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SEASONAL DYNAMICS AND STRUCTURAL CHANGES IN THE CENOSES BELONGING TO THE PHRAGMITETEA ASSOCIATION CLASS AT LAKE SULYMOS

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Abstract

Cenological and seasonal dynamic studies were performed in the years 1985—86 at the area of the Kiskunság National Park, at Lake Sulymos running next to the Dead-Tisza at Lakitelek, in respect to the cenoses of marshy (Phragmition) and high sedgy (Magnocaricion) character.

In the initial phase of the Spring aspect, the preponderance of the Phragmition character associations is characteristic to the cenoses occurring in Lake Sulymos. High species diversity is manifest in the littoral zone, while towards the middle of the Lake the diversity shows a decrease and at the same time, there is an increase in the individual number of the species.

Correct interpretation of the seasonal dynamic as well as structural changes is possible based on the classification of the relevés. The zonality of the associations growing in the lake is only observable at the littoral zone. The development of the zonation is on the one hand caused by the relief relations of Lake Sulymos, the fluctuation of the water level and the trend of the water depth. On the other hand, it is defined by the ecological demand of the species forming the zonally appearing associations, as well as by the competition developing between them.

A succession series can be set up during the decomposition of the phytomass promoting the advancement of the eutrophication and siltation processes. According to the results the presumed succession series is: *Typhetum angustifoliae→Scirpo-Phragmitetum typhetosum→Scirpo-Phragmitetum phragmitetosum→Glycerietum maximae→Caricetum gracilis.*

The trend of the succession corresponds to the direction of the shift of the R-characteristic indicator value, it is therefore presumable that the acidity relations within the biotope have determinative significance. Based on the T, W and N-characteristic indicator values, the results of the vegetation dynamic studies can well be interpreted.

Introduction

According to the data of the potential vegetation maps about 2—4% of the Hungarian territory is covered with reeds (HORTOBÁGYI and SIMON 1981). The associations of Phragmitetea character play an important role in the protection of the aquatic ecosystems (TÓTH and SZABÓ 1962, FELFÖLDY 1986). In the course of the years human impacts have increasingly enhanced the eutrophication of our natural waters. This process is worsened by the disintegration of the reed banks growing at the side of the lakes and playing role as the closing association of the aquatic series, and as a consequence, by the establishment of foreign species, leading to the steady degradation of these communities (FELFÖLDY 1981). Among numerous natural and ecological factors, the formation of the zonation of the Phragmitetea associations is mainly determined by the development of the bank-profile and the distribution

according to water demand (SEBESTYÉN 1963). The competition between the species bears great significance in the development of the zonation (BUTTERY and LAMBERT 1965).

A correct interpretation of the seasonal dynamic and structural changes of the Phragmitetea-like cenoses can be achieved with the help of the characteristic indicator values. As a result, the trend of the succession processes is traceable within the biotope depending on the degree of the eutrophication as well as the advancement of the siltation processes. Based on the classification and ordination of the relevés, conclusions can also be drawn in respect to the degree of similarity — in the statistical sense — of the different cenoses as well as regarding the environmental effects prevailing at the time of the development of the association zonations.

The studies were performed at Lake Sulymos located at the area of the KNP. According to water area-typology category the lake is of „Fertő" type (DÉVAI 1976). Its water turnover is of semistatic character. Open water surface is only observable at the beginning of the vegetation period. The enhanced marshy character of the lake is indicated by the closed stands of Phragmition and Magnocaricion cenoses found along the bank in ca. 30—50 m width.

Materials and Methods

The cenological and seasonal dynamic analysis of the higher marsh-plants found a Lake Sulymos located at the area of the Kiskunság National Park South to Tőserdő was performed in the years 1985—86. The relevés were taken monthly during the vegetation period. The results are demonstrated in a cenological table, giving the relative part-coverage of the different cenoses as well as the covering values for the populations in percentage. The cenosystematic classification of the different associations was done according to the manual of Soó (1978, 1980). The data regarding the life form of the species of the cenoses were considered on the basis of the works of ELLENBERG (1952), Soó (1980) and HUTCHINSON (1975). During the appreciation of the results, the similarity of the relevés was defined with the help of the Czekanowski-index (CZEKANOWSKI 1909), the reductions were performed using the "group average" method (PODANI 1979, 1980). The ordination of the relevés was accomplished by means of the Centroid analysis (JAHN and VAHLE 1974, LAWLEY and MAXWELL 1971, FEKETE 1981). The Sörensen-index was used for the comparison of the associations according to species composition (HORTOBÁGYI and SIMON 1981).

The indicator values (N, T, R) elaborated by ZÓLYOMI and his co-workers served as basis for the classification and ordination of the characteristic indicator values (ZÓLYOMI et *al.* 1967, Soó 1980). The "group average" reduction technique was used, starting from the similarity matrix calculated with the Renkonnen-index on the basis of the reduced part-coverage values of the plant species characterized by identical indicator values (BAGI 1984, SZALMA 1986).

The hydroecological appreciation of the cenoses (W-characteristic indicator value) was based on the work of Gy. Bodrogközy comprising 30 hydroecological categories (BODROGKÖZY 1982).

Results

According to the relevés taken in the Spring, Summer and Autumn aspects of the vegetation periods in the years 1985—86, 53 plant species were found at the area These are listed in Table 1. according to life form, cenosystematic classification and characteristic indicator values.

