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HYDROECOLOGY OF THE GRASS-ASSOCIATIONS FOUND AT THE DAMS ALONG THE UPPER-TISZA

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Abstract

To this day, the grass stands developing at the dams of the Upper Tisza-valley by means of sowing performed close to one century ago, have come close to the populations of the alpine meadows. Their zonal arrangement is determined by the frequent, but short-termed inundations and the exposition of the dam-slope. A significant variation was demonstrable compared to the similarly located dam grass zones found at the Southern Tisza-valley.

1. *Alopecuro-Arrhenatheretum* developed on the effect of repeating floods in the lower zones of the Northern-, North-Eastern dam-slope. The helo-hygrophyton and hygrophyton representatives were dominating.

2. *Pastinaco-Arrhenatheretum* was found located at the upper zone of the dam-slope. Depending on the moisture conditions, three sub-associations could be distinguished and the species belonging to the various subunits of the hygro-mesophyton category were demonstrable.

3. The *Lolio-Plantaginetum* developed on enhanced zoogenic effect at the dam's Western-, South-Western flood-protected area.

4. The zone of the *Salvio-Festucetum rupicolae* could be differentiated into four sub-associations and occupied the central and upper protected dam zone. Their species components were meso-xerophyton representatives.

Introduction

During the course of the geological periods, the process of down-cast fault and alluvial deposit took place at the Great Hungarian Plain section of the Carpathian Basin. As a consequence, this plain became evenly sloped in Southern direction. The rainwater gathering from the environs also proceeds in this direction. The transmitter of these periodically high water masses is the second largest river of the country, the Tisza.

In the past centuries, mainly in the XVII.,—XVIII. centuries, the South-Eastern Lowland turned to flood-area in the Spring months following snowbreak. To prevent this, dam systems were established. On their effect developed the so-called flood-plain formed between the dams, and dominated by the repeating floods of various durations; as well as the flood area outside of the dam, free from floods. Regarding the soil relations of these two separated areas, significant variation also developed during the course of the decades. While in the flood-plain zone the repeatedly formed mud layers from the floods established young irrigation soil without structure, at the protected flood area meadow soil of irrigation nature developed with the outset of the soil development. The dams having conspicuous relief extend between these two as a boundary line.

Well distinguishable grass-associations developed during the course of the past century at their slopes and zones, respectively, exposed to different environmental-biological effects. The species components found here reflect well the variations in duration and effect of climate, exposition (BODROGKÖZY et *al.* 1967) and flood level. Significant differences were also found due to the varying macroclimatic relations when comparing the climatic relations of the Northern and Southern Lowlands. Taking all these into account, significant variation could be determined during the course of the analysis and comparison, respectively, of the grassassociations at the dam zones of the Northern, as well as the Southern Tisza-valley (BODROGKÖZY 1966, 1968).

These dam system were protected from the flood and rainwater erosions by grass coverings established by means of sowing, applying uniform seed-mixtures. The possibilities available against flood control have been reported by SZALAY (1959), GRUBER (1970) and SZARVAS (1970). During the course of the past decades, however, this cultura grass stand overwent significant changes in composition. Nowadays it is becoming all the more similar to the composition of the damp-, fresh- and dry meadows known both from Hungarian and foreign literature, the majority of which are also of secondary origin. Therefore, these can now be regarded as related to or same as those. This conclusion could be drawn when comparing the meadows and pastures found at the environs of the South Hungarian Mecsek (HORVÁT 1960) with the date of the Hungarian publications originating from the environments of Gödöllő at the Central range of mountains and the border of the Lowlands (KOVÁCS 1954), the area alongside the Rába (JEANPLONG 1960, 1970), the environs of Buda (ZÓLYOMI 1958) or from the Eastern Central range of mountains (MÁTHÉ and KOVÁCS 1960).

Materials and Methods

In respect to the Northern-Lowlands, the phytocenological and hydroecological studies on dam-grasses ranged North from Vásárosnamény to the frontier of the Soviet Union. By means of the regular phytocenological surveyings, the upper gradient zone of Eastern exposition located near the water, affected by floods and free from waters, was separated from the lower-, central- and upper zones of Western exposition, located at the protected side. There was also possibility for comparative analysis regarding the dam-grasses of similar location at the Southern Lowlands.

From hydroecological viewpoint, the grouping and evaluation of the species components of the various grass stands could be accomplished with the aid of the methods used earlier (ZÓLYOMI et al. 1967: W factor; ELLENBERG 1979, Soó 1964—80: F factor; BODROGKÖZY 1982a, b). The analyses also comprised the covering quota of the various species within the different associations, since the hydroecological diagram of each species was also constructed. These curves — mirroring the moisture demands — also demonstrate the ecological adaptability of the certain species. The representatives in which case the culmination points of their curves are under 50%, have wide hydroecological adaptability, being less characteristic to the site relations in question, and vice versa (Fig. 2).

Discussion

Figure 1 demonstrates the studied grass stands which developed depending on the macroclimate exposition- and zone condition at the Northern Hungarian Tisza-valley dams.

1. *Alopecuro pratensis — Arrhenatheretum* (MÁTHÉ and KOVÁCS (60) Soó 71.

Along the Upper-Tisza the river floods are more frequent but not so long-lasting as in the Southern lowland section. This explains the reason why the lower zone of the dam-side next to the water is not covered by water for longer duration. Therefore, in the place of the originally sown *Arrhenatherum — Dactylis—Bromus* grass composition, after the destruction of the species being more sensitive against the covering

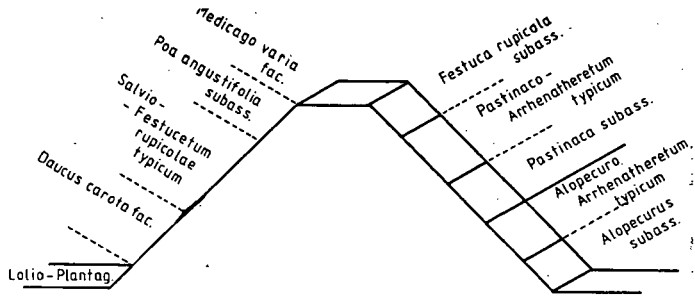

Fig. 1. Zonation system of the grass association found at the dams located at the Northern Tisza-valley.

by water, the species components characteristic of this association became settled at this area, like the *Rumex acetosa, Daucus carota, Poa angustifolia.* The grass stand of the dam zone exposed to this flood effect can be separated into three units of association:

1.1. *A.-A. alopecuretosum pratensis* MÁTHÉ and KOVÁCS 60.

This is situated at the lower section of the flood water zone, at the place where the covering by water is of relatively longer duration and the soil of the dam is more deeply humid. This is reflected by the distribution of the characteristic species. The nitrophylic *Arrhenatheretum* stands reported from the Matopolska Plato meadows of Poland are somewhat similar (MEDWECKA-KORNAS, A. 1959). The meadows rich in nutriments are well known from the district of Brün (BALÁTOVÁ—TULÁCKOVÁ 1968), from which area the seasonal changes of the underground water level are also known from the Fifties. Their secondary stands from the environs of Stechlinsee in Germany have been reported as *Dauco-Arrhenatheretum* (BR.—BL. 19) OBD. 65, where even the *Alopecurus pratensis* forms a sub-association (KRAUSCH 1966, 1967).

The similarly secondary meadows at the South-Western territory developing at Transdanubia (Zala county) also have distinguishable types; namely, one characterisable by the more damp *Alopecurus pratensis* and one being drier: the *Poa angustifolia* (ÚJVÁROSI 1947). In the North Hungarian (Mátra Mountains) secondary stands having moist soil, the *Alopecurus pratensis* sub-association was described through

Cenological relations

Regarding the average of their phytocenological pictures, the strictly taken Alopecurion, Molinion and Molinietalia representatives were generally only found in blades, however, the Arrhenatherion species played role with higher species number and covering quota, and the Molinio-Arrhenatherea species played role in the highest species number and covering quota (Table 1 and 2).

