetation influenced by animals (see p. 136.).

METHODS.

For the plant ecological survey I used the BRAUN-BLANQUET quadrate method, ascertaining the abundance-dominance values (A—D) on a square of 2×2 m. I calculated the frequency from 10 or 20 surveys.

In every plant community I investigated the quantitative distribution of polyploid plants, using my own method (FELFÖLDY, 1948: 14 and 27).

The life forms were established on the basis of RAUNKIAER'S Excursions flora, but I also kept in mind the mutability due to environment.

I employed the areal types as given in MÁTHÉ'S work (1940. 1941). As to nomenclature, I followed the „Hung. Excursionsflora" of JÁVORKA (1937).

I took samples of soils on September 10th, 1948, with a drill, from the root level and different depths. In every case I drilled till I reached ground water.

The moisture of the soils, collected on the spot in drying glasses with close-fitting covers, was determined by drying them at 105° C to constant weight.

I carried out the mechanical analysis of the sedimentation by pipette method and graphed it after PRESCOTT, TAYLOR and MARSHALL'S (1934) triangular diagram method (F i g u r e 3).

As to the physical constants, I also determined the sticky point of the soils by the method of ARANY. The total soluble salt content was ascertained by determining the specific conductivity, which was measured by means of a WHEATSTONE bridge, after M. PLEISSNER, except that I used a cathode ray oscillograph instead of a telephone receiver. For measuring the specific conductivity I used the semi-fluid mass obtained in determining the sticky point according to ARANY, for which I took the total salt concentration from ENDRÉDY's empirical Table (BALLENEGGER-MADOS, 1944:139).

The total nitrogen was determined after KJELDAHL in a PARNASS-WAGNER apparatus by semi-micro method. The ammonia N was distilled from a 1% KCl extract after adding 3—4 g MgO. The nitrates were determined by PYNE'S method, and following this I made the reduction with DEVARDA'S alloy.

For the physiological Ca determination I used the aliquot part of the clay fraction in which I determined the calcium by MURRER'S (1937) method. I used the hydrochloric acid extract of 5 g soil for determining the total Ca, and measured the calcium oxalate precipitate as CaC_2O_4 in a G_4 glass-filter.

*

Abbreviations: P=polyploid, d=diploid, i=chromosome number unknown. (P)% and (d)%=polyploids and diploids exclusive of i. (Pm)%=polyploids, the small „m" meaning that the values represent the mean valuse of the individuals of several associations, and the brackets that they relate to the sum of Pm+dm without i.

The life forms are: HH=hydro-helophytes, G=geophytes, H=hemikrytophytes, TH=hemitherophytes (biannuals), Th=therophytes. The areal types are: Eua=Eurasiatic, Eu=European, Em=Central European, Kont=Continental, M=Mediterranean, P=pontic, Cp=circumpolar, B=Balkan, end=endemic, Adv=Adventiv.

I. BIDENTETUM TRIPARTITAE

This community is living in the most favourable, fertile locality. It finds a place at the outside of the inundation area, under the ledge marking the actual shore. It is immediately distinguished from its environment by its tall growth. It was remarkable that its Thm% was low, 44.7%.

TABLE I.

Bidentetum tripartitae.

Q=2×2 m. 1948. IX. 10.

				1	2	3	4	5	A—D	Fr_{20}
d	Eua	Th	Setaria viridis	—	—	1	1	1	1	3
P	K	Th	Echinochloa crus galli	2	1	1	1	2	1—2	5
P	Cp	H	Agrostis stolonifera	2	2	2	1	2	2	5
P	K	HH	Phragmites vulgaris	1	—	—	—	1	1	1
i	K	HH	Bolboschoenus maritimus	3	3	2	1	2	1—3	5
d	K	Th	Polygonum lapathifolium	2	1	1	2	2	2	5

Q = 2 × 2 m. 1948. IX. 10.