The cenoses occurring in Lake Sulymos are characterized by the preponderance of the Phragmition character associations at the initial stage. These are the following associations and subassociations: *Caricetum gracilis, Glycerietum maximae, Scirpo-Phragmitetum phragmitetosum, Scirpo-Phragmitetum typhetosum;* at places *schoenoplectetosum-, Typhetum angustifoliae.*

Table 1. *Cenosystematic classification, life form and indicator values of the species found at the region of Lake Sulymos in 1985—86*

Specific name		Hydroecol. category		Life form	R	T	W	N
1. *Hydrocharis morsus-ranae*	Lemno-Potamea	Hydato-phyta	hd_1	MH	6	6	10	6
2. *Riccia fluitans*			hd_1	HH				
3. *Salvinia natans*	Hydrocharicion		hd_1	HH	0	8	10	6
4. *Lemna trisulca*	Lemno-Potamea		hd_2	HH	8	6	10	6
5. *Utricularia vulgaris*			hd_2	HH	5	4	10	6
6. *Potamogeton lucens*	Potamion		hd_2	HH	8	6	10	8
7. *Polygonum amph. v. aquat.*	Phragmitetea		hd_3	G-HH	0	0	8	7
8. *Stratiotes aloides*			hd_3	M-H	6	6	10	7
9. *Nuphar lutea*			hd_3	HH	5	6	10	0
10. *Hottonia palustris*		Hydato-helophyta	hhe_1	HH	6	6	10	4
11. *Sparganium erectum*			hhe_1	HH	0	6	10	5
12. *Schoenoplectus lacustris*	Phragmition		hhe_2	HH-G	7	0	9	5
13. *Butomus umbellatus*	Phragmitetea		hhe_2	HH	0	6	10	7
14. *Rumex hydrolapathum*			hhe_3	H-HH	7	6	8	7
15. *Alisma plantago-aquatica*	Phragmitetea		hhe_3	HH	0	0	10	7
16. *Saggitaria sagittifolia*	Phragmition		hhe_3	HH	7	6	10	6
17. *Iris pseudacorus*	Phragmitetea		hhe_3	G	0	4	9	7
18. *Glyceria maxima*	Phragmition		hhe_3	G-HH	7	6	9	7
19. *Bolboscoenus maritimus*	Bolboschoenion		hhe_3	HH-G	7	0	8	6
20. *Oenanthe aquatica*	Phragmitetalia	Helophyta	he_1	HH	0	6	10	5
21. *Phragmites australis*	Phragmitetea		he_1	HH	7	0	0	5
22. *Typha angustifolia*	Phragmitetea		he_1	HH	0	0	10	7
23. *Carex gracilis*	Magnocarcion		he_1	HH	6	5	8	5

Table 1.

Specific name		Hydroecol. category		Life form	R	T	W	N
24. *C. vulpina*			he_1	H-HH	6	6	8	5
25. *C. elata*			he_1	HH	6	6	8	4
26. *C. pseudocyperus*			he_1	HH	7	6	8	5
27. *C. flacca*			he_1	G	9	6	0	6
28. *C. riparia*			he_1	HH	8	6	8	5
29. *Equisetum palustre*			he_2	G	0	2	9	1
30. *Lycopus exaltatus*	Phragmitetea		he_2	HH	7	6	9	6
31. *Lysimachia vulgaris*	Molino-Juncetea		he_2	HH	0	4	7	0
32. *Stachys palustris*	Phragmitetea		he_2	H	7	4	10	6
33. *Sium latifolium*	Phragmition		he_2	HH	7	6	10	6
34. *Rorippa amphibia*	Phragmitetea		he_2-	HH	7	6	9	7
35. *Mentha aquatica*	Phragmitetalia		he_2	H-HH	7	6	9	5
36. *Euphorbia palustris*	Molinion		he_2	H-HH	8	6	9	5
37. *Urtica kioviensis*			he_2	H	6	8	8	6
38. *Lytrum salicaria*	Molinion-Juncetea	Helohygrophyta	hhg_1	H-HH	0	4	8	5
39. *Juncus compressus*	Agrostion		hhg_3	G	8	6	8	6
40. *Symphytum officinale*	Molinetalia	Hygrophyta	hg_1	H	0	4	9	7
41. *Galium palustre*			hg_2	H	0	4	10	5
42. *Calystegia sepium*	Phragmitetea		hg_2	H	6	6	8	8
43. *Galium aparine*		Hygromesophyta	hgm_1	Th	0	4	7	9
44. *Polygonum lapatifolium*	Polygonion-Chenopodion		hgm_3	Th	0	0	7	7
45. *Cardamine amara*			hgm_3	H	6	4	8	5
46. *Leersia oryzoides*			hgm_3	HH	0	6	9	7
47. *Solanum dulcamara*			hgm_3	Ch	0	6	9	7
48. *Geranium robertianum*			hgm_3	H	0	0	6	7
49. *Juncus articulatus*			hgm_3	H	0	0	8	3
50. *Leucojum aestivum*			hgm_3	G	8	8	7	5
51. *Amorpha fruticosa*	Calystegion-Bidentetea	Mesophyta	m_1	M	0	6	7	5
52. *Salix fragilis*			m_2	M-MM	6	6	8	6

After this, the appearance and closure of the reed-grass associations characteristic to the end of the Spring and Summer aspects are observable. At the littoral zone high species-individual diversity is a characteristic phenomenon, while towards the middle of the lake there is a decrease in the diversity of the species composition regarding certain zones. Contrary to the decrease in diversity, an increase in individual number can be experienced (SZALMA 1986). Based on the results of the relevés, it can be concluded that the distribution and appearance within biotope of certain character cenoses can be typified according to the relief relations and the water depth of Lake Sulymos (Fig. 1).