Hydroecological situation

On the effect of the frequent, but short durational inundations certain helo-hygrophyton and hygrophyton representatives appeared, like the *Galium rubioides, Vicia cracca* and the *Viola elatior* as the representatives of the flood-plain marsh-meadows, with low covering quota. Otherwise, the hydroecological curve of the sub-association shows double culmination point. The total covering quota of the denominating *hgm1*-like species components is higher, first of all, that of the *Alopecurus pratensis,* showing a transition towards the hygrophylic category. From the view-

Table 1. *Alopecuro pratensis — Arrhenatheretum 1. alopecuretosum (typicum) 2. poëtosum angustifoliae*

F	W	sub-assaciation	1	2
		Helo-hygrophyta:		
		hhg1		
4	8	*Angelica silvestris* (Molinietalia)		
4		*Galium rubiodies* (Alopecurion pratensis)		
		Hygrophyta:		
		hg2, 3		
0	4	*Vicia cracca* (Molinio-Arrhenatherea)		
3—4	5	*Viola elatior* (Molinietalia)		
		Hygro-mesophyta:		
		hgm1		
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)		
3—4	4	*Serratula tinctoria* (Molinion)		
0	7	*Ranunculus acris* (Molinio-Arrhenatherea)		
	8	*Equisetum arvense* (Secalietea)		
		hgm2		
3—4	6	*Pastinaca sativa* ssp. *pratensis* (Molinio-Arrhen.)		
3	5k	*Campanula patula* ssp. *neglecta* (Molinio-Arrhen.)		
		Mesophyta:		
		m1		
0	6	*Dactylis glomerata* (Molinio-Arrhenatherea)		
3	4	*Anthoxanthum odoratum* (Festuco-Brometea)		
3	5	*Pimpinella major* (Arrhenatheretalia)		
2—4	2	*Rumex acetosa* (Molinio-Arrhenatherea)		
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)		
		m2		
3	5	*Arrhenatherum elatius* (Arrhenatherion)		
3	5	*Plantago media* (Molinio-Arrhenatherea)		
		m3		
0	5	*Daucus carota* (Molinio-Arrhenatherea)		
0	6	*Leontodon hispidus* ssp. *hastilis* (Molinio-Arrhen.)		
		Meso-xerophyta:		
		mx1		
2	3	*Bromus inermis* (Festuco-Brometea)		
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)		
2—3	5a	*Knautia arvensis* (Molinio-Arrhenatherea)		
0	3	*Clinopodium vulgare* (Querco-Fagea)		
2	5a	*Tanacetum vulgare* (Calystegion)		
3		*Cruciata levipes* (Quercetea)		
2	3	*Trifolium montanum* (Festuco-Brometea)		
3	5k	*Inula salicina* (Molinio-Arrhenatherea)		
0	3	*Genista elata* (Festucetalia valesiacae)		

F	W	sub-assaciation	1	2
		mx2		
2	3	*Poa angustifolia* (Festuco-Bromea)		
1—2	3	*Coronilla varia* (Festuco-Brometea)		
3	5	*Agrimonia eupathoria* (Festuco-Brometea)		
2—3	4	*Plantago lanceolata* ssp. *sphaerostachya* (Festuco-Bromea)		
0	3	*Pimpinella saxifraga* (Festuco-Bromea)		
1—2		*Cuscuta epithymum* (Festuco-Bromeea)		
2—3	5	*Vicia sepium* (Molinio-Arrhenatherea)		
2	1	*Festuca rupicola* (Festuco-Bromea)		
		mx3		
2	3	*Fragaria viridis* (Festucetalia valesiacae)		
2—3	3	*Viola hirta* v. *fraterna* (Festuco-Bromea)		

Symbols: D-value:

25—50 %
5—25 %
1— 5 %
0,5— 1 %

(The symbols apply to table 1., 4., 6., 7)

Table 2. *Distribution according to cenosystematic units of the species number and covering quota of the species components of the association*

	Species number		Covering quota	
	1	2	1	2
Alopecurion pratensis	1	.	1	.
Molinion	1	.	0,5	.
Molinietalia	2	.	2	.
Calystegion	.	1	.	1
Arrhenatherion	1	1	20	20
Arrhenatheretalia	1	.	1	.
Molinio—Arrhenatherea	12	9	61	39
Secalietea	1	1	1	1
Chenopodio-Scleranthea	.	1	.	5
Festucetalia valesiacae	2	2	2	3
Festuco-Brometea	4	4	6	9
Festuco-Bromea	.	7	.	34
Quercetea, Querco—Fagea	1	2	1	2

the *Festuca pratensis Cardamine pratensis, Poa trivialis* separative species, which are similar to those found around the environs of the Mecsek (MÁTHÉ—KOVÁCS 1960). The subunits of the associations reported from the alluvial areas of the French mediterranean Montpellier region differ from the composition of the meadows found at Central and Eastern Europa (ILIJANIC 1965).

point of species number the majority of the mesophyta belong to the *m1* subgroup. The secon dculmination point, however, is firstly formed by the *Arrhenatherum elatius* from the *m2* subgroup (Fig. 3). From the *m1*-s the *Anthoxanthum odoratum, Pimpinella major, Rumex acetosa* are mainly characteristic of the dams located ilongside the Upper-Tisza, and have shown good adaptability to the periodical anundations.

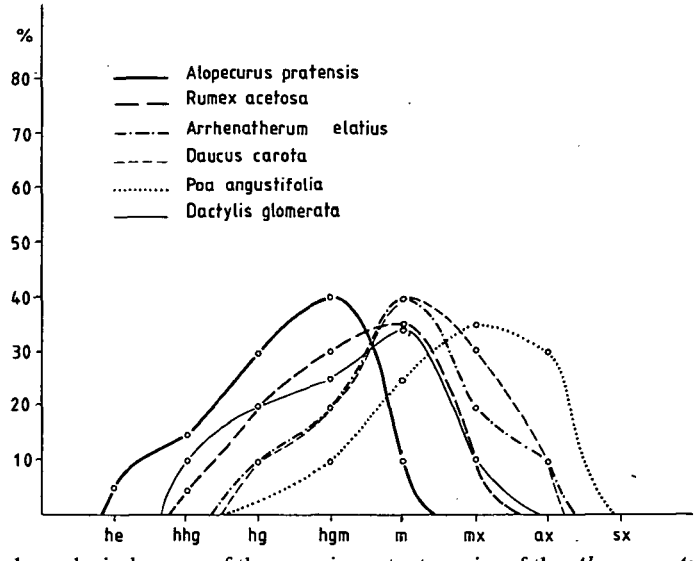

Fig. 2. The hydroecological curves of the more important species of the *Alopecuro-Arrhenatheretum*.

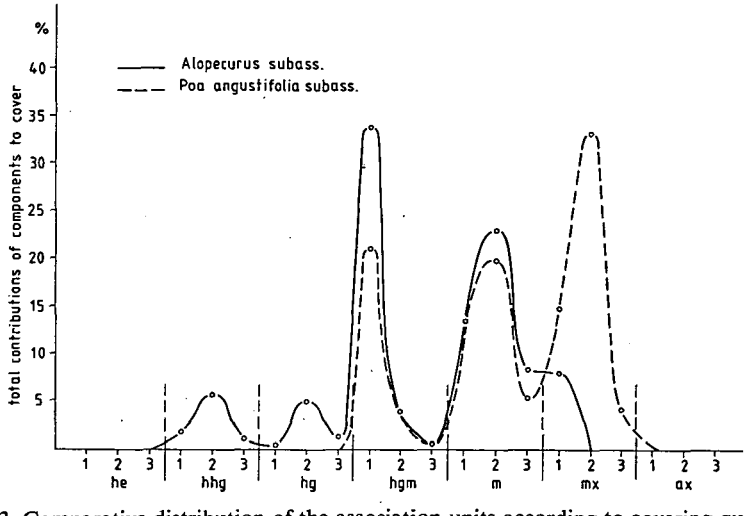

Fig. 3. Comparative distribution of the association-units according to covering quota.