				1	2	3	4	5	A—D	Fr_{20}
P	Cp	Th	Chenopodium rubrum	—	—	—	1	—	1	3
d	Cp	Th	Atriplex hastatum	—	1	1	1	—	1	3
d	Adv	Th	Amaranthus retroflexus	—	1	—	—	—	1	1
P	Adv	Th	Medicago sativa	—	—	1	—	1	1	1
P	Eua	H	Lotus corniculatus	—	1	1	1	—	1	3
d	Eua	H	Trifolium fragiferum	—	1	1	1	—	1	3
P	Eua	H	T. repens	1	1	1	1	1	1	5
d	Eua	H	T. pratense	—	—	—	1	1	1	1
d	K	H	Verbena officinalis	—	1	1	1	—	1	3
i	M	Th	Stachys annua	—	—	—	1	—	1	1
d	Eua	H	Lycopus europaeus	1	1	1	1	1	1	4
P	K	Th	Solanum nigrum	—	—	—	—	1	1	2
d	M	Th	Kickxia spuria	1	—	—	—	—	1	1
P	Cp	H	Veronica anagallis-aquatica	1	—	—	1	1	1	2
d	Eua	H	Plantago major	1	2	1	1	1	1	5
d	Adv	Th	Erigeron canadense	—	—	—	1	1	1	2
i	Adv	Th	Xanthium spinosum	1	—	—	1	1	1	2
P	Eu	Th	X. strumarium	—	1	—	1	1	1	3
P	Eua	Th	Bidens tripartita	2	2	3	3	2	2—3	5
d	Eu	Th	Anthemis arvensis	—	—	—	1	—	1	1
P	Eua	Th	Arctium lappa	1	—	—	—	—	1	1
d	Eu	Th	Carduus acanthoides	1	—	—	—	—	1	1
i	Em	H	Centaurea pannonica	—	—	—	—	1	1	1
d	Eua	H	Taraxacum officinale	—	—	—	1	1	1	2
P	Eua	G	Sonchus arvensis	—	—	—	—	1	1	1

Acc.: d—Eu—Th Trifolium hybridum, P—Eua—H Mentha aquatica.

Cytological analysis: P = 42.4, d = 45.5, i = 12.1%; (P_m)% = 51.4, (d_m)% = 48.6%.

Areal types: Eua = 36.4, Eu = 12.1, Em = 3.0, K = 18.2, M = 6.1, Cp = 12.1, Adv = 12.1%.

Spectrum of life forms: Th = 48.5, H = 39.4, HH = 6.1, TH = 3.0, G = 3.0; Th_m % = 44.7, H_m % = 45.7, HH_m % = 7.5, TH_m % = 1.9, G_m % = 1.9.

Frequency spectrum: Fr5 = 21.2, Fr4 = 3.0, Fr3 = 21.2, Fr2 = 15.1, Fr1 = 39.5%.

II. PYCREETUM FLAVESCENTIS

After the *Bidentetum* comes a richly growing but short-turfed strip, like the *Nanocyperion*-type plant communities in general. The dwarfism of the plants living in it is striking, as in the neighbouring *Bidentetum* they are of normal size *(Echinochloa, Polygonum lapathifolium, Lycopus europaeus, Plantago major, Bidens tripartita, etc.)* (Cf. MOOR, 1936:114—115, PRISZTER, 1947:84, SOÓ, 1948:53, etc.)

TABLE II.

Pycreetum flavescentis.

Q = 2 × 2 m. 1948. IX. 10.

				1	2	3	4	5	A—D	Fr_{20}
d	K	HH	Typha latifolia juv.	1	—	—	—	—	1	1
d	K	HH	Alisma plantago aquatica	1	—	—	1	—	1	3
P	K	Th	Echinochloa crus galli	—	—	—	—	1	1	1
P	K	G	Cynodon dactylon	—	—	—	—	1	1	1
P	K	HH	Phragmites vulgaris	1	—	1	1	—	1	3
P	K	Th	Poa annua	1	1	1	1	—	1	3
P	Kont	H	Puccinellia distans	—	—	—	1	2	1	1
d	Eua	H	Lolium perenne	—	1	—	—	—	1	1
d	K	Th	Pycreus flavescens	2	3	5	5	4	3—5	5
P	K	HH	Schoenoplectus lacustris	—	—	—	—	1	1	1
P	Eua	G	Juncus Gerardii	1	1	—	1	—	1	2

Q = 2 × 2 m. 1948. IX. 10.