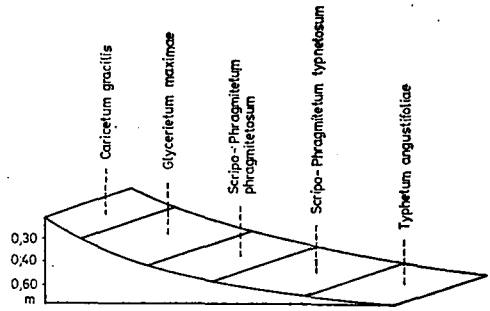

Fig. 1. Zonation of the cenoses belonging to the Phragmitetea association at Lake Sulymos

In the cours of the phytomass decomposition promoting the eutrophication and siltation processes of the lake (MASON and BRYANT 1975), a succession series can be set up which — as assumable from the results — is the following: *Typhetum angustifoliae → Scirpo-Phragmitetum typhetosum → Scirpo-Phragmitetum phragmitetosum → Glycerietum maximae → Caricetum gracilis.*

Classification and ordination of the relevés

Fig. 2. demonstrates the dendogram obtained during the clasisfication based on the covering values of the relevés shown in Table 2. According to the dendogram, the relevés can be divided into 4 well distinguishable groups. In the first group

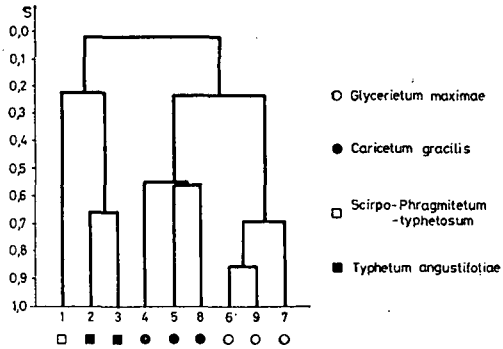

Fig. 2. Dendogram of the classification based on the relevés of July 17, 1985

Table 2. *July, 17. 1985*

Serial number of the stands	1	2	3	4	5	6	7	8	9
Total coverage	60	80	80	85	80	70	60	90	85
1. *Potamogeton lucens*	—	—	—	—	—	—	15	—	—
2. *Polygonum amphibium*	—	—	—	—	3,2	3,5	7	—	3
3. *Hottonia palustris*	+	+	1,4	—	+	+	10	—	—
4. *Schoenoplectus lacustris*	—	—	—	—	—	1,6	3	—	—
5. *Rumex hydrolapathum*	—	—	—	+	12,2	15,6	4	2,5	8,7
6. *Alisma plant.-aquatica*	—	—	—	1,2	+	—	—	0,5	—
7. *Sagitaria sagittifolia*	—	—	—	—	—	1,6	—	—	—
8. *Iris pseudacorus*	—	—	—	9,1	7,2	2,6	+	29,5	1
9. *Glyceria maxima*	—	—	—	+	22,3	65,4	61	7,5	68,6
10. *Phragmites australis*	27,6	13,8	1,4	—	—	—	—	—	—
11. *Typha angustifolia*	2,7	58,8	90,4	—	—	—	—	—	—
12. *Carex gracilis*	—	—	—	54,1	42,3	6,5	—	29,5	13,7
13. *Carex riparia*	17,6	8,9	—	—	—	—	—	—	—
14. *Carex elata*	17,6	3,9	—	—	—	—	—	—	—
15. *Lycopus exaltatus*	—	—	—	2,1	—	—	—	3,5	—
16. *Lysimachia vulgaris*	—	—	—	—	+	1,6	—	2,5	—
17. *Stachys palustris*	—	—	—	+	3,3	—	—	0,5	+
18. *Sium latifolium*	—	—	—	2,1	5,2	—	—	4,5	3
19. *Mentha aquatica*	—	—	—	5,1	+	—	—	0,5	—
20. *Euphorbia palustris*	0,7	—	—	—	—	—	—	—	—
21. *Urtica kioviensis*	0,7	4,9	5,4	—	+	1,6	—	—	1
22. *Symphytum officinale*	+	—	—	6,1	4,3	+	—	14,5	1
23. *Galium palustre*	17,7	—	—	—	—	—	—	—	—
24. *Solanum dulcamara*	2,7	0,9	1,4	2,1	—	+	—	—	—
25. *Amorpha fruticosa*	12,7	8,8	—	18,1	+	—	—	4,5	+

(6., 9., 7) the relevés of the *Glycerietum maxima* association are linked at high similarity level. The group linking to the former one at low similarity level (4., 5., 8) is formed by the relevés belonging to the *Caricetum gracilis* association.

The group consisting of the relevés originating from the *Typhetum angustifoliae* (2., 3) association is segregated from the former. The *Scirpo-Phragmitetum typhetosum* subassociation (1) is linked to these groups at rather low similarity level. The results of the classification regarding the relevés taken in the Autumn aspect of the vegetation period are demonstrated in Fig. 3.

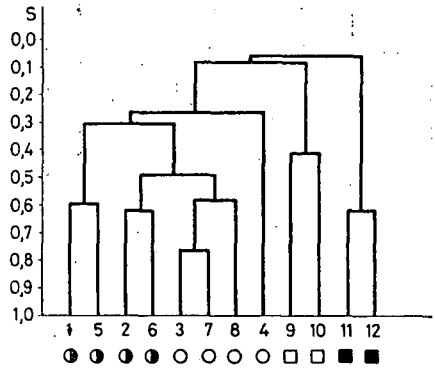

Fig. 3. Dendogram of the classification based on the relevés of October 20, 1985

The stands of the *Typhetum angustifoliae* (11., 12) and separately of the *Scirpo-Phragmitetum typhetosum* subassociations form a well distinguishable cluster core in the dendogram. Segregated from these two groups, another group is formed by the stands of the *Glycerietum maximae* (3., 8., 7., 4) association as well as *Glycerietum maximae caricetosum* (1., 5., 2., 6) subassociation. The differing similarity levels within group are partly caused by the fact that the different relevés originate from different water depths. As a consequence, two cores are separable within the *Glycerietum maximae caricetosum* subassociation (1., 5. and 2., 6). The 1. and 5. relevés derive from the epilittoral grade of the paralimnolittoral zone, where the *Amorpha fruticosa* foreign to the community occurs with a relatively high covering quota. The 2. and 6. relevés originate from the area of the supralittoral grade.

