

STUDY OF THE INDICATOR ROLE OF PLANT POPULATIONS OF MARSH-MEADOWS ALONG THE TISZA IN THE WATER-HOUSEHOLD OF THE ENVIRONMENT IN THE DISTRICT OF KISKÖRE

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Abstract

The construction of the second series of locks on the Tisza will lead to the largest artificial water-reservoir in Hungary. With its tremendous water surface and water mass, this reservoir can be expected to exert an influence on the surrounding plant populations via the rising of the subsoil water and the increase of the moisture content of the air. With the aim of the qualitative and quantitative measurement of the changes involved, a few years ago the hydrologists, climatologists, botanists and zoologists of the Tisza Research Working Group initiated a complex research programme in the district of Kisköre and Tiszafüred (HORVÁTH et al. 1973).

Within the framework of this programme, in the past few years (1968—1973) we have carried out studies of the synecological state of this area in the period prior to the formation of the reservoir, this being planned as the basis of comparison for later investigations. In this respect we set out to establish the following:

- a) what hygro-meso- and xerophil meadow associations occur on the two banks of this section of the Tisza outside the area of the reservoir;
- b) what the species compositions of these plant populations are;
- c) what changes take place in these plant populations as a result of precipitation.

In accordance with these aims, the zonal ordering brought about in the individual populations by the differences in height of the areas was studied, and for 5 years their regional variations were recorded.

Material and method

Our investigations began in the autumn of 1969. On both banks of the planned reservoir meadow associations were selected which included both dry pastures and various types of riverside marsh-meadows. As regards a dry pasture, a *Peucedano-Asteretum punctati* MÁTHÉ—Soó (1933) 1947 population was selected on the uncultivated Telekhát steppe at Cserőköz, about 1.5 km from the left embankment of the Tisza.

The site for study of the hygrophil marsh-meadow types (*Agrosti-Alopecuretum pratensis* Soó (1933) 1947) was in the Sarud pony-pasture, about 800 m from the embankment on the right bank opposite Cserőköz.

The site at Cserőköz is flat, but the Sarud pasture exhibits differences in level of 80—110 cm. In such meadows zones develop with different supplies of water. As a consequence of the various precipitation conditions (wet and dry periods) these differences become more enhanced. In these zones of varying ecological characteristics, different types of marsh-meadow associations develop.

From 1969 systematic phytocenological and soil-moisture examinations were carried out at these two sites. Since the zonally ordered types of marsh-meadow in the Sarud area could be

well distinguished from each other, their extents and the changes in these were recorded on a profile diagram (Fig. 1).

In the evaluation of these long investigations it is hoped to provide answers to the questions of what degree of change takes place in the extents of these zones as a result of the changes brought about in the wet and dry periods by the precipitation, and what close correlation can be established in the species composition of the individual populations.

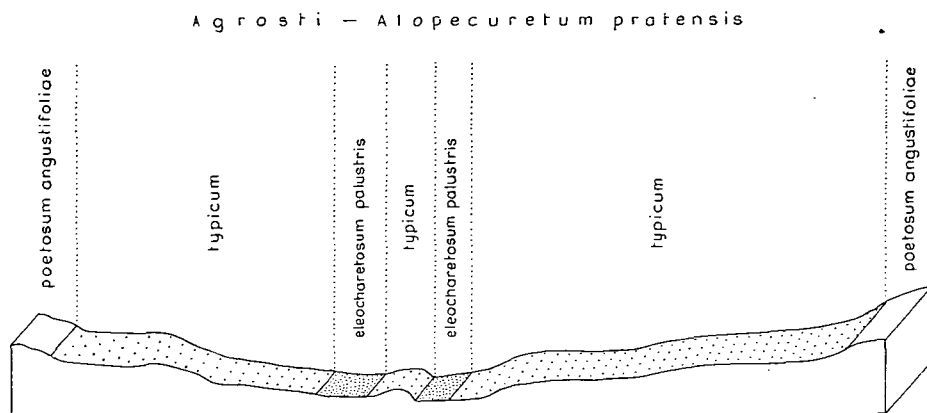


Fig. 1

The soil-moisture examinations were carried out at one spot in the dry lawn-type, and in 4 zones on the Sarud sample area, sampling being performed at 10 cm intervals to a depth of 60 cm. The water content of the soil was expressed in dm^3/l .