				1	2	3	4	5	A—D	Fr_{20}
P	Cp	H	J. articulatus	—	—	—	2	1	1	3
P	Eua	H	Rumex crispus p. p. juv.	1	1	1	1	1	1	5
P	K	H	Polygonum amphibium	—	—	1	1	1	1	2
d	K	Th	P. lapathifolium	—	—	1	1	—	1	3
P	K	Th	P. persicaria	—	—	1	—	1	1	1
P	K	Th	P. aviculare	1	1	1	1	1	1	4
P	Cp	Th	Chenopodium rubrum	1	—	1	1	1	1	4
d	Eua	Th	C. glaucum	1	1	—	—	1	1	3
P	K	Th	C. album	—	—	—	1	1	1	1
d	Eu	Th	Ranunculus trichophyllus	1	1	1	—	1	1	4
P	Cp	Th	R. sceleratus	2	1	1	1	—	1	3
P	Eua	Th	Potentilla supina	—	—	—	1	1	1	2
d	Eua	Th	Medicago lupulina	—	—	—	1	1	1	2
d	Eua	H	Trifolium fragiferum	—	—	—	1	1	1	2
P	Eua	H	T. repens	—	1	1	1	1	1	3
P	K	Th	Lythrum hyssopifolium	—	1—2	1	1	—	1	2
d	K	H	Verbena officinalis	—	1	1	1	1	1	2
d	Eua	H	Lycopus europaeus	—	1	1	1	1	1	3
i	B	H	Veronica scardica	—	—	—	1	—	1	1
P	Cp	H	V. anagallis aquatica	—	—	—	1	1	1	1
d	Eua	H	Plantago major	1	1	1	1	1	1	5
d	end	H	Aster pannonicus	—	—	—	1	—	1	1
d	Adv	Th	Erigeron canadense	—	—	—	—	1	1	1
P	Eua	Th	Bidens tripartita	—	1	1	1	1	1	2
P	Eua	Th	Senecio vulgaris	—	—	1	—	—	1	1
d	Eua	H	Taraxacum officinale	—	—	1	—	1	1	1

Cytological analysis: P = 56.8, d = 40.5, i = 2.7%; (P_m)% = 55.5, (d_m)% = 44.4%.
Areal types: Eua = 35.2, Eu = 2.7, Kont = 2.7, K = 40.5, Cp = 10.8, B = 2.7, end = 2.7, Adv = 2.7%.
Biological spectrum: HH = 10.8, Th = 46.0, G = 5.4, H = 37.8%; Th_m % = 51.4, HH_m % = 10.13, H_m % = 35.6, G_m % = 2.74%.
Frequency spectrum: Fr5 = 8.1, Fr4 = 8.1, Fr3 = 24.4, Fr2 = 21.6, Fr1 = 37.8%.

III. PYCREETUM FLAVESCENTIS XANTHIOSUM SPINOSAE

This occupies a place corresponding to the *Bidentetum* in the parts traversed by animals, trampled and grazed. The plants are low, but mutilated by the grazing and trampling. Nanism cannot be found among them. The usually dwarf *Pycreus flavescens* also has long stalks but is flattened on the ground, its bunches trampled to pieces. There are very many foreign elements intermixed with the weed plants (Fr. 1: 45.6%).

TABLE III.

Pycreus flavescens — Xanthium spinosum assn.

Q = 2 × 2 m. 1948. IX. 10.

				1	2	3	4	5	A—D	Fr_{10}
P	K	Th	Digitaria sanguinalis	—	1	—	—	—	1	1
P	K	Th	Echinochloa crus galli	1	1	1	1	1—2	1	5
d	Eua	Th	Setaria viridis	1	1	—	1	1	1	4
P	Cp	H	Agrostis stolonifera	—	—	1	1	1	1	2
P	K	G	Cynodon dactylon	—	1	—	1	—	1	2
P	K	Th	Poa annua	1	1—2	1	1	1	1	5
d	Eua	H	Lolium perenne	1	1	—	1	1	1	4
d	K	Th	Pycreus flavescens	2	2	2	2	1	2	5
P	Eu	H	Carex distans	—	1	1	—	—	1	2
P	Cp	H	Juncus articulatus	1	—	—	—	—	1	1
P	Eua	G	J. Gerardii	—	—	1	—	1	1	1