A good comparison is possible between the dendogram obtained during the classification based on the species composition of the different cenoses and the dendogram of the classification based on the covering quota of the relevés. Thus, supporting the previous results, the cenoses can be classified according to species composition and structure, and they form as well distinguishable cluster core in the dendogram (Fig. 4).

Studying the dendograms of the classification based on the covering quota values in the relevés for the species of the studied cenoses (Fig. 5—6), the changes in species composition and covering quota of the cenoses can be followed with attention in the course of the Summer and Autumn aspects. During the appreciation of the different cluster cores the species of the zonally located cenoses were found to form groups and were well distinguishable. The species of transitional character foreign to the community linked to these groups at low similarity level.

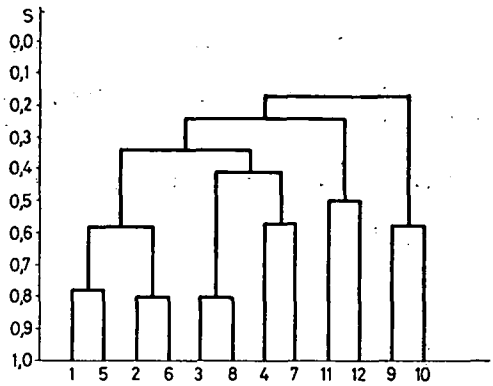

Fig. 4. Dendogram of the classification based on the species composition of the relevés from October 20, 1985

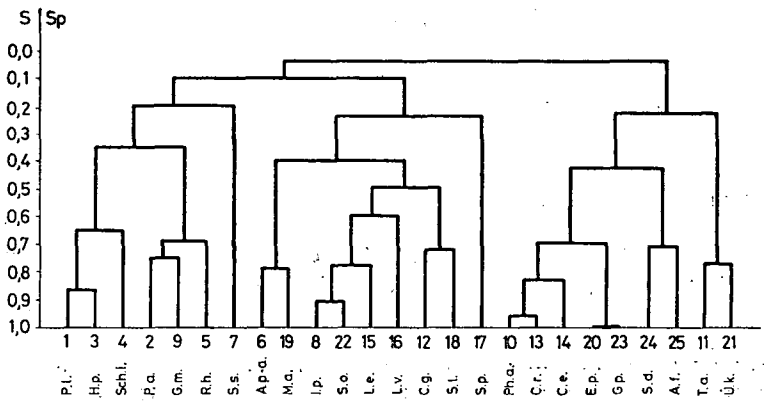

Fig. 5. Dendogram of the classification based on the covering values of the species occurring ni teh relevés of Table 2

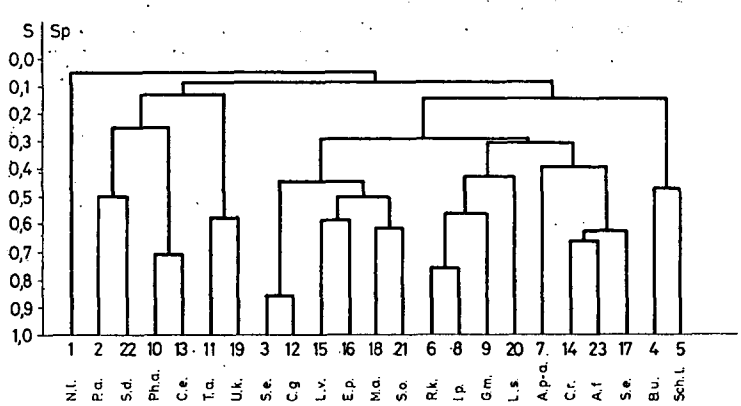

Fig. 6. Dendogram of the classification based on the covering values of the species occurring in the relevés of September 5, 1986

Classification and ordination according to the characteristic indicator values

The results of the vegetation dynamic studies on the cenoses can well be interpreted with the help of the characteristic indicator values (HEJNY 1960, BAGI 1985). The dendogram of the classification based on the T-characteristic indicator values obtained for the relevés of Table 2. is demonstrated in Fig. 7. Great similarity is

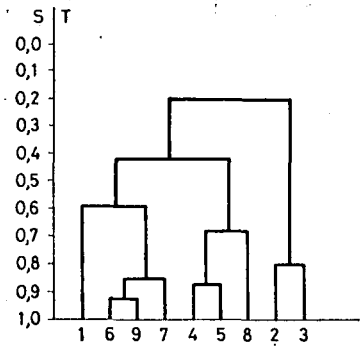

Fig. 7. Dendogram of the classification based on the T-characteristic indicator values of the relevés of July 17, 1985

manifest to the dendogram of the classification based on the relevés, on the basis of which it is assumable that temperature demand belongs to the primary determinative factors in the appearance of the character species of the cenoses at the time of the Spring aspect. In the later relevés, however, the N-demand, acidity relations and the hydroecological demand play emphasized role within the cenoses in the development of he plant populations. It is apparent from the results of the classification based on the N-characteristic indicator values that the character cenoses within the biotope form separate groups easily distinguishable from each other. According to their nitrogen demand, the relevés of the clear stands of the *Glycerietum maximae* association are linked to the relevés of the *Typhetum angustifoliae* association as well as the *Glycerietum maximae caricetosum* subassociation. On the contrary, the fact that the clear stands of the *Glyceria maxima* and the *Typha angustifolia* populations do not, or only partially mix with each other is explained by the competition being present between them (BUTTERY and LAMBERT, 1965) (Fig. 8).