As regards the amount of precipitation, the data from the nearest large meteorological station (Szolnok) were taken into consideration.

From 1973 the dry-matter production too was systematically determined, by a mowing method, in three repetitions from 40×40 cm plots.

Comparative discussion of the results

Cserőköz

a) Wet period

The amount of precipitation in the last two months of 1969 resulted in the accumulation of the soil moisture. This state, which was favourable for the hygrophil species, was maintained in the first five months of 1970 and not only here, but on the whole of the Great Hungarian Plain, led to the saturation of the soil with water.

The experimental area at Cserőköz can be regarded as the *Peucedano-Asteretum punctati* (MÁTHÉ—Soó 1933) Soó 1947 *alopecuretosum pratensis* Soó 1957 drier variant characteristic of sodic forest clearings. It is possible to find in them the characteristic species of the association: *Peucedanum officinale*, *Aster punctatus*, *Veronica orchidea*. Meadow solonetz soil, steppefying deep down, is indicated by the deeply-rooting *Limonium gmelini* and *Artemisia salina*. The sodic representatives of the ephemeral Papilionaceae are *Trifolium striatum* and *T. retusum*.

The differential species of the sub-association emerge from among the hygrophil species components: *Alopecurus pratensis*, *Lythrum virgatum*, *Trifolium hybridum*, *T. repens*, *Senecio jacobea*, etc.

Table 1. *Peucedano-Asteretum punctati*

	Percent coverage	
	wet period (August 1970)	dry period (June 1973)
Glyco-hygro-mesophil species:		
<i>Alopecurus pratensis</i>	20,0	10,0
<i>Trifolium repens</i>	14,0	5,0
<i>Trifolium hybridum</i>	0,5	.
<i>Senecio jacobea</i>	0,5	.
<i>Centaurium minus</i>	0,1	.
	36,6	15,0
Glyco-mesophil species:		
<i>Daucus carota</i>	0,1	0,5
<i>Trifolium pratense</i>	0,5	.
<i>Eryngium planum</i>	0,5	.
<i>Mentha pulegium</i>	0,2	.
	2,1	0,5
Glyco-meso-xerophil species:		
<i>Inula britannica</i>	1,0	0,5
<i>Centaurea pamonica</i>	1,0	1,0
<i>Veronica orchidea</i>	2,0	.
<i>Trifolium campestre</i>	0,1	0,1
<i>Cichorium intybus</i>	5,0	6,0
<i>Agropyron repens</i>	2,0	3,0
<i>Galium mollugo</i>	1,0	1,0
	14,2	11,6
Glyco-xerophil species:		
<i>Festuca pseudovina</i> + <i>Festuca sulcata</i>	6,0	25,0
<i>Achillea collina</i>	7,0	10,0
<i>Potentilla argentea</i>	0,5	0,5
<i>Gypsophila muralis</i>	0,5	0,5
<i>Scorzonera cana</i>	0,5	1,0
<i>Plantago lanceolata</i>	1,0	1,0
<i>Trifolium arvense</i>	0,5	.
	17,0	38,0
Halo-hygro-mesophil and mesophil species:		
<i>Peucedanum palustre</i>	6,0	5,0
<i>Lotus tenuis</i>	1,0	.
<i>Trifolium striatum</i>	0,5	3,0
<i>Trifolium angulatum</i> .....	.	2,0
	7,5	10,0
Halo-meso-xerophil and xerophil species:		
<i>Aster punctatus</i>	2,0	5,0
<i>Limonium gmelini</i>	0,5	2,0
<i>Artemisia salina</i>	2,0	2,0
	4,5	9,0

As regards the quantitative relations, the high dominance values of *Alopecurus pratensis* and *Trifolium repens* are the most striking, as a consequence of the favourable hydrographic effect (Table 1). The data of 10 recordings were used to calculate the participations of the species present, expressed quantitatively as percentage covers, according to the hydroecological classification. In the summer aspect of the vegetation period in 1970, a year with a particularly high precipitation, the glyco-hygro-mesophil species became predominant and overshadowed the glyco-xerophil species. The dominant species was *Alopecurus pratensis*, which represented more than half of the phytomass of the hygro-mesophil species. This was followed by the accompanying *Trifolium repens*, the total cover of these species being more than 36%.