Analysing the hydroecological curves of the species characteristic to the sub-association, it could be determined that these have a wider ecological adaptability. This explains the reason why the peak of their curve does not overreach the value of 40% (Fig. 2).

1.2. *A.—A. poëtosum angustifoliae* (n. nov.)

Environmental-biology: In the case when the dam follows the river bends in such manner that the slope from the side of the water has a Southern-, South-

Western exposition, the species composition of the grass covering changes. It does not always cover exquisitely and frequently, in the case of the development of inundation, the danger of soil erosion may arise.

Cenological relations

In their cenoses the Festuco-Brometea species of wider ecological adaptability have become more wide-spread. Concerning their covering quota, they have a dominative role. Their differential species are the *Poa angustifolia, Agrimonia eupathoria, Pimpinella saxifraga.* In the Autumn aspect, the Festuco-Brometea representative, the *Cuscuta epithymum* causing destruction in smaller-larger patches, has gained larger ground at places (Table 1).

The relationships between the species number and covering quota of the various cenosystematic units are well followable on Table 2.

Hydroecology

After the subsiding of the smaller floods which vary from those at the Lower-Tisza section (BODROGKÖZY 1966, 1968), and mainly on the effect of the more increased insolation, the helo-hygrophyta and the hygrophyta disappear in the Summer period. Their place is occupied by the meso-xerophyta which is richer in species and has higher covering quota. Even from these, the denominator of the sub-association, the *mx2*-like *Poa angustifolia,* having wide hydroecological amplitude, is highly conspicuous.

The majority of the characteristic species, however, are mesophyta. Nevertheless, it should be added that the culmination points of their hydroecological curves show values of 40% or below this. Accordingly, they could also develop in the company of the meso-xerophyton and even in that of the asteno-xerophyton representatives, living at the sometimes damper, other times drier dam-slopes. The *Arrhenatherum elatius* is such a species.

Its hydroecological curve constructed on the basis of the total covering quota of the two association-units shows three culmination points (Fig. 3).

1.3. *A.—A. arrhenatheretosum* (typicum)

The cenosis located between the zone of the previous two sub-associations. Since good separation is rarely possible at the area chosen for study, here the evaluation had to be disregarded. It has been studied from other areas, firstly from practical aspects. Therefore, it is known on the basis of the reports by SCHNEIDER (1954), ELLENBERG (1952), MÁTHÉ (1956), SCHUBERT et *al.* (1959).

2. *Pastinaco—Arrhenatheretum* (KNAPP 54) PASSR. 64
(Syn.: *Dauco-Arrhenatheretum* GÖRS 66)

This has developed in the zone located upwards from the long-standing flood level at the slopes of Northern-, North-Eastern exposition of the dams along the Upper-Tisza. Thus, the two hayfield associations described by MÁTHÉ and KOVÁCS (1960) can be found at the studied area above each other, in zonal arrangement. In their stands established close to one century ago, essentially more sepcies have developed during the course of the past decades at this dam section, than at the lower zone exposed to the selective effect of floods.

The cenosystematic analysis evidenced that here also the greatly accomodating Molinio-Arrhenatherea are the frequent representatives, both in respect to species

Table 4. *Pastinaco — Arrhenatheretum elatioris 1. pastinacetosum 2. arrhenatheretosum (typicum) 3. festucetosum rupicolae*

F	W	Sub-association:	1	2	3
		Helo-hygrophyta: *hhg1, 2*			
3—4	8	*Lysimachia nummularia* (Mol.-Juncetea)			
4	7	*Lathyrus pratensis* (Molinio-Arrhenatherea)			
4	8	*Angelica silvestris* (Molinio-Juncetea)			
		Hygrophyta: *hg1, 2, 3*			
3—4	7	*Carex hirta* (Molinio-Arrhenatherea)			
3—4	6	*Potentilla reptans* (Molinio-Arrhenatherea)			
4	9	*Calystegia sepium* (Calystegion)			
2—4	4	*Vicia cracca* (Molinio-Arrhenatherea)			
3—4	8	*Stenactis annua* (Calystegion)			
		Hygro-Fmesophyta: *hgm1*			
2—4	7	*Ranunculus acris* (Molinio—Arrhenatherea)			
3—4	8	*Galega officinalis* (Molinietalia)			
2—3	7	*Glechoma hederacea* (Molinio-Arrhenatherea)			
0	8	*Equisetum arvense* (Secalietea)			
		hgm2			
3—4	6	*Pastinaca sativa* ssp. *pratensis* (Molinio-Arrhenatherea)			
2—3	3	*Galium mollugo* (Molinio-Arrhenatherea)			
3—4	6	*Prunella vulgaris* (Plantaginetea)			
0	8	*Rubus caesius* (Salicetea)			
3		*Cuscuta europaea* (Calystegion)			
3—4	5	*Campanula patula* ssp. *neglecta* (Molinio-Arrhenatherea)			
		hgm3			
3	4	*Aristolochia clematitis* (Calystegion)			
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)			
2—3	5	*Rumex crispus* (Agropyro—Rumicion)			
		Mesophyta: *m1*			
0	6	*Trifolium repens* (Molinio-Arrhenatherea)			
0	5	*Lotus corniculatus* (Molinio-Arrhenatherea)			
0	4	*Rumex acetosa* (Molinio-Arrhenatherea)			
2—3	2	*Convolvulus arvensis* (Chenopodio-Scleranthea)			
0	3	*Taraxacum officinale* (Molinio-Arrhenatherea)			
2—3	5	*Centaurium erythraea* (Molinio-Arrhenatherea)			
2—3		*Centaurea jacea* (Molinio-Arrhenatherea)			
2—3		*Oxalis fontana* (Chenopodio-Scleranthra)			
2—3	6	*Knautia drymeia* (Fagetalia)			
3	6				
		m2			
3	5	*Arrhenatherum elatius* (Arrhenatherea)			
2—3	4	*Medicago sativa* (Festuco-Brometea)			
3	5	*Plantago media* (Molinio-Arrhenatherea)			
0	6	*Trifolium pratense* (Molinio-Arrhenatherea)			
0		*Verbascum blattaria* (Arrhenatherion)			
		m3			
0	5	*Daucus carota* (Arrhenatherion)			
2—3	3	*Agropyron repens* (Chenopodio-Scleranthea)			
2—3	4	*Silene alba* (Chenopodio-Scleranthea)			
		Dactylis glomerata (Molinio-Arrhenatherea)			

