

## EFFECT OF LASTING FLOODS ON THE SPECIES COMPOSITION AND ORGANIC-MATTER PRODUCTION OF THE MARSHY MEADOW-LANDS IN THE FLOODPLAINS OF THE TISZA

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### Abstract

In the grass-lands of floodplains enclosed between the levees of the Tisza, two associations may be separated. In the sections on higher levels *Lythro (virgatae)-Alopecuretum pratensis* BODROGK. 77 is dominant and in those on lower levels *Carici (melanostachyae)-Alopecuretum pratensis* SOÓ 71, showing a transition towards the flood-plain Magnocaricio. As a result of the lasting water-covering, the meadow association, composed by species components that require hygro-mesophilic environmental essential conditions, changes into a flood-plain grass-land of helo-hygrophilous character. In the years free from lasting flood-waves, the regeneration of *Lythro-Alopecuretum* begins. As an intermediary stage, a meadow overgrown with weeds develops. The development of this can be hastened by the missing of regular mowings. Consequently, the seeds of *Glycyrrhiza echinata*, *Lythrum salicaria*, *Iris pseudacorus*, *Glyceria maxima* and of other species will be spread by the floods. Their fast multiplication prevents, therefore, the spread of *Alopecurus pratensis*.

By the six years long systematical investigations an answer was given to the dominance relations, organic-matter productions of the species components of both meadow-associations, as well as to the change in the proportions of the living and dead matters.

The flood-plain of the Tisza is regularly covered by the spring flood-waves. Flood-free years rarely occur. Depth and lastingness of floods are, however, changing. And the local climatic conditions during floods are also different. As a result of these, the water covering of the vegetation may grow considerably warmer or colder and the species-selecting effect of flood may weaken or intensify.

In case of a lasting water-covering, the species-composition of the associations of the marshy meadow-lands, their phytomass production and zonation system change. The meso-hygrophytic species will be replaced by helophytic components. We wanted, on the way of our investigations, performed for several years, to obtain an answer to the qualitative and quantitative degrees of the changes in phytocoenoses taking place as a result of the lasting water-covered period, following the effect of floodwave-free or short-lasting inundations of shallow water-height.

### Materials and Methods

The investigations began in 1972. There has proved to be the most suitable for this purpose a contiguous marshy meadow-land of several ha extension on the island Körtvélyes, taking place in the Tisza Nature Conservation District at Mártély, being the least disturbed by civilization effects.

Our observations which included the changes in the conditions of associations and the organic-matter production of the constant designated stands and in the hydrographic conditions of their habitats, as well as the clearing up of their physical and chemical characteristics, were repeated in the course of the growing period yearly more than once.

For the sake of keeping track of the changes, taking place as a result of the overground quantitative distribution of the phytomass and the abiotic effect of this, the cut organic matter was first selected into living and dead components and then the living material into species. After being dried, it was weighed in air-dried state. For determining the quantity of root-production, monolith was taken out from the soil of stands till 20, cm depth, in 5, resp. 10 cms.

The moisture-content of the soil was established for ml/cubic dm soil, and in the dry-weight percentage of the soil, and the total salt content on the basis of its electrical conductivity.

### **Terrain conditions of the marshy meadow-lands in the experimental area**

Before building up the levees of the Tisza, the water mass of the melting snow from the Northern and Eastern Carpathians, the Central Range of Mountains, and the Northern Great Hungarian Plain had brought about extensive but shallow inundations in the deeper situated areas of our Southern Plain (ANDÓ & VÁGÁS 1973). Consequently, the face of the landscape in that time was primarily characterized by a uliginous vegetation and helophytic gallery forests.

As a result of the levees built and raised higher and higher in the course of Centuries XVIII and XIX, the inundation areas outside the levees and the flood-plains within these sharply separate from each other, in respect both of the vegetation and the hydrographical conditions. (BODROGKÖZY 1961, 1962, 1967; BODROGKÖZY-HORVÁTH 1972, HORVÁTH-BODROGKÖZY 1977.) In the flood-plains, the water mass of the spring and early-summer flood-waves can namely be as high as 3 to 4 m, as well. In the area of our investigations, e.g. in 1974, the water-covering was as high as this, for some months long. This had a devastating influence on the phytocoenoses of meso-hygrophilous character which had developed here, and in the years following the flood, a change of associative value took place in the vegetation.