Q = 2 × 2 m.				1948. IX. 10.						
				1	2	3	4	5	A—D	Fr10
d	K	Th	Polygonum lapathifolium	1	1	—	1	1	1	3
P	K	Th	P. aviculare	1	1	1	1	1	1	5
d	Eua	Th	Chenopodium glaucum	1	—	—	—	—	1	1
d	Cp	Th	Atriplex hastatum	—	1	—	—	—	1	1
P	Eu	H	Rubus caesius	—	—	—	1	—	1	1
P	Eua	Th	Potentilla supina	—	1	1	—	—	1	1
d	Eua	Th	Medicago lupulina	1	1	1	1	1	1	5
d	Eua	H	Trifolium fragiferum	—	1	—	1	1	1	3
P	Eua	H	T. repens	—	1	1	—	—	1	2
P	Eua	H	Lotus corniculatus	1	1	—	1	1	1	3
d	Eu	Th	Geranium pusillum	1	—	—	—	1	1	2
P	K	Th	Erodium cicutarium	1	1	1	1	—	1	3
P	Eua	Th	Malva pusilla	—	—	—	—	1	1	2
P	K	Th	Lythrum hyssopifolia	1	—	—	—	—	1	1
P	K	Th	Anagallis arvensis	1—2	1—2	1	1	—	1	3
d	K	H	Verbena officinalis	1	1	1	1	1	1	5
P	Eua	H	Marrubium vulgare	1	—	—	1	—	1	1
d	Eua	H	Lycopus europaeus	—	1	—	—	—	1	1
d	M	Th	Kickxia spuria	—	1	—	—	—	1	1
P	M	Th	K. elatine	—	—	—	—	1	1	1
P	Cp	H	Veronica anagallis-aquatica	1	—	1	—	—	1	1
i	B	H	V. scardica	—	—	—	1	—	1	1
d	Eua	H	Plantago lanceolata	—	1	—	—	—	1	2
d	Eua	H	P. major	2	2	1	1	1—2	1—2	5
d	end	H	Aster pannonicus	—	—	—	—	1	1	1
d	Adv	Th	Erigeron canadensis	1—2	1	1	1	1	1(—2)	5
i	Adv	Th	Xanthium spinosum	2	1—2	2	2	2	2	5
P	Eua	Th	Bidens tripartita	—	1	—	—	—	1	1
P	Eua	Th	Senecio vulgare	—	1	—	—	—	1	1
d	Eu	TH	Carduus acanthoides	1	—	1	1	—	1	3
d	Eua	G	Cirsium arvense	1	—	1	1	—	1	3
d	Eua	H	Taraxacum officinale	1	1	—	—	1	1	2

Acc.: P—Eua—H Potentilla reptans, P—Eu—Th Xanthium strumarium.

Cytological analysis: P = 52.2, d = 43.5, i = 4.3%; (P_m)% = 47.1, (d_m)% = 52.83%.

Areal types: Eua = 43.5, Eu = 10.9, K = 23.9, Cp = 8.7, M = 4.3, B = 2.2, end = 2.2, Adv = 4.3%.

Biological spectrum: H = 41.3, G = 6.5, Th = 50.0, TH = 2.2%; H_m% = 34.9, G_m% = 6.7, Th_m% = 56.4, TH_m% = 1.3%.

Frequency spectrum: Fr5 = 19.6, Fr4 = 2.2, Fr3 = 15.2, Fr2 = 17.4, Fr1 = 45.6%.

IV. PYCREETUM FLAVESCENTIS PAUPERUM

Inhabits the most unfavourable strip. The trampling and grubbing of the animals near the water is of very great extent here, as can be seen from the poverty of its composition.

TABLE IV.

Pycreus flavenscens assn. (pauperum).

Q = 2 × 2 m.				10th Sept. 1948.						
				1	2	3	4	5	A—D	Fr10
P	K	Th	Echinochloa crus galli	1	1	1	—	1	1	5
P	Cp	H	Agrostis stolonifera	—	—	—	—	1	1	1
P	K	HH	Phragmites vulgaris	—	1	—	—	—	1	1
P	K	Th	Poa annua	—	—	1	1	1	1	3
P	Kont	H	Puccinellia distans	—	1	—	—	—	1	2
d	K	Th	Pycreus flavescens	5	3	3	3	3	3—5	5
P	Eu	H	Carex distans	1	1	—	1	1	1	4
P	Cp	H	Juncus articulatus	—	—	1	1	1	1	1

Q = 2×2 m. 1948. IX. 10.