		Sub-association:	1	2	3
0	6	*Leontodon hispidus* ssp. *hastilis* (Molinio-Arrhenatherea)			
2—3	4	*Tanacetum vulgare* (Calystegion)			
3	4	*Setaria lutescens* (Agropyro-Rumicion)			
2—3	6	*Heracleum sphondylium* (Molinio-Arrhenatherea)			
2—3	4	*Stellaria graminea* (Molinio-Arrhenatherea)			
		Meso-xerophyta: *mx1*			
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)			
0	4	*Trifolium campestre* (Festuco-Brometea)			
2—3	3	*Silene vulgaris* (Molinio-Arrhenatherea)			
2—3	2	*Picris hieracioides* (Festuco-Bromea)			
2—3	4	*Tragopogon dubius* ssp. *major* (Festuco-Brometea)			
2—3	5	*Cerastium fontanum* ssp. *triviale* (Molinio-Arrhenathera)			
2—3	3	*Agrimonia eupatoria* (Festuco-Brometea)			
2	3	*Astragalus cicer* (Festucion rupicolae)			
2	3	*Vicia pisiformis* (Quercetalia)			
		mx2			
2	3	*Poa angustifolia* (Festuco-Bromea)			
1—2	3	*Coronilla varia* (Festuco-Brometea)			
2—3	4	*Plantago lanceolata* (Festuco-Bromea)			
1—2		*Cuscuta epithymum* (Festuco-Brometea)			
2	2	*Achillea collina* (Chenopodio-Scleranthea)			
1—4	3	*Pimpinella saxifraga* (Festuco-Bromea)			
1—2	3	*Erodium cicutarium* (Festuco-Bromea)			
2—3	5	*Astragalus glycyphyllus* (Querco-Fagea)			
2—3	3	*Carduus acanthoides* (Festuco-Brometea)			
2	3	*Echium vulgare* (Festuco-Brometea)			
		mx3			
2	1	*Festuca rupicola* (Festuco-Bromea)			
1—2	1	*Thymus serpyllum* (Festuco-Sedetalia)			
1—2	2	*Potentilla argentea* (Festuco-Bromea)			
2	3	*Fragaria viridis* (Festucetalia valesiacae)			
2—3	3	*Veronica teucrium* (Festucetalia valesiacae)			
1—2	2	*Trifolium arvense* (Festuco-Bromea)			
2—3	4	*Erigeron canadensis* (Chenopodio-Scleranthea)			
2	3	*Nonea pulla* (Festucion rupicolae)			
2	2	*Centaurea sadleriana* (Festucetalia valesiacae)			
2—3	3	*Viola hirta* v. *fraterna* (Festuco-Brometea)			
1—2	3	*Anchusa officinalis* (Chenopodietea)			
2—3	3	*Verbascum nigrum* (Quercetea)			
		Asteno-xerophyta: *ax1*			
1—2	3	*Medicago varia* (Festuco-Brometea)			
1	1	*Sedum sexangulare* (Festuco-Bromea)			
		Calamintha clinopodium (Cluerco Faged)			
2	2	*Centaurea micranthos* (Festucion vaginatae)			

number and covering quota. Progressing upwards along the dam-slope, the Festuco-Brometea and the Festuco-Bromea species, respectively, have become dominating. The Quercetea and Querco Fagetalia species at the gallery-forest zone stretching near the dam are frequently found in their cenoses, mostly in the form of blades. Such are the *Knautia drymea, Vicia pisiformis, Verbascum nigrum.* Due to the changes in the species composition taking place in their certain cenoses, three association-units could be separated.

2.1. *P.—A. pastinacetosum* (n. nov.)

This species is located at the lower section of this dam-meadow zone, showing a transition towards the zone of the previous association.

Cenological relations

The certain Molinio-Juncetea and Calystegion representatives frequently appearing in blades are characteristic. Their differential species are the *Vicia cracca, Ranunculus acris, Angelica silvestris.* This latter, being mainly a brook-shore, marsh-meadow species, would rather have been expected at the lower zone of the dam. It is assumed that the water covering of longer duration would be disadvantageous for this species. Certain Agropyro-Rumicion species, like the *Rorippa austriaca, Rumex crispus, Setaria lutescens* could also be found, although their total covering quota was not significant. Nevertheless, both concerning species number and covering quota, more important is the presecne of the Chenopodio-Scleranthea and Festuco-Brometea, still partly missing from the lower dam-zone. (Table 3).

Hydroecology

Since this sub-association is adjacent to the lower zone of the *Alopecuro-Arrhenatheretum* at the central zone of the dam-meadow, the total covering quota of the hygromesophyton representatives is significant. From the latter the *hgm1* and mainly the *hgm2* species are regarded as being frequent, like the *Ranunculus acris, Equisetum arvense,* the denominative *Pastinaca sativa* ssp. *pratensis* and the *Galium mollugo* (Fig. 7).

Table 3. *Comparative evaluation of the three sub-associations of the Pastinaco-Arrhenatheretum in respect to species number and covering quota*

	Species number			Covering quota		
	1	2	3	1	2	3
Molinio-Juncetea	2	.	.	3	.	.
Molinietalia	1	.	.	1	.	.
Arrhenatherion	2	1	1	35	50	25
Molinio-Arrhenatherea	25	16	13	45	31	18
Calystegion	5	3	3	7	4	2
Plantaginetea	1	1	.	0,5	3	.
Agropyro-Rumicion	3	.	1	2	.	1,5
Chenopodietea	.	.	1	.	.	0,5
Chenopodio-Scleranthea	4	3	5	10	7	15
Festucion rupicolae	.	1	1	.	0,5	0,5
Festucion vaginatae	.	.	1	.	.	2
Festuco-Brometea	5	5	8	4	8	15
Festuco-Bromea	.	3	10	.	7	34
Festuco-Sedetalia	.	.	1	.	.	3
Querco-Fagea, Quercetalia, Quercetea	3	2	2	5	1	1

Regarding moisture-demand the highest values were shown by the mesophyton components. Dividing the 75% total covering quota of the species of this category into subgroups, the following succession appeared: *m2*, *m1*, *m3*. Among the *m1*-s, the prominent species are the *Dactylis glomerata* and the *Trifolium repens* remaining from the halfculture period. The weeds occupying the sown but exterminated ones are the *Convolvulus arvensis, Taraxacum officinale,* etc. From the *m2*-s, the *Arrhena-*

Table 6. *Lolio-Plantaginetum majoris.*
1. plantaginetosum majoris 2. lolietosum perennis 3. portulacetosum

F	W	Sub-association:	1	2	3
		Helo-hygrophyta:			
		Hygrophyta:			
		hhg3, hg1			
3—4		*Rorippa sylvestris* (Agropyro-Rumicion)			
4	8	*Mentha pulegium* (Agropyro-Rumicion)			
		hg2, hg3			
4—5	8	*Ranunculus sardous* (Agropyro-Rumicion)			
3—4	6	*Potentilla reptans* (Agropyro-Rumicion)			
3	7	*Festuca pratensis* (Molinio-Arrhenatherea)			
		Hygro-mesophyta:			
		hgm1			
2—3	7	*Plantago major* (Plantaginetea)			
2—3	5	*Alopecurus pratensis*			
2—3	7	*Glechoma hederacea* (Molinio-Arrhenatherea)			
2—3	6	*Leontodon autumnalis* (Molinio-Arrhenatherea)			
		hgm2			
0	8	*Poa annua* (Chenopodio-Scleranthea)			
3—4	6	*Prunella vulgaris* (Plantaginetea)			
2—3	3	*Galium mollugo* (Molinio-Arrhenatherea)			
3—4	6	*Pastinaca sativa* (Molinio-Arrhenatherea)			
0	6	*Matricaria maritima* ssp. *inodora* (Chenopodio-Scleranthea)			
		hgm3			
2—3	5	*Stellaria media* (Chenopodio-Scleranthea)			
2—3		*Verbena officinalis* (Plantaginetea)			
3	6	*Eryngium planum* (Alopecurion pratensis)			
		Mesophyta:			
		m1			
0	5	*Trifolium repens* (Molinio-Arrhenatherea)			
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)			
2—3	5	*Centaurium erythraea* (Molinio-Arrhenatherea)			
2—4	4	*Rumex acetosa* (Molinio-Arrhenatherea)			
2—3	6	*Centaurea pannonica* (Molinio-Arrhenatherea)			
3—4	6	*Arctium lappa* (Plantaginetea)			
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)			
		m2			
2—3		*Lolium perenne* (Plantaginetea)			
0	6	*Trifolium pratense* (Molinio-Arrhenatherea)			
0		*Verbascum blattaria* (Arrhenatherion)			
3		*Solanum nigrum* (Chenopodio-Scleranthea)			
		m3			
0	5	*Daucus carota* (Molinio-Arrhenatherea)			
2—3	4	*Silene alba* (Chenopodio-Scleranthea)			
0	3	*Ballota nigra* (Chenopodio-Scleranthea)			
3		*Sisymbrium officinale* (Chenopodietea)			
		Meso-xerophyta:			
		mx1			
2—3	5	*Cerastium fontanum* ssp. *triviale* (Mol.-Arrhenatherea)			
2—4	6	*Medicago lupulina* (Molinio-Arrhenatherea)			