In contrast, the participations of the glyco-meso-xerophil and the glyco-xerophil species were almost the same: total covers of 14% and 17%, respectively. These values were made up from relatively high numbers of species, even the participation of *Cichorium intybus*, which was dominant among the meso-xerophil species, not being more than 4%.

The result was similar for the xerophil species too. Appreciable declines and low values were exhibited by the two *Festuca* species present, *F. pseudovina* and *F. sulcata*. The participation of *Achillea collina* was outstanding.

Since the soil possessed favourable physical and chemical properties, and contained sodium salts only in the lower layers, the total cover of the halophil species scarcely exceeded 10%. Of these, the halo-hygro-mesophil and mesophil association-character species, *Peucedanum palustre*, was the most significant. The *Limonium* and *Artemisia* species dominating on other sodic steppes were forced into the background here.

b) Dry period

The extremely dry year of 1970 was followed by a dry period. The most suitable year for study was 1973, when the amount of precipitation was about 70% of the many years' average. In the third year of the dry period the state of the ecological groups had developed as follows. The comparison of the two extreme ecological groups, the hygrophil and the xerophil species, gave exactly the opposite picture to that for 1970. The group of the hygro-mesophil species was decreased to about half of the earlier area. Certain species were so repressed that they were observed only as individual stems. The cover of *Alopecurus* too fell by 50%. An ever greater reduction was that of *Trifolium repens*, the cover of which was nearly 70% less than in the wet period. In contrast, as regards the xerophil species the coverages of the previously overshadowed two *Festuca* species increased by a factor of four. This was due in part to the bushing-out of the individual specimens, and to the revival of these hair-grass lawns following the repression of the foxtail grass and the white clover.

An increased participation was similarly shown by *Achillea collina*. The other xerophil species did not exhibit appreciable changes.

The coverages of the halophytions, and especially the meso-xerophil halophytions, increased during these three dry years; for example, that of *Aster punctatus* more than doubled. The hygro-mesophil and mesophil halophytes similarly achieved their spreading through the annual ephemeral *Trifolium* species.

Sarud pony-pasture

Three zones could be distinguished on the lower-lying sections of the *Agrosti-Alopecuretum* in the selected area. The deepest zone belongs in the *Eleocharis palustris* meadow-type, or its *Lythrum virgatum* sub-type. The middle zone was a typical variant of the Tisza-side *Agrosti-Alopecuretum*, or its *Senecio jacobea* sub-type. In the bank-side zone of this deeperlying flat area, which is about 300 m in diameter, where the rise is more significant, the dry types of this hay-meadow, *Poa angustifolia* and *Festuca pseudovina*, have developed alternately. The variation of the wet and dry periods could be observed not only in the species composition of the individual meadow types and in the participation proportions of the species components, but also in the change of the zone boundaries.

a) Wet period

In the course of the examinations in August, 1970 it was found that of these zones that of *Eleocharis palustris*, favouring the hygrophil conditions, was dominant. Even on the slightest rise the vegetation reacted sensitively to the change of the hydrographic conditions. The vegetation conditions of the middle zone developed on mounds 10—15 cm in height and 5—10 m in diameter.

The species composition of this low zone according to the hydroecological classification was the following:

Eleocharis palustris, forming the lower lawn layer the two-layer meadow, made up nearly half of the hygrophil species components. The upper lawn level was dominated in part by the hygrophil *Agrostis alba*, but its participation did not exceed 5%. *Lythrum salicaria* contributed with a further 5%, while as expected the meso-xerophil and xerophil species were completely absent. Of the mesophil species too, only *Mentha pulegium* occurred.

The picture changes, as regards both species composition and coverage proportions, in the middle zone, where following the extensive decrease of the hygrophil species the hygro-mesophil species came into the foreground. In 1970, therefore, a complete ecological group-difference appeared between the two zones, in that *Alopecurus pratensis* occurred as 50% of the total coverage, whereas the other species each comprised less than 5%.