				1	2	3	4	5	A—D	Fr10
P	Eua	H	Rumex crispus (pp. juv.)	—	—	1	—	—	1	1
d	K	Th	Polygonum lapathifolium	1	1	—	—	1	1	3
P	K	Th	P. aviculare	—	1	1	1	—	1	3
P	Cp	Th	Chenopodium rubrum	1	1	—	—	1	1	3
d	Eua	Th	C. glaucum	—	—	1	1	—	1	2
P	Eua	H	Lotus corniculatus	—	—	1	—	—	1	2
P	K	Th	Anagallis arvensis	—	—	—	1	—	1	1
d	K	Th	Verbena officinalis	—	—	1	1	1	1	3
d	Eua	H	Lycopus europaeus	1	1	1	1	1	1	5
P	K	Th	Solanum nigrum	—	1	1	—	1	1	2
P	Cp	H	Veronica anagallis-aquatica	—	1	—	1	1	1	4
i	B	H	V. scardica	—	—	1	—	—	1	1
d	Eua	H	Plantago major	1	1	1	1	1	1	5
d	end	H	Aster pannonicus	—	—	—	—	1	1	1
i	Adv	Th	Xanthium spinosum	1	—	1	—	—	1	2
P	Eua	Th	Bidens tripartita	1	1	1	—	1	1	3

Acc.: P—Eu—Th Xanthium strumarium.

Cytological analysis: P = 64.0, d = 28.0, i = 8.0%; (P_m)% = 61.6, (d_m)% = 38.3%.

Areal types: Eua = 24, Eu = 8, Kont = 4, K = 36, Cp = 16, B = 4, end = 4, Adv = 4%.

Biological spectrum: HH = 4, H = 48, Th = 48%; HH_m% = 1.4, H_m% = 46.8, Th_m% = 51.6%.

Frequency spectrum: Fr5 = 16, Fr4 = 8, Fr3 = 24, Fr2 = 20, Fr1 = 32%.

SOIL INVESTIGATION

According to the literature on plant geography, the societies of dwarf species of *Cyperaceae* and *Juncaceae* are of edaphic orgin, as they are considered to be related to the largest silt content of the soil (Soó, 1940:31, Ubrizsy, 1948:13, etc.). A good occasion thus offered itself for investigating this, for not only had three types of the same *Pycreus flavescens* association evolved under the same conditions on a small area, but one of them was a *Bidentetum* differing essentially from them in many respects. I made comparative investigations on the soils of four plant societies.

There was no difference in the moisture of the soil on September 10th, 1948, in the four biotopes, as can be seen in Table V.

TABLE V.

Moisture of soils of different biotopes.

	0—10	10—20	20—30	30—40 cm.
Bidentetum	23.9	33.1	33.7	44.2%
Pycreetum typ.	27.9	31.2	41.6	ground water
Pycreeto-Xanth.	22.6	30.0	45.0	43.8%
Pycreetum paup.	20.5	29.8	42.0	ground water

Mechanical analysis of the sedimentable parts (<2 mm) of the soils shows that the soils of the different plant communities resemble each other. Figure 3 shows that all the soil, whether taken from the upper or the lower level, can be considered loam. No significant difference can be found in silt content between the *Bidentetum* and the *Pycreetum.*