F	W	Sub-association:	1	2	3
2—3	4	*Polygonum aviculare* (Chenopodio-Scleranthea)			
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)			
2—3	5	*Silene vulgaris* (Molinio-Arrhenatherea)			
2		*Malva sylvestris* (Chenopodio-Scleranthea)			
2—3		*Lepidium ruderale* (Chenopodio-Scleranthea)			
2		*Xanthium spinosum* (Onopordion)			
		mx2			
0	4	*Lotus corniculatus* (Molinio-Arrhenatherea)			
2	3	*Poa angustifolia* (Festuco-Brometea)			
2—3		*Verbascum phlomoides* (Festuco-Bromea)			
3	4	*Plantago lanceolata* ssp. *sphaerostachya* (Festuco-Bromea)			
0	3	*Pimpinella saxifraga* (Festuco-Bromea)			
2	2	*Achillea collina* (Chenopodio-Scleranthea)			
1—2	3	*Coronilla varia* (Festuco-Brometea)			
1	2	*Eryngium campestre* (Chenopodio-Scleranthea)			
2—3	4	*Viola arvensis* (Secalietea)			
1—2		*Cuscuta epithymum* (Festuco-Brometea)			
		mx3			
2		*Portulaca oleracea* (Chenopodio-Scleranthea)			
1—2	3	*Erodium cicutarium* (Festuco-Bromea)			
2—3	4	*Erigeron canadensis* (Chenopodio-Scleranthea)			
2	3	*Fragaria viridis* (Festucetalia valesiacae)			
2—3	3	*Hypericum perforatum* (Festuco-Bromea)			
1—2	2	*Potentilla argentea* (Festuco-Bromea)			
2—3	3	*Carex praecox* (Festuco-Brometea)			
		Asteno-xerophyta: *ax1*			
1—2	3	*Medicago varia* (Festuco-Brometea)			
2	3	*Cynodon dactylon* (Chenopodio-Scleranthea)			
2		*Eragrostis minor* (Polygonion avicularis)			
0		*Atriplex tatarica* (Chenopodio-Scleranthea)			

therum elatius has by far an outstanding value; since for this species, the Northern-North-Western dam-slope provided favourable living conditions from bioclimatic point of view.

2.2. *P.—A. arrhenatheretosum* (typicum) n. nov.

From the 3 subunits of the association, this species is the most wide-spread at the studied area, occupying the middle zone of the dam-slope. Compared to the previous sub-association, its environmental-biological situation changed to a significans degree, both in regard to the cenosystematic affiliation of their species and the phytomass production. The continual aridity of the environs reduced the competitivenest of the more fastidious species to the benefit of those which are droughtresistant. Therefore, the Molinio-Juncetea components, together with the less adaptive Molinio-Arrhenatherea and the Calistegion representatives were missing from their phytocenoses. Due to this the total covering quota of the Festuco-Bromea species is significant, apart from the certain species of the Molinio-Arrhenatherea having wider ecological amplitude.

Their characteristic species are the *Rumex acetosa, Daucus carota, Prunella vulgaris*. The further data are observable from Table 5.

Table 5. *Evaluation of the subunits of the Lolio-Plantaginetum majoris regarding species number and covering quota.*

	Species number			Covering quota		
	1	2	3	1	2	3
Alopecurion pratensis	.	1	1	.	3	0,5
Plantaginetea	3	4	4	31	34	26
Arrhenatherion	.	1	1	.	1	0,5
Mol.-Arrhenatherea	12	14	11	38	23	19
Agropyro-Rumicion	4	4	.	16	4	.
Onopordion	.	.	1	.	.	0,5
Chenopodietea	.	1	.	.	1	.
Polygonion avicularis	.	.	1	.	.	1
Chenopodio-Scleranthea	3	4	.	7	5	.
Secalietea	.	.	1	.	.	1
Festuco-Brometea	.	3	4	.	13	10
Festuco-Bromea	3	3	6	3	2	9
Festucetalia valesiacae	.	1	1	.	1	2

Hydroecology

It showed significant variation from the previous cenosystematic subunit even on the basis of its curve showing its moisture-demand, since the helo-hygro- and hygrophyton species were already missing. The hygro-mesophyta also evidenced an enormous reduction in quota. Nevertheless, as expected, here too, the mesophyton representatives were the dominating ones. Comparing the culmination points of the hydroecological curves regarding the three sub-associations, the highest value was observable in the case of the *m2* subunit. This is partly the inheritance of the period from the half-culture condition, since the *Medicago sativa* also joined to the *Arrhenatherum* being present with high values (Fig. 4).

As the consequence of the continuous aridity of the site conditions, both in regard to species number and total covering quota, the *mx1* subunit species of the meso-xerophyta category became frequent in this dam-slope zone.

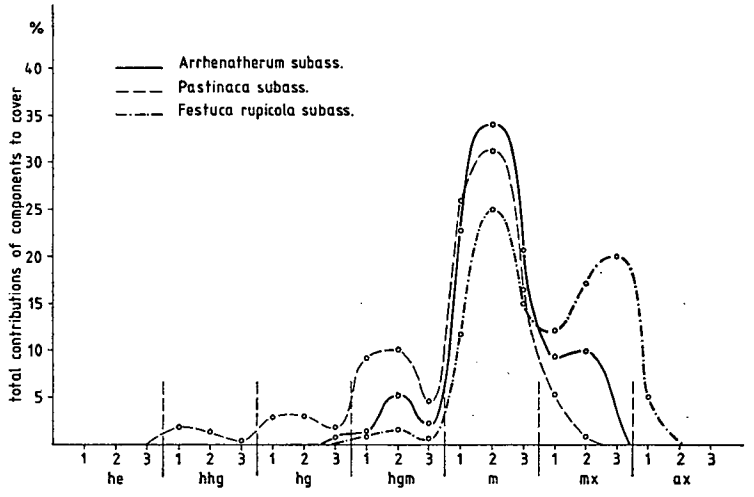

Fig. 4. The constructed comparative hydroecological curves of the three units of the association according to total covering quota.

2.3. *P.—A. festucetosum rupicolae* (n. nov.)

Despite the fact that such a dam-slope was chosen for study which directed at the water in North-Eastern-, Eastern, or South-Eastern position, drier environmental-biological relations developed at the dam-top zone, since the dammoisturing effect of the periodically appearing floods did not prevail at this zone. This explains why significant differences could be demonstrated compared to the zone of the plant stand found beneath (Table 4).

Hydroecology

Likewise, as it could be determined in the case of the typical stands, here too, those belonging to the helo-hygrophyta, hygrophyta category were missing and even the hygro-mesophyton species appeared only in blades. Analysing the mesophyta, no significant alteration could be demonstrated, neither in regard to those belonging to the *m1* or *m2* subunit — compared to the previous sub-associations. The greatest variation could be evidenced during the course of separating the species belonging to the meso-xerophyton category. Firstly the amount and covering quota of those belonging to the *mx3* subgroup increased. Further data are observable on Figure 4.