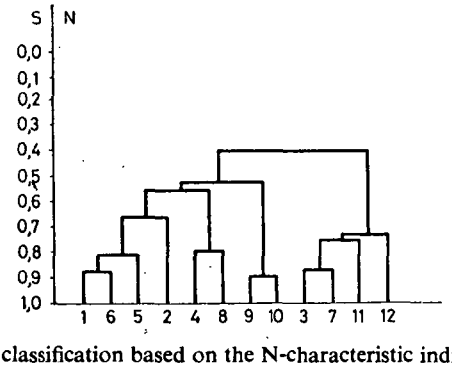

Fig. 8. Dendogram of the classification based on the N-characteristic indicator values of the relevés of October 20, 1985

Table 3. *Oct., 20. 1985*

Serial number of the stands	1	2	3	4	5	6	7	8	9	10	11	12
Total coverage	60	75	70	30	30	80	60	40	15	90	90	50
1. *Stratiotes aloides*	—	—	—	—	—	—	—	—	—	—	—	8
2. *Nuphar lutea*	—	—	—	21,9	—	—	—	18,8	—	—	—	30
3. *Hottonia palustris*	—	4,3	9	16,9	—	1,6	11,8	13,8	—	3,2	4,3	2
4. *Schoenoplectus lacustris*	—	—	—	9,8	—	—	—	13,8	—	—	—	—
5. *Rumex hydrolapathum*	9,8	7,3	—	—	5	2,6	9,8	—	—	—	—	—
6. *Alisma plant.-aquatica*	1,8	—	—	—	4	—	—	—	—	—	—	—
7. *Iris pseudacorus*	—	11	—	—	8	1,6	—	—	—	—	—	—
8. *Glyceria maxima*	29,8	43,3	73	9,8	8	35,6	58,8	34	—	—	—	—
9. *Phragmites australis*	—	—	—	—	—	—	—	—	19,2	27,2	—	—
10. *Typha angustifolia*	—	—	—	—	7,7	—	—	—	—	12	91,4	60
11. *Carex gracilis*	—	8,3	—	9,8	8	35,6	—	—	—	—	—	—
12. *Carex elata*	—	—	—	—	—	—	—	—	16,2	32,2	—	—
13. *Lycopus exaltatus*	1,8	—	—	8,7	4	1,6	—	—	—	—	—	—
14. *Lysimachia vulgaris*	—	4,3	9	—	—	3,6	—	9,8	—	—	—	—
15. *Stachys palustris*	1,8	—	—	—	4	1,6	—	—	—	—	—	—
16. *Sium latifolium*	—	4,3	—	—	—	1,6	—	—	—	—	—	—
17. *Mentha aquatica*	2,7	—	—	—	5	1,6	—	—	—	—	—	—
18. *Euphorbia palustris*	—	—	—	—	—	—	—	—	—	4,2	—	—
19. *Urtica kioviensis*	5,7	—	—	7,7	4	1,6	—	—	—	3,2	4,3	—
20. *Lytrum salicaria*	—	4,3	9	—	4	5,6	9,8	9,8	—	4,2	—	—
21. *Symphytum officinale*	—	—	—	—	—	—	—	—	12,2	3,2	—	—
22. *Galium palustre*	—	4,3	—	—	5	—	—	—	—	—	—	—
23. *Calystegia sepium*	—	4,3	—	—	4	1,6	—	—	—	—	—	—
24. *Polygonum lapatifolium*	—	—	—	7,7	—	—	9,8	—	—	—	—	—
25. *Cardamine amara*	—	—	—	—	—	—	—	—	+	3,2	—	—
26. *Solanum dulcamara*	1,8	—	—	—	4	2,6	—	—	—	4,2	+	—
27. *Amorpha fruticosa*	44,8	4,3	—	—	33	1,6	—	—	26,2	3,2	—	—

Fig. 9. shows the ordination analysis of the relevés of Table 4. Sharply segregated groups are detectable on the diagram along the I. and II. axis. These groups are formed by the *Typhetum angustifoliae* (11., 12.), *Scirpo-Phragmietum typhetosum* (13), *Glycerietum maximae caricetosum* (7., 8), *Caricetum gracilis* (1) and the *Glycerietum maximae* (10., 2., 9., 4., 5., 6) associations. The groups can be placed beside each other at the I. axis, which can be compared with the direction of succession series of the Phragmitetea cenoses.