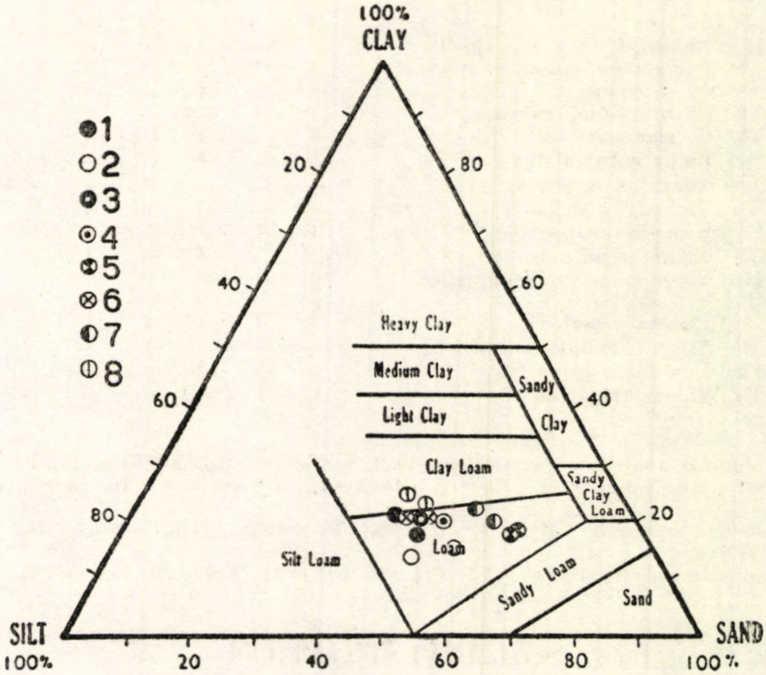

Fig. 3. Triangular diagram showing the various textures of soils investigated. 1. Bidentetum 0 cm; 2. Bidentetum 30 cm; 3. Pycreetum typ. 0 cm; 4. Pycreet. typ. 30 cm; 5. Pycreet.-Xanth. 0 cm; 6. Pycreet.-Xanth. 30 cm; 7. Pycreet. paup. 0 cm; 8. Pycreet. paup. 30 cm.

TABLE VI.

Results of the mechanical analysis of the sedimentable parts of soils and the sticky point according to ARANY. (S. P.)

		Sand 2—0.02 mm	Silt 0.02–0.002	Clay 0.002 mm	S.P.
Bidentetum	0—10 cm	47.7	36.0	16.3	47.4
		42.5	38.2	19.3	45.2
	30 cm	54.4	31.7	13.9	51.9
		48.5	38.9	12.6	50.4
	0—10 cm	46.1	33.7	20.2	50.8
Pycreetum typ.	30 cm	49.5	31.3	19.2	47.6
	0—10 cm	61.8	21.4	16.8	43.8
		61.7	20.8	17.5	44.4
Pycreetum		46.3	34.3	19.4	57.0
Xanthiosum	30 cm	43.6	37.1	19.3	57.6
	0—10 cm	58.8	23.0	18.2	41.4
		54.6	25.6	19.8	43.5
Pycreetum	30 cm	46.8	33.1	20.1	59.7
pauperum		41.6	35.2	23.2	57.4

The pH values and the buffer capacity of the soils investigated are as follows:

TABLE VII.

pH values and buffer capacity of the soils.

	cm	pH_{H_2O}	pH_{KCl}	0·1n HCl				0·1n KOH			
				25	10	4	2cm³	1	4	10	25cm³
Bidentetum	0	8·01	7·54	7·1	7·2	7·5	7·9	8·2	8·8	9·4	11·2
	30	7·84	7·40	6.0	7·3	7·4	7·6	8·0	9 0	9·6	11·0
Pycreetum typ.	0	8·11	7·61	7·2	7·3	7·6	7·8	8·4	8·6	9·9	11·0
	30	7·95	7 60	7·1	7·5	7·6	7·7	8·1	9·0	10·3	11·2
Pycreetum-Xanth.	0	8 04	7 90	7·2	7 6	7·7	7·8	8·5	9·1	9·6	10·3
	30	7·99	7·61	7·1	7·3	7·7	7·8	8·2	8·7	9·6	11·3
Pycreetum paup.	0	7·93	7·71	7·1	7·5	7·7	7·7	8·3	8·8	9·5	11·3
	30	7·99	7·53	7·1	7·5	7·6	7·7	8·1	8 6	9·3	11·2

Table VIII. shows the results of the chemical analysis of the soils, with special reference to N and Ca content.

TABLE VIII.