3. *Lolio—Plantaginetum majoris* (LINKOLA 21) BEGER 30
(Syn.: *Lolietum perennis* GAMS 27)

This species was formed in the lower zone of the outer side of the dam-slope, devoid of floods, mainly near settlements and water-guard houses. Its development was determined by two external factors; on one part, through the effectiveness of the favourable soil-moisture relations ensured by the Tisza water oozing through below the dam at the time of higher flood level, and on the other part on the effect of the grazing, treading and dunging of the small live stock reared by the population at the environs, as complex effect of zoogenic factor. Depending on the degree of effectiveness of these two external factors — to which further also joined, as for example, the physical and chemical composition of the soil — the species components of this grass stand may show significant variation. On this base, three association-units could be differentiated at this section of the dam.

3.1. *L.—P. plantaginetosum majoris* (n. nov.)

On the effect of enhanced treading of small live stock, such nitrophylic plant species became dominant, which are capable of accomodating against this influence, and are trailing on or adnating to the soil surface. Such are the *Plantago major Potentilla reptans, Trifolium repens, Medicago lupulina, Polygonum aviculare, Erodium cicutarium,* etc. The high value of the covering quota of the *Plantago major* demonstrable at places was reached by the fact that the species suppressed others within its environment by means of its effusing leaves.

Differential species: *Rorippa silvestris, Poa annua, Mentha pulegium.*

Cenological relations

The Molinio-Arrhenatherea components capable of accomodating to the local conditions, are the dominant species both regarding species number and total covering quota. The Plantaginetea and the joining Agropyro-Rumicion species have lower species number, but are of dominant character. The Chenopodio-Scleranthea and the Festuco-Bromea representatives have subordinate role (Table 6).

Hydroecology

Since the lower zone of the dam becomes damp periodically even at the protected side, certain species, like the *Rorippa sylvestris, Mentha pulegium, Ranunculus sardous, Potentilla reptans,* — belonging to the helo-hygrophyton and hygrophyton category, — may show more significant covering quota. The *Plantago major* of the *hgm1* subunit was nevertheless dominant.

Analysing the distribution of the species belonging to the certain categories and sub-groups, respectively, on the basis of their total covering quota, by drawing the obtained hydroecological curves, it could be seen that these species have four smaller-larger culmination points. The highest value, which at the same time is also the characteristic of the sub-association, was found in the case of the *hgm1* subunit. The values of the *m* category are still regarded as being subordinate (Fig. 3).

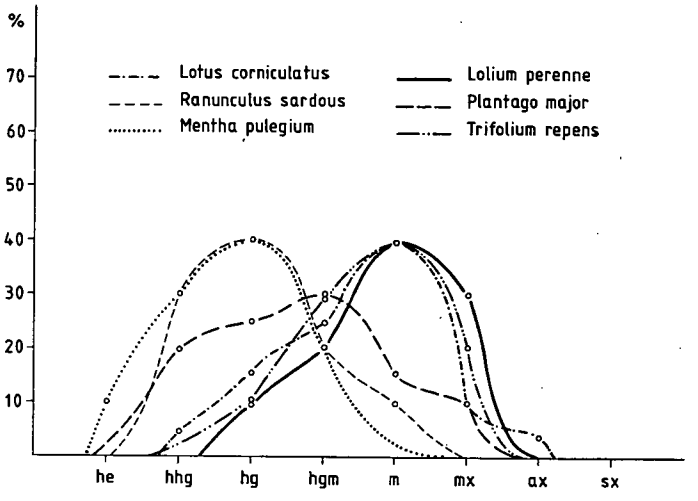

Fig.5. The comparative hydroecological curves of the characteristic species of the *Lolio-Plantaginetum.*

3.2. *L.—P. lolietosum perennis* (typicum) n. nov.

This species appeared at the lower section of the protected side of the dams at the Northern Lowland, when this zone was located somewhat farther from the inhabited areas than the previous; therefore the zoogenic effect showed a slight decrease. At the same time the effect of the soil moisture prevailed further on. It presumably developed from the grass stand of the previous association. The results of the analysis regarding their species combination refer to this.

Cenological relations

Even here, the Molinio-Arrhenatherea species are the dominant, at the same time, the Plantaginetea elements have leading role in respect to the total covering quota. Even so, the Festuco-Brometea species are still competitive under the environmental-biological circumstances manifested here, and their total covering quota is significant, as was experienced in the case of, e.g. the *Poa angustifolia.*

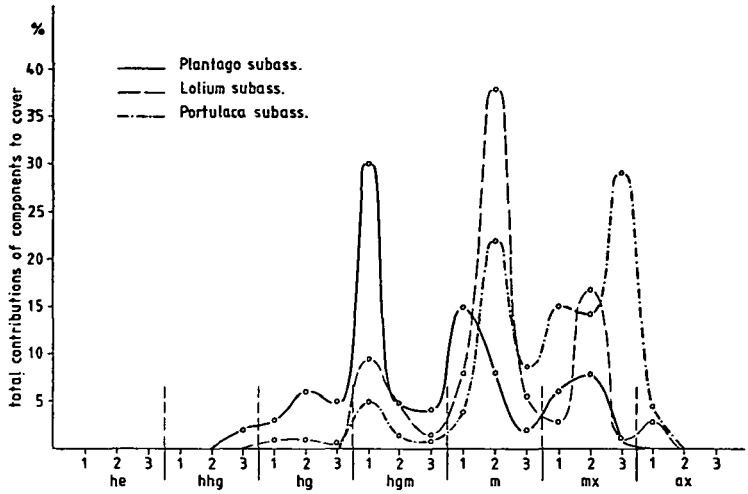

Fig. 6. Distribution according to total covering quota of the three subunits of the association.

Hydroecology

Compared to the previous sub-association, the highest values of the total covering quota were determined at the *hgm1* subunit; a decrease to 1/3 was observed in the case of this stand. Therefore, this can be regarded as a typically mesophyton association, since the culmination point of its hydroecological curve can be found at the *m2* (Fig. 6). This presented itself firstly from the dominating role of the *Lolium perenne*. However, depending on the rate at which the number of the species demanding moisture increased, a close to similar increase was found in the covering of the meso-xerophyta, first of all, in the case of the *mx2*-s. Nevertheless, a few representatives which could be regarded as being asteno-xerophyta were also detectable, firstly the consolidated hybrid, the *Medicago varia* of *ax1* nature, which became general at the sand-soils poor in lime-carbonate found at the Nyir in Northern Hungary.

3.3. *L.—P. portulacetosum oleraceae* (n. nov.)

At those areas of the Hungarian Northern Lowlands, where the dams are contiguous with chernozem-like sandy-soils, is the area where this sub-association developed at certain sections of the dam-slopes. Its development, however, is not only observable exclusively along the dams, since it can also be found the flood-plain pastures of higher relief.

Cenological relations

Their differential species determined during the course of the cenosystematic analysis were those from the Chenopodio-Scleranthea, like the *Portulaca oleracea* and the *Erigeron canadensis*.

Hydroecology

The site relations of this species are essentially drier than those of the previous sub-association. This is reflected by the distribution according to subunits of the speci-

es components within the certain categories. On the basis of the curve drawn regarding the total covering quota, it can well be seen that the hygrophyton representatives are completely missing; but minimal covering was also observed in the case of the hygromexophyta. From the mesophyta, the *Lolium perenne* belonging to the *m2* group also had a leading role here, due to its wide hydroecological adaptability. The highest peak of the curve was found at the line of the *mx3* subunit, firstly by means of the total covering of the *Portulaca oleracea* and the *Erigeron canadensis, Erodium cicutarium.* From the astenoxerophyton species the *ax1*-like *Medicago varia* did not show considerable expansion. In the case of more enhanced zoogenic utilization, however, the *Cynodon dactylon* also belonging to the *ax1* unit grew here at places and could also be regarded as facies component.