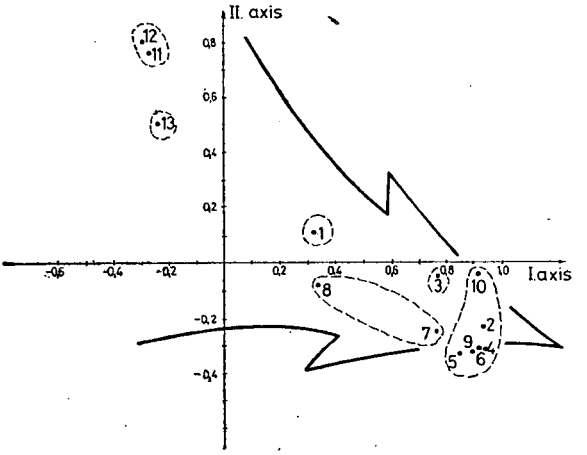

Fig. 9. Diagram of the ordination based on the relevés of September 5, 1986. Arrow indicates the trend (possible shift) of the succession for the different groups

According to the obtained data, the zonation of the cenoses and, as a consequence, the trend of the succession are determined by the R and W characteristic indicator values in case of the cenoses at Lake Sulymos belonging to the Phragmitetea association class. Studying the clusters formed on the dendogram shown in Fig. 5. (the dendogram of the classification based on the covering values of the species occurring in the relevés of July 17, 1985), it could be seen that the cluster cores correspond to the zonally located cenoses. The species belonging to identical or close to identical hydroecological groups were found to aggregate in the cluster cores. In the present case it was not expediential to classify the populations based on the conventional W-characteristic indicator values elaborated by ZÓLYOMI ET *al.* (1967); instead the system developed by BODROGKÖZY was used, distinguishing 3—3 subunits of these indicator values within 10 categories (BODROGKÖZY 1982). The species forming the first group were mainly those growing at the littoral zone, belonging to the hydatophyta 2 and 3, hydato-helophyta 1—3 categories. The second group was firstly composed of helophyta 1—2 species, the third again of helophyta 1—2 species — but here the hygrophyta 2, hygro-mesophyta 3 and mesophyta 1 species also appeared. These species are firstly found at the paralimnolittoral zone. The zonations are well separable from each other, in conformity with the non-constant and constant inundation.

A relationship is manifest between the ordination of the relevés of Table 3 and the W-characteristic indicator values of the different cenoses. On the diagram a W straight line can be drawn for the relevés (Fig. 10), and by letting a perpendicular

Table 4. *Sept., 5. 1986*

Serial number of the stands	1	2	3	4	5	6	7	8	9	10	11	12	13
Total coverge	70	80	75	95	65	85	85	95	65	80	70	70	60
1. *Nuphar lutea*	—	—	—	—	5,2	+	—	—	7	—	—	—	—
2. *Polygonum amphibium*	—	—	—	+	0,1	7,6	11,7	—	—	1	—	—	—
3. *Sparganium erectum*	1,2	1	+	—	—	—	—	+	—	1	+	—	—
4. *Butomus umbellatus*	+	0,5	3,6	1,1	—	0,6	2	—	—	—	—	—	—
5. *Schoenoplectus lacustris*	+	—	22,7	—	+	—	1	+	3	—	—	—	—
6. *Rumex hydrolapathum*	9,2	7,9	12,6	20,2	1,2	15,4	21,7	23,5	12	16	—	—	—
7. *Alisma plantago-aquatica*	—	+	+	+	—	—	—	4,3	—	1	—	—	—
8. *Iris pseudacorus*	4,2	2,9	—	5,2	1,2	+	6,7	10,5	3	6	—	—	—
9. *Glyceria maxima*	3,9	32,8	32,7	70,2	80,1	71	26,7	10,5	72	42	—	—	—
10. *Phragmites australis*	—	—	—	—	—	—	—	—	—	—	—	7,3	18
11. *Typha angustifolia*	—	—	—	—	—	—	—	—	—	—	92,6	32,3	23
12. *Carex gracilis*	29,1	12,8	3,6	1,1	—	2,5	—	—	—	24	—	—	—
13. *Carex elata*	—	—	—	—	—	—	—	—	—	—	—	—	23
14. *Carex riparia*	2,2	2,4	+	—	—	—	16,7	28,6	—	—	—	—	28
15. *Lysimachia vulgaris*	19,1	4,9	17,6	2,2	—	1,7	1,9	10,5	—	5	3,7	—	—
16. *Equisetum palustre*	9	1,4	3,6	+	—	—	5,7	0,8	—	—	—	—	—
17. *Sium latifolium*	—	0,5	—	—	—	—	—	1,3	—	1	—	—	1
18. *Mentha aquatica*	0,2	—	—	—	—	—	—	0,3	—	—	—	—	—
19. *Urtica kioviensis*	—	—	3,5	—	2,2	—	2	+	—	—	3,7	10,4	—
20. *Lytrum salicaria*	0,2	—	+	—	—	—	1	0,8	3	2	—	—	—
21. *Symphytum officinale*	13,5	2,4	+	—	—	—	1,9	5,5	—	—	—	—	1
22. *Solanum dulcamara*	—	—	—	+	—	—	1	—	—	+	—	—	1
23. *Amorpha fruticosa*	3,2	0,5	—	—	—	—	+	3,3	+	1	—	+	5

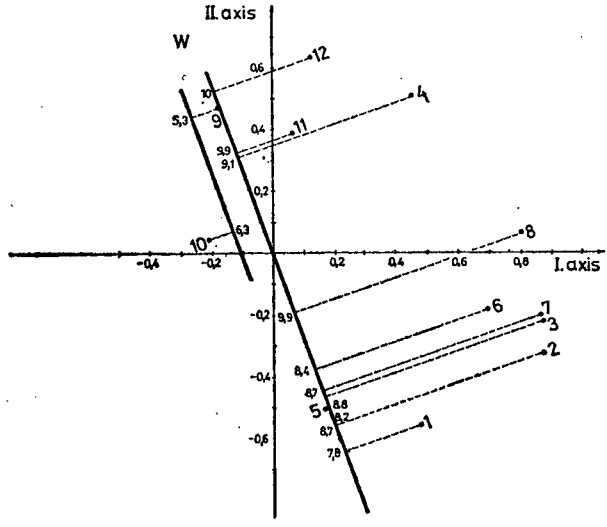

Fig. 10. Relationship between the ordination based on the relevés from October 20, 1985 and the W-characteristic indicator values of the different stands

fall on this from the object (relevés), the arising foot-ends can be ranged in order of magnitude. Based on this the zonation of the character cenoses is easily classifiable, which is related to the raise in water depth and the fluctuation of the inundation. In case of two objects (10., 9) negative deviation was found in the direction of the straight line. These two objects were formed by the stands of the *Scirpo-Phragmitetum* association. This result can be explained by the wide ecological amplitude of the *Phragmites australis* species (BJÖRK 1967). Fig. 11 demonstrates the diagram for the ordination of the stands of the 2. cenological table. Comparing the groups formed along the II.—III. axis of the diagram with the dendogram of the classification of the relevés