Results of chemical analysis of soils.

	cm	Total-N %	NH_3-N	NO_3-N	Ca < 2μ %	Ca %	Total soluble salts %
			mg/100 g soil				
Bidentetum	0	0·15	8·1	10·7	2·84	2·03	0·09
	30	0·16	8·1	7·4	2·20	4·69	0·07
Pycreetum typ.	0	0 15	6·2	9·1	2·76	8·20	0·07
	30	0 05	2·5	18·6	18·12	51·55	0·06
Pycreetum-Xanth.	0	0·14	1·2	18·0	4·85	15·04	0·08
	30	0·08	9·3	16·2	15·6[illegible]	38·35	0·08
Pycreetum paup.	0	0·12	3·6	5·2	4 08	13·45	0 08
	30	0·08	2·5	14·0	15·64	40·8[illegible]	0·10

DISCUSSION

All observations and the results of our measurements show that edaphic factors do not play a decisive role in the four biotopes, which differ essentially as to habitat and floristic composition, as was hitherto belived of the *Nanocyperion* type of plant societies („vegetation of silty soils"). (MOOR, 1936:17).

We must take other factors into consideration instead. In the case of *Pycreetum Xanthiosum* and *Pycreetum pauperum,* the grazing, trampling and seed-dispersing activities of animals pastured there, undoubtedly play an important part. This explains the mixed nature of the weedy *Pycreetum,* made up of many species. But we do not get satisfactory results in the dwarf societies formed near the water, which can be found both on trampled and undisturbed surfaces, and aside from their composition, the low stature of the plants growing in them, their nanism, is the most remarkable. The silt content of the soil is not the determining factor for this because we find no difference in it (Table

VI), neither is there any difference in the moisture of the soil (Table V). The close proximity of the body of the lake however, reminds us that these strips become dry late, usually in the middle of July, so that the life of the vegetation can only begin then for them. A definite difference thereby also develops between the *Bidentetum*, which begins in April and the tardier *Pycreetums* from the photo-periodic standpoint. This observation is also supported by the literary data. Societies of the *Nanocyperetum* type always form on the sites of dried-out puddles or on sections of the shore which become dry in the middle of the vegetative season (MOOR, 1936:115). The investigations of TIMÁR (1947) on a bank of the Tisza at Szolnok show that *Dichostylieto-Gnaphalietum* can also live on sandy soil (p. 5) but the *Bidentetums* grow only on the upper crest of the bank islet which is above water by June (p. 3). The *Nanocypereta* can be found on places which have become dry during August. According to the graphs of UBRIZSY (1948:6) the *Nanocyperion* species *(Schoenoplectus supinus, Heleocharis acicularis, Elatine hungarica)* flower at the end of August or beginning of September, whereas the higher growing rice and *Echinochloa crus galli* reach their maximum in July.

The range of the polyploids can brought into relationship with photo-periodicity and on all four biotopes. From this standpoint the order of the plant communities is: ***Pycreetum pauperum, Pycreetum typ., Bidentetum, Pycretum Xanthiosum.*** The mixed composition of the weedy *Pycreetum* explains the low (Pm)% value which, however, is very similar to the 41.5% value of the dry *Xanthietums* FELFÖLDY, 1948:15). GUSTAFFSON'S (1948 1—2) explanations do not hold good here, for the polyploid-abundancy is parallel with the increase in the number of therophytes, as the following Table proves:

TABLE IX.

(P_m)% and Th_m% values of plant societies examined.

	Th_m%	σ *	m*	(P_m)%	σ	m
Bidentetum	44.7	6.37	2.12	51.4	8.81	2.93
Pycreetum-typ.	51.4	5.8	1.9	55.5	5.3	1.7
Pycreetum paup.	51.6	7.5	2.5	61.6	6.8	2.2
Pycreetum-Xanth.	56.4	7.2	2.4	47.1	6.2	2.0

TABLE X.

k* values for (Pm)% and Thm%

^kTh_m%	Pycr. typ.	Pycr. paup.	Pycr.-Xanth.	(^kP_m)%	Pycr. typ.	Pycr. paup.	Pycr.-Xanth.
Bidentetum	**2.4**	**2.1**	**3.8**		1.2	**2.8**	1.2
Pycreetum typ.	—	0.06	1.6		—	**2.2**	**3.2**
Pycreetum paup.	—	—	1.4		—	—	**5.0**

$$^{*)}\ \sigma = \pm\sqrt{\frac{\Sigma(\bar{x})^2}{n-1}},\quad m = \frac{\sigma}{\sqrt{n}},\quad k = \frac{M_1 - M_2}{\sqrt{m_2^1 + m_2^2}}.$$

If k > 2, there is a significant difference between the two mean values. (These values are given in fat type).