The upper zone, for which there was a difference in levels of about 80—110 cm compared to the deepest point, resulted in a further substantial change in that the meso-xerophil species assumed importance. *Poa angustifolia* appeared, and even became dominant. It was here, however, that the really hygro-mesophil nature and broader ecological adaptability of *Alopecurus pratensis* appeared, for as a result of the favourable precipitation conditions it exhibited a decrease of barely one-third in the upper zone, compared to the previous zone. *Trifolium repens* accompanied it, with a similarly significant participation of up to 5%. This gave rise to the situation that, although the examinations were carried out in a dry-type zone of the foxtail grass, the total participation proportion of the hygro-mesophil species exceeded that of the meso-xerophil species.

However, the picture changes if the values for the hygrophil and hygro-mesophil species and the proportions for the xerophil and meso-xerophil species are added together. The joint participation of the latter two ecological groups will then be the higher. This is due to the appearance of the xerophil species and the coverage of *Festuca pseudovina* and *Achillea collina*.

Table 2. *Agrosti-Alopecuretum*

	Percent, coverage							
	lower zone				middle zone		upper zone	
	cleocharetosum				Typicum		Poa angustifolia subass.	
	normale		Lythrum fac		70	73	70	73
	70	73	70	73				
Hygrophil species:								
<i>Eleocharis palustris</i>	25,0	10,0	8,0	2,0	.	.	.	.
<i>Agrostis alba</i>	10,0	5,0	2,0	5,0	.	.	.	.
<i>Lythrum salicaria</i>	5,0	1,0	5,0	.	3,0	.	.	.
<i>Juncus compressus</i>	3,0	.	.	.	.	.	.	.
<i>Alisma plantago-aquatica</i>	2,0	.	.	.	.	.	.	.
<i>Lythrum hissopifolia</i>	0,5	.	0,5	.	0,2	.	.	.
<i>Juncus atratus</i>	2,0	.	0,5	.	.	.	.	.
<i>Baldingera arundinacea</i>	1,0	1,0	.	.	.	.	.	.
<i>Typha latifolia</i>	1,0	.	.	.	.	.	.	.
	48,5	17,0	16,0	7,0	3,2	—	—	—
Hygro-mesophil species:								
<i>Alopecurus pratensis</i>	5,0	30,0	25,0	40,0	50,0	35,0	30,0	10,0
<i>Lythrum virgatum</i> .....	.	6,0	.	8,0	2,0	5,0	1,0	.
<i>Trifolium repens</i> .....	.	.	.	1,0	.	1,0	5,0	1,0
<i>Lysimachia nummularia</i>	2,0	.	0,5	.	.	.	.	.
<i>Senecio jacobea</i>	0,5	.	.	1,0	2,0	.	.	.
<i>Bidens tripartitus</i> .....	.	.	.	0,5	0,2	.	.	.
<i>Ranunculus sardous</i> .....	.	.	.	.	.	.	0,2	.
	7,5	36,0	25,5	51,0	54,2	41,0	36,2	11,0
Mesophil species:								
<i>Mentha pulegium</i>	4,0	1,0	6,0	2,0	3,0	3,0	.	.
<i>Lotus corniculatus</i> .....	.	.	.	.	.	1,0	6,0	4,0
<i>Daucus carota</i> .....	.	.	.	.	.	1,0	2,0	1,0
<i>Medicago lupulina</i> .....	.	.	.	.	.	0,5	0,5	1,0
	4,0	1,0	6,0	2,0	3,0	5,5	8,5	6,0

Meso-xerophil species:

<i>Cichorium intybus</i> .....	.	.	.	0,5	1,0	2,0	0,5
<i>Poa angustifolia</i>	2,0	.	.	.	15,0	20,0	35,0
<i>Inula britannica</i> .....	.	.	.	0,5	0,5	1,0	1,0
<i>Lolium perenne</i> .....	.	.	.	.	5,0	5,0	10,0
<i>Convolvulus arvensis</i> .....	.	.	.	.	.	0,5	1,0
<i>Trifolium campestre</i> .....	.	.	.	.	0,5	.	0,5
<i>Lathyrus tuberosus</i> .....	.	.	.	.	.	.	1,0
	— 2,0	—	—	1,0	22,0	28,5	44,0