4. *Salvio nemorosae — Festucetum rupicolae* ZÓLYOMI 58 corr. Soó 64

This species appeared at the flood-free slopes of the dams along the Upper-Tisza in case the slope was of Southern- South-Western exposition. On the effect of enhanced and long-lasting insolation, both the bioclimate of the slope and the moisture supply of the soil showed significant variations, contrary to the similar relations of the opposite side. As the consequence of this, gradual transformation was observable regarding the grass stand sown earlier to prevent the damage in the erosion of the new dam; since the species components of this culture-grass stand, e.g. the *Arrhenatherum elatius, Dactylis glomerata, Poa pratensis, Bromus inermis, Medicago sativa,* etc. could not be competetive against the penetrating more drought-resistent plant species besides the environmental-biological relations developing at this area. This is how centuries ago, the cenoses of rather poor species composition, the *Salvio-Festucetum rupicolae tibiscense* ZÓLYOMI 58 developed; the speciesrelated to the hill-counttry and hechernozem inapl-grass of loes origin.

Cenological relations

During the course of the more thorough studying of this damslope zone, subassociations and facies of differing species composition could also be differentiated in the case of this grass association.

4.1. *S.—F. festucetosum rupicolae* (typicum)

This species occupied the lower and at the same time wider zone of the damslope being of Southern-, South-Western exposition. This was no longer two-levelled, the sinuosity of the grass blades was missing and its stand was not always terminated. The variation was striking when comparing this species with the grass developing on the effect of the similar site relations found at the Hungarian Central and Lower Tisza region where this association is missing, and the various association-units of the *Cynodonto-Poëtum angustifoliae* are the wide-spread. The spontaneous settling and expansion of the *Festuca rupicola* may firstly be the result of the climatic effect of mountain character of the nearby highlands.

Cenological relations

The Festuco-Bromea are the most dominating species, both in regard to species number and covering quota. Therefore, the Molinio-Arrhenatherea elements are only represented by a few species. Their numerical distribution is demonstrated on Tables 7 and 8.

Table 7. *Salvio—Festucetum rupicolae.*
1. Daucus fac. 2. festucetosum rupicolae 3. Medicago varia fac. 4. poëtosum angustifoliae

F	W	Sub-association:	1	2	3	4
		Hygrophyton, Hygro-mesophyta: *hg3, hgm2, 3*				
3—4	8	*Stenactis annua* (Calystegion)				
0	8	*Rubus caesius* (Salicetea)				
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)				
		Mesophyta: *m1, 2*				
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)				
0	4	*Cirsium arvense* (Chenopodio-Scleranthea)				
2—3	4	*Medicago sativa* (Festuco-Bromea)				
0	5	*Daucus carota* (Molinio-Arrhenatherea)				
2—3	4	*Tragopogon orientale* (Molinio-Arrhenatherea)				
2—3	4	*Silene alba* (Chenopodio-Scleranthea)				
3	4	*Setaria lutescens* (Agropyro-Rumicion)				
		Meso-xerophyta: *mx1*				
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)				
		mx2				
2	3	*Poa angustifolia* (Festuco-Bromea)				
2—3	4	*Plantago lanceolata* (Festuco-Bromea)				
2	2	*Achillea collina* (Chenopodio-Scleranthea)				
2	3	*Nonea pulla* (Festucion rupicolae)				
		mx3				
2	1	*Festuca rupicola* (Festuco-Bromea)				
2—3	4	*Erigeron canadensis* (Chenopodio-Scleranthea)				
1—2	3	*Euphorbia cyparissias* (Festuco-Brometea)				
2—3	3	*Crepis rhoeadifolia* (Festuco-Brometea)				
2—3	1	*Hieracium pilosella* (Festuco-Bromea)				
1—2	2	*Potentilla argentea* (Festuco-Bromea)				
1—2	2	*Trifolium arvense* (Festuco-Bromea)				
2		*Tunica prolifera* (Festuco-Bromea)				
2	3	*Fragaria viridis* (Festucetalia valesiacae)				
		Asteno-xerophyta: *ax1, 3*				
1—2	3	*Medicago varia* (Festuco-Brometea)				
1	1	*Sedum sexangulare* (Festuco-Bromea)				
		Steno-xerophyton: *sx1*				
1	0	*Sedum acre* (Festuco—Bromea)				

Hydroecology

The majority of the species components of the *S.—F. festucetosum rupicolae* which can be regarded as being typical, can be grouped into the *mx3* subunit of the meso-xerophyton category. The culmination point of the hydroecological curve drawn for this species reached and even surpassed the value of 50%, respectively (Fig. 7). Regarding its total covering quota, it reached an extremely high peak — close to a value of 70% — at the *mx3* subunit line. At the same time, neither the presence of the mesophyton, nor that of the asteno-xerophyton can be regarded as considerable.

4.1.1. *S.—F. festucetosum Daucus* facies

From cenosystematic point of view, it could be determined that the *Daucus carota* having wide ecological adaptability expanded at places (Fig. 7).

4.2. *S.-F. poëtosum angustifoliae*

At the upper zone of the dam-slope prevented from floods the environmental-biological, firstly the soil-moisture supply, and the bioclimate relations, are more unfavourable than at the zone underneath.

Cenological relations

The differential species of the sub-association were composed of certain Festuco-Bromea representatives. Such are the *Medicago varia, Sedum sexangulare, S. acre.* Regarding the mass relations of the denominating *Poa angustifolia,* this species outrivaled the *Festuca rupicola.* Both belonged to the mentioned cenosystematic unit.

Table 8. *Evaluation of the four subunits of the association according to species number and covering quota.*

	Species number				Covering quota			
	1	7	3	4	1	2	3	4
Molinio-Arrhenatherea	2	2	3	2	16	7	3	4
Calystegion	1	.	.	.	1	.	.	.
Agropyro-Rumicion	2	.	.	1	2	.	.	3
Chenopodio-Scleranthea	4	4	4	5	15	16	14	16
Festucetalia valesiacae	.	1	.	.	.	1	.	.
Festuco-Brometea	.	1	1	3	.	5	15	12
Festuco-Bromea	4	8	12	8	81	41	60	65
Salicetea	1	.	.	.	1	.	.	.

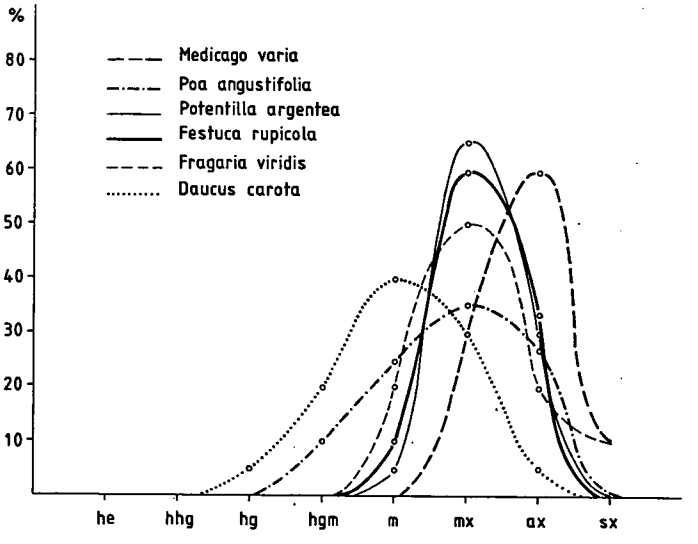

Fig. 7. The hydroecological curves of the more important six species of the *Salvio-Festucetum.*

Hydroecology

From the species components of the stand, the total covering quota of those belonging to the mesophyton category, was found to be similar to the values of the previous sub-association. The meso-xerophyta were found distributed on the *mx2* and *mx3* subunit lines. The *Poa angustifolia* had the leading role in the case of the *mx2* subunit, and the *Festuca rupicola* in the case of the *mx3*. Although reverse order would have been expected, the *Poa angustifolia* was found to have an extremely wide adaptability. This is also shown by its drawn hydroecological curve (Fig. 7), where the minimal points are found at the *hg* and *sx* categories. Division into at least two ecotypes would be reasonable on this base, since regarding the appearance of this species, it can be found just the same at the river-side marshy-meadows, as at the areas of dry quick ground. Further details are observable on Figure 8.