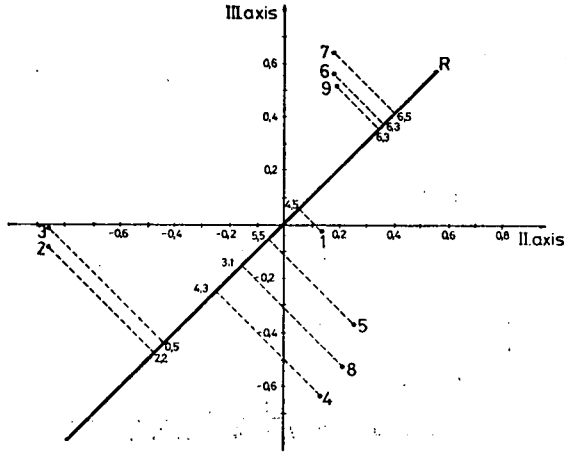

Fig. 11. Relationship between the ordination based on the relevés from July 17, 1985 and the R-characteristic indicator values of the cenoses

(Fig. 2), great similarity was experienced. Beside positive II. and negative III. axis, the *Caricetum gracilis* (4., 8., 5) and well separated from this, the *Scirpo-Phragmitetum typhetosum* (1) cenosis groups showed segregation. Beside negative II. and negative III. axis-values the *Typhetum angustifoliae* (2., 3) association group could be distinguished.

The objects obtained on the basis of the ordination results could be ranged in succession along an R-straight line. The order of succession was formed by the foot-ends of the objects obtained by means of projection perpendicularly on the R straight line. The highest mean indicator value was manifest in the *Glycerietum maximae* cenosis, followed in decreasing order by the *Scirpo-Phragmitetum typhetosum*, the *Caricetum gracilis* and the *Typhetum angustifoliae* associations.

Fig. 12. shows the results obtained for the ordination of the relevés of Table 3 (with consideration of the results of the I.—III. axes). The points of the stands were grouped according to the cluster cores found on the dendogram (Fig. 13) of the classification based on the R characteristic indicator values. Approximately identical orders of magnitude were evidenced for the mean R-values of the stands in the different

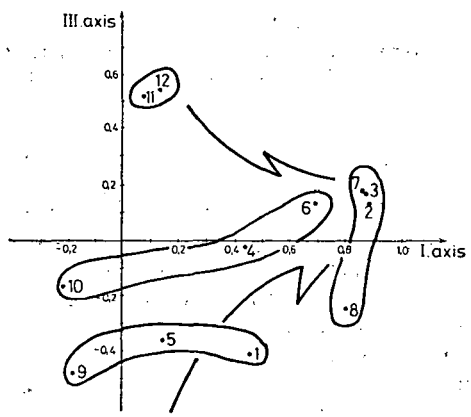

Fig. 12. Diagram of the ordination of the relevés from October 20, 1985. Arrow indicates the direction of the shift according to the R-characteristic indicator values of the different cenoses, which is comparable with the trend of the succession relations of the cenoses

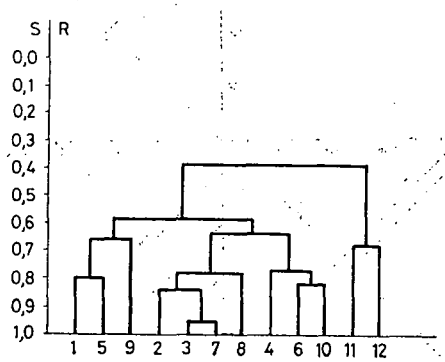

Fig. 13. Dendogram of the classification based on the R-characteristic indicator values of the relevés from October 20, 1985

groups. Examination of the mean R—values of the groups revealed an increase according to order of magnitude along the I. axis, the trend and order of which could be compared with that of the succession of the cenoses. The observed increase is indicated on the Figure by the direction of the arrow.

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Legend

◐ — *Glycerietum maximae caricetosum*
○ — *Glycerietum maximae*
□ — *Scirpo-Phragmitetum typhetosum*
■ — *Typhetum angustifoliae*
● — *Caricetum gracilis*
N. l. — *Nuphar lutea*
P. a. — *Polygonum amphibium var. aquaticum*
Ph. a. — *Phragmites australis*
C. e. — *Carex elata*
T. a. — *Typha angustifolia*
U. k. — *Urtica kioviensis*
S. e. — *Sparganium erectum*
C. g. — *Carex gracilis*
L. v. — *Lysimachia vulgaris*
M. a. — *Mentha aquatica*
E. p. — *Euphorbia palustris*
S. o. — *Symphytum officinale*
R. h. — *Rumex hydrolapathum*
I. p. — *Iris pseudacorus*
G. m. — *Glyceria maxima*
L. s. — *Lytrum salicaria*
A. p-a. — *Alisma plantago-aquatica*
C. r. — *Carex riparia*
A. f. — *Amorpha fruticosa*
S. l. — *Sium latifolium*
D. u. — *Butomus umbellatus*
Sch. l. — *Schoenoplectus lacustris*
S. a. — *Stratiotes aloides*
H. p. — *Hottonia palustris*
S. p. — *Stachys palustris*
S. d. — *Solanum dulcamara*
L. e. — *Lycopus exaltatus*
C. s. — *Calystegia sepium*
G. a. — *Galium aparine*
C. a. — *Cardamine amara*
F. o. — *Fraxinus* sp.
P. l. — *Potamogeton lucens*
G. p. — *Galium palustre*
S. s. — *Sagittaria sagittifolia*