Xerophil species:

<i>Festuca pseudovina</i> .....	.	.	.	.	.	5,0	10,5
<i>Achillea collina</i> .....	.	.	.	.	.	6,0	8,0
<i>Plantago lanceolata</i> .....	.	.	.	.	.	2,0	3,0
<i>Scorzonera cana</i> .....	.	.	.	.	.	1,0	2,0
<i>Gypsophila muralis</i> .....	.	.	.	.	.	0,5	2,0
<i>Potentilla argentea</i> .....	.	.	.	.	.	0,5	1,0
<i>Eryngium campestre</i> .....	.	.	.	.	.	0,5	1,0
<i>Carex praecox</i> .....	.	.	.	.	.	0,1	0,5
	—	—	—	—	—	15,6	27,0

b) Dry period

For the evaluation of the changes, use was made of the results for 1973. The study of soil samples collected on 14 June 1973 revealed the effect of the lack of precipitation on the moisture content of the soil (Fig. 2).

The three dry years gave rise to a considerable change in the zone boundaries and in the extents of the zones. The *Lythrum* sub-type of the lower zone became

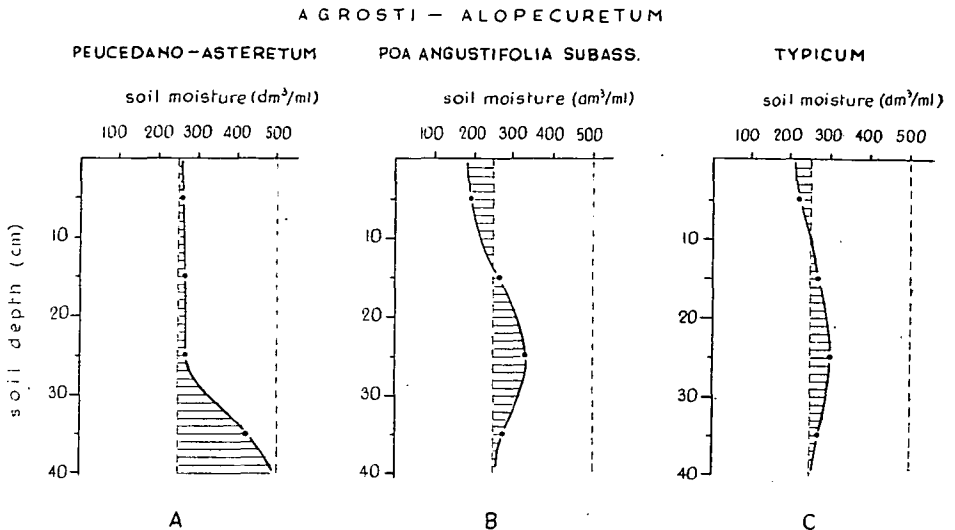


Fig. 2

in its entirety the *typicum*, but the higher stage of the *Eleocharis* type also developed as a *typicum*. In this way the extent of the lower zone was only 36 m, in contrast with the diameter of 150 m three years previously.

The coverages of the ecological groups and their species components resulted in appreciable changes. The *Eleocharis* population of the lower lawn level of the deepest lower zone exhibited a participation decrease of more than 70%, and the hygrophil *Agrostis alba* suffered a similar decline. At the same time, the participations of *Alopecurus pratensis* and *Lythrum virgatum* increased by a factor of eight. In the dry period, therefore, the hygro-mesophil species assumed a leading role in the lower zone, with a total coverage participation of 36%.

In the examination of the middle zone it turned out that the participation of *Alopecurus* decreased, in contrast to the increase in the lower zone. The participation of *Lythrum virgatum* too was nearly the same, and thus similar findings can be reached as in the case of the foxtail grass.

Poa angustifolia, on the other hand, which had earlier lain dormant in the middle zone, after the three years appeared with a participation of 15%. A contribution to this was due to the occurrence of *Lolium perenne*, which attained a participation of 5%.

It can be seen from all this that the succession showed very considerable changes during the three years (Table 2).

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