4.2.1. *F.-S. poëtosum angustifoliae Medicago varia* fac.

This facies-forming species appearing in masses formed a zone along the driest upper section (dam-top) of the damslope. Dam sections containing higher sand fractions are frequent at the areas of the Nyir in North-Eastern Hungary, at which region

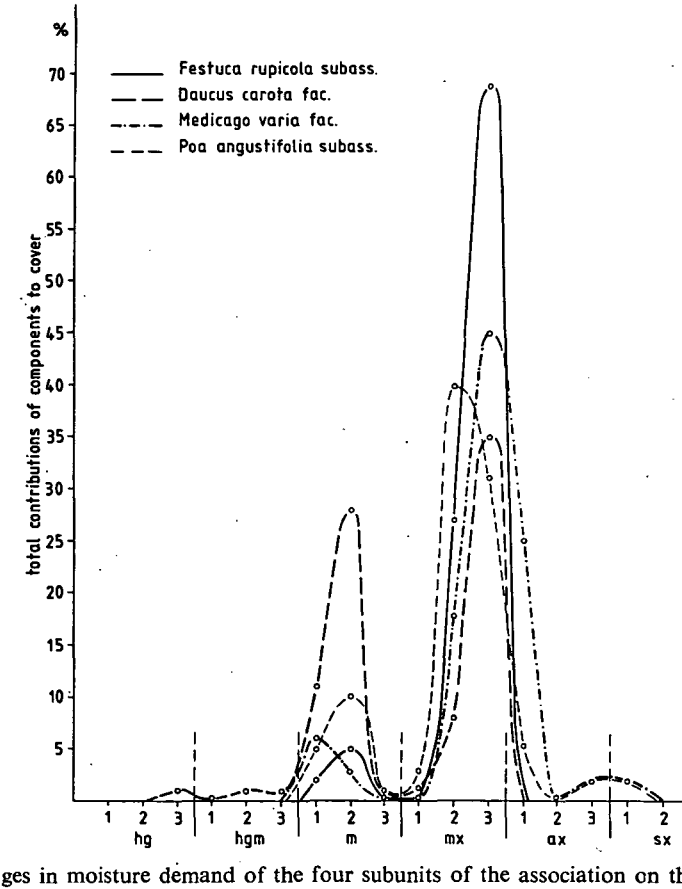

Fig. 8. Changes in moisture demand of the four subunits of the association on the basis of their total covering quota.

the representatives of this Festuco-Bromea species found favourable living conditions for themselves. The *Sedum sexangulare* and the *S. acre* belonging to the same cenosystematic unit were also found in this ame stand.

Hydroecology

This facies-forming *Medicago varia* is such an asteno-xerophyton species which can be grouped into the *ax1* subunit, but may also show transition towards the *mx3* (Fig. 7). At the same time, in its grass stand — just the same as in the zone found below — certain deeply rooted species, like the *Convolvulus arvensis, Cirsium arvense, Tragopogon orientale, Silene alba,* and the feral *Medicago sativa* remaining after plantation even during the course of several decades, are also detectable in this cenosis. From the viewpoint of moisture demand, however, the leading role is still played by the *Festuca rupicol,* belonging to the *mx3* subunit.

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A Felső-Tisza menti árvédelmi töltések gyeptársulásainak hydroökológiája

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Kivonat

A terület védtöltésein a közel egy évszázaddal ezelőtt vetés útján kialakított gyepállományok nagymértékben megváltoztak. Zonális elrendeződésüket a gyakori de rövid ideig tartó árhullámok és a töltéslejtők expozíciója szabta meg. Az egyes állományok összetétele eltér a dél-tiszavölgyiekétől.

1. *Alopecuro-Arrhenatheretum* az északi-, északkeleti töltéslejtő alsó zónájában az ismétlődő árvizek hatására alakult ki. Uralkodók a helo-hygrophyton és hygrophyton képviselők.

2. *Pastinaco-Arrhenatheretum* a töltéslejtő felső zónájában három szubasszociációja volt elkülöníthető s a hygro-mesophyton kategória különböző alegységeibe tartozó fajok jelentkeztek.

3. *Lolio-Plantaginetum* a védtöltés nyugati-délnyugati árvizektől mentett alsó zónájában, fokozott zoogén hatásra alakult ki.

4. *Salvio-Festucetum rupicolae* a mentett töltéslejtő középső- és felső zónájában négy szubasszociációra volt különíthető. Fajkomponensei már meso-xerophyton képviselők voltak.

Гидроэкология травянистых сообществ защитных дамб вдоль верхнего течения Тисы

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Резюме

Состав сформировавшегося около ста лет назад путём посева травостоя на территории защитных дамб сильно изменился. Его зональное распределение определилось частыми, но краткими наводнениями и склоном дамб. Состав отдельных травостоев отличается от характерного для южно-тисайской долины.

1. Alopecuro-Arrhenatheretum сформировался в нижней зоне северного и северно-вос-

точного склона дамб под влиянием повторных наводнений. Преобладают гело-гидрофитонные и гидрофитонные представители.

2. Pastinaco-Arrhenatheretum выделялся в трёх субассоциациях в верхней зоне склона дамб и был представлен видами, относящимися к различным подразделениям гидро-мезофитной категории.

3. Lolio-Plantaginetum сформировался в нижней, защищённой от наводнений зоне западных и юго-западных склонов под усиленным зоогенным влиянием.

4. Salvio-Festucetum rupicolae можно было выделить в четырёх субассоциациях в защищённой средней и высшей зоне склонов. Компонентами видов являются уже мезо-ксерофитные представители.

Hidroekologija travnatih zajednica na nasipima gornjeg toka reke Tise

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Abstrakt

Travnate zajednice kultivisane na nasipima pre skoro jednog veka, značajno su se izmenile. Zonalni raspored je odredjen čestim i kratkotrajnim plavljenjima, kao i ekspozicijom stranica nasipa. Sastav pojedinih zajednica se razlikuje od onih u južnom toku reke.

1. Pod uticajem ponovljenih plavljenja *Alopecuro-Arrhenatheretum* zajednice su se razvile u donjoj zoni severo- i severoistočnih padina nasipa, sa dominacijom helo-hygrophyton i hygrophyton elemenata.

2. U gornjoj zoni padine nasipa moguće je razdvojiti tri subasocijacije *Pastinaco-Arrhenatheretum* zajednice, pri čemu u kategoriji hygro-mesophyton se javljaju vrste pripadnici različitih nižih jedinica.

3. *Lolio-Plantaginetum* zajenica je nastala pod zoogenim uticajem u donjoj neplavljenoj zoni nasipa, sa zapadnom i jugozapadnom ekspozicijom.

4. U središnjoj i gornjoj zoni neplavljenog dela nasipa izdvajaju se četiri subasocijacije *Salvio-Festucetum* zajednice, već sa meso-xerophyton vrstama.