A Sulymos-tó Phragmitetea asszociáció osztályba tartozó cönózisainak szezonális dinamikai és strukturális változásai

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Kivonat

A Kiskunsági Nemzeti Park területén, a lakiteleki Holt-Tisza mellett húzódó Sulymos-tó mocsári (Phragmition) és magassásos (Magnocaricion) karakter cönózisainak cönológiai és szezónális dinamikai vizsgálatát 1985—86. évben végeztük.

A Sulymos-tóban előforduló cönózisokra, a tavaszi aszpektus iniciális fázisában a Phragmition karakter asszociációk túlsúlya a jellemző. A litorális övben a fajok nagy diverzitását figyelhetjük meg, ezzel szemben a tó közepe felé haladva a diverzitás csökkenését, s vele egyidőben a fajok egyedszámának növekedését tapasztalhatjuk.

A cönológiai felvételek klasszifikációja alapján az egyes cönózisok szezonális dinamikai strukturális változásai jól értelmezhetők. A tóban tenyésző asszociációk zonalitását csak a part-

menti régióban figyelhetjük meg. A zonáció kialakulását egyrészt a Sulymos-tó domborzati viszonyai a vízszint ingadozása, a vízmélység alakulása okozza. Másrészt a zonálisan megjelenő asszociációkat alkotó fajok ökológiai igénye, s a közöttük kialakuló kompetíció határozza meg.

A eutrofizációs és feltöltődési folyamatok előrehaladtát elősegítő fitomassza dekompozíciója során szukcessziós sor állítható fel. Az eredményekből feltételezett szukcessziós sor: *Typhetum angustifoliae→Scirpo-Phragmitetum typhetosum→Scirpo-Phragmitetum phragmitetosum→Glycerietum maximae→Caricetum gracilis.*

Sezonsko-dinamične i strukturne promene svakog cenozisa koje pripadaju asocijaciji phragmitetea jezera Šuljmoš

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Abstrakt

U 1985—85. godini vršena su cenotička ispitivanja jezera Sulymos kraj mrtvaje Tise Lakitelek na području Nacionalnog parka Kiskunság, u močvarnim (Phragmition i Magnocarition) zajednicama u sezonskom aspektu. U jezeru Sulymos od zajednica prolećnu inicijalnu fazu karakteriše pretežno asocijacija Phragmition. U litoralnoj zoni utvrdjen je veliki diverzitet vrsta, nasuprot sredini jezera, gde se diverzitet smanjuje a broj jedinki pojedinih vrsta povećava.

Klasifikacija cenotičkih snimaka ukazuje na dinamiku strukturalnih promena u datim zajednicama u sezonskom aspektu. Zonalnost asocijacija je uočljiva samo u priobalnoj zoni jezera. Zonalnost je uslovljena delom promenama vodostaja, dubinom vode i konfiguracijom jezera. S druge strane ona je odredjena ekološkim zahtevima i kompeticijom vrsta datih asocijacija.

Dekompozicija fitocenoza ubrzava proces eutrofizacije i nasipavanja, pri čemu je moguće uspostaviti sledeći sukcesivni niz: *Thyphetum angustifoliae→Scirpo-Phragmitetum typhetosum→ →Scirpo-Phragmitetum phragmitetosum→Glycerietum maximae→Caricetum gracilis.*

Сезонные динамические и структурные изменения биоценозов класса ассоциаций Phragmitetea озера Шуймош

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Резюме

В 1985—1986 годах проведены ценологические и сезонно-динамические исследования биоценозов болот (Phragmition) и пойменных лугов (Magnocarition) озера Шуймош, находящегося рядом со старицей Тисы вблизи Лакителек на территории Национального парка «Кишкуншаг».

В самый характерый период весны в биоценозах озера Шуймош преобладают ассоциации типа Phragmition. В прибрежном поясе наблюдается большое разнообразие признаков (дивергенция) видов. Приближаясь к центру озера, при увеличении численности особей по видам уменьшается дивергенция видов.

Исходя из классификации ценологических съемок, рассмотрены сезонно-динамические и структурные изменения отдельных биоценозов. Разделение на зоны ассоциаций в озере наблюдается только в прибрежном районе. Возникновение зон обусловлено рельефом дна, колебаниями уровня воды, изменениями глубины озера Шуймош, а также экологическими потребностями видов, образующих сообщества по зонам, и взаимоотношениями между ними.

В результате разложения фитомассы, способствующей ускорению эвтрофии и зарастания, можно определить следующую последовательность сукцесси:

Typhetum angustifoliae → Scirpo-Phragmitetum typhetosum → Scirpo-Phragmietum phragmitetosum → Glycerietum maximae → Caricetum gracilis.

Так как направление сукцессии совпадает с направлением изменения показателя R — характеристик, предполагается, что кислотная среда внутри биотопа имеет замедляющее действие. По показателям индикаторов T, W и N — характеристик определены результаты вегетационно-динамических исследования.