That the shore floras display a derived chromosome status (ROHWEDER, 1937, SOÓ, 1947:108, FELFÖLDY, 1948:8 and 26) can be explained by the great capacities for adaptation and dispersal of the polyploids (ROHWEDER, TISCHLER) by the exuberance in the vegetative system which polyploidy causes, permitting a dispersal by rhizomes, stolons and runners (GUSTAFSSON, 1948:3), to which we may add the fact observed especially in respect to artificially produced polyploids, that the low osmotic pressure of their cells attaches them to localities favourable as to water supply. But, as not of least importance, we must take into consideration the observation of LÖVE-LÖVE (1943:158) concerning the *Nanocypertums* which live in direct proximity to the water, that there are many factors of long day or neutral reactivity to the photo-period among the polyploids as compared with the diploids.

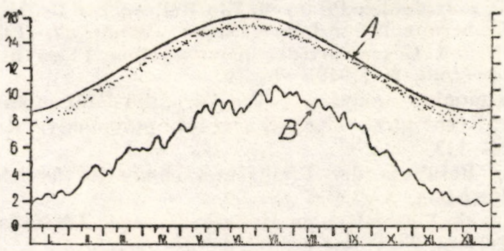

Fig. 4. Abscissa: Months of the year; ordinate: hours. A = astronomically possible sunlight: length of days. B = Mean values of the empirical intervals of sunlight for 50 years. Dots = Maximal sunlight registered over 50 years (TAKÁCS, 1949:4).

If we examine Figure 4 we can see the yearly change in the sun's rays and it is evident from the curves that the empirical maximum (beginning of July) does not fall together with the maximum obtained astronomically (June 21th). This can be attributed to meteorological causes and can be explained by the cloudier, more hazy state of the sky in the spring and at the beginning of summer, as opposed to the drier, clearer weather in July, August and September. As we know, besides the primarily significant periodicity (the length of the days) especially in the life of germinating plants, the amount of light obtained and its force are also important, and according to the empirical maximum undoubtedly fall into the three summer months. Neither can we leave out of consideration the qualitative composition of the light, which is also a consequence of the vapour content of the atmosphere.

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ИССЛЕДОВАНИЯ ВЕГЕТАЦИИ ПОБЕРЕЖЬЯ ОЗЕРА „БЕЛЬШЕ-ТО“ ВБЛИЗИ ТИХАНЬ

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РЕЗЮМЕ

1. В области наводнения озера „Бельше-то“, соответственно экологическим условиям, развиваются 4 сообщества растений: I. Bidentetum tripartitae. II. Pycreetum flavescentis. III. Pycreetum flavescentis-Xanthiosum spinosae. IV. Pycreetum flavescentis pauperum. 2. Не говоря о ботаническом составе (Таблицы I—IV) имеются бросающиеся в глаза разницы во внешнем виде между этими четырмья сообществами: Pycreetum'ы живут непосредственно около воды. Это короткие травы, всегда низкого роста (нанизм). Дерн Pycreetum Xanthiosum также короток, вследствие вытаптывания пастущимся там скотом, т. е. мы имеем дело с механическим повреждением. Bidentetum состоит из нормальных растений высокого роста.

3. Имеется очевидная связь между внешним видом, средой и экологическими отношениями сообществ растений. Bidentetum живет в спокойной, самой выгодной полосе, свободной от воды приблизительно с начала апреля. Беспокоющее влияние скота отмечается в случае Pycreetum Xanthiosum в таком же растоянии от края озера. Характерный для проживающих по близости воды Pycreetum-ов нанизм, их богатство полиплоидами и условия среды говорят за то, что в их развитии фотопериодические факторы играют большую роль, чем эдафичные факторы.

4. Это подтверждается и исследованием почвы (влажность, механический анализ, точка осаждения росы, общая концентрация солей, содержание натрия, кальция, pH, буферная сила и т. д.), которые указывают на то, что с точки зрения науки о почве, нет существенных разниц между четырьмя биотопами.

5. Самым ценным результатом моей работы является рабочий гипотез, на основе которого последует выяснение вопроса путем физиологических опытов, с применением фото-периодических исследований над преобладающими здесь растениями.