In the flood-plain of Körtvélyes island considerable relief differences took shape. These partly are old riverbed-remains filled up, partly depressions brought about by the current of water, taking part as smaller or larger areas of stagnant waters. The soil of the area is an alluvial soil, prevented in its development by the accumulation of the silt and clay fractions, regularly and uninterruptedly transported by the flood-waves.

Containing no, or only very little, calcium-carbonate, it may be considered as an alluvial soil of acid or neutral reaction. In the area of stagnant waters, in the rooting zone, the accumulation of harmful sodium salts can here and there be demonstrated and can even reach 0.1 percent. This value is to be regarded as the lower limit of sodification (BALLENEGGER 1953).

The appearance of hydrogen sulphide, left behind after floods, getting warm in the summer season, and being formed in the course of the decomposition of the dead matter of vegetation may have a harmful effect on the composition of species components of the meadow-associations. Its presence can be ascertained already on the site by the opaline colour and characteristic smell of water.

### **Zonation of the plant-associations of the area**

The deepest zone of the meadow plant-associations on Körtvélyes island is to be found in the dried-out dead-arms or at the side of those.

The species components of *Potamogeton lucentis* Hueck 31 can accommodate

themselves well to the drying-up summer season, too. The pioneer plant-association of the riverside zone is *Polygono (amphibio)-Bolboschoenetum* BODROGK. 62, indicating a soil becoming more and more saline and turning into the stands of *Scirpo-Phragmitetum* W. KOCH 26. It contains large numbers of *Schoenoplectus lacustris*.

In the deep-lying areas of the island flood-plains with stagnant waters *Caricetum gracilis* Almquist 29, *Carici-Typhoidetum* Soó 71 and, in a smaller degree, *Glycerietum maximae* HUECK 31 predominate. Their spreading in years with lasting floods is more considerable and are connected together by several sub-association units.

In areas with boar-rootings, as a result of the intensive devastation, mud-vegetation: *Cypero-Juncetum* Soó et CsÜRÖS 44 occurs. The latter one is the dominant weed-association of the flood-plain plough-lands abandoned in the years with lasting floods.

In the higher situated areas of the flood-plain, among which the above mentioned marshy ecosystems, marshy meadows are mosaic-like wedged in, become dominant. Their species composition shows considerable differences, depending upon the degree and length of time of the water covering. In flood-free years or in those with short-term floods, *Lythro (virgatae)-Alopecuretum* BODROGK. 1977 predominates. After the formation of lasting flood-waves, mainly in years with many floods, *Carici (melanostachiae)-Alopecuretum* Soó 71, showing a transition to the Magnocaricion representatives of the marshy ecosystems of the flood-plain, takes over leadership.

#### Comparative investigations performed in the stands of *Lythro-Alopecuretum*, in case of different water-coverings

We have systematically investigated into the changes in the species combinations and organic-matter production of this marshy meadow, since 1972. For control, there are chosen from among the flood-free years or those with floods of short duration, the conditions in 1972 (Fig. 1).

Investigating into the state of the period in early June, immediately before mowing-time, it could be established that, in respect of its participation in covering, *Alopecurus pratensis* was dominant and showed, together with *Agropyron repens*, 80 percent participation in the total covering. In our area, the characteristic species of this association are — apart from the meadow foxtail — *Agropyron repens*, *Lythrum virgatum*, *Thalictrum flavum*, *Euphorbia lucida*.

In respect of their organic-matter production, in July, 86 percent of the total overground organic-matter production of the two dominating species was living matter. 82 percent of their root production takes place in the upper 5 cm layer of the soil.

The species composition of the association, the participation of the components in covering and the extent of their phytomass production show connection primarily with the hydrographical conditions of the habitat.

On the basis of the change in the moisture content of their soil, after flood-free periods or those with short-time water-coverings, here the hygromesophilous habitat relations are characteristic.

The autumn aspect was first investigated in September 1970. As compared with the summer states, there were considerable differences both in species composition and in the distribution of production. Its two characteristic species, *Glycyrrhiza echinata* and *Lythrum virgatum* took part in 43 percent of the total production of phytomass. Their dominating role is still more remarkable if we take into consideration their participation in covering. After the withdrawal of species which can be observed in the course of the Autumn, their sudden advance is still more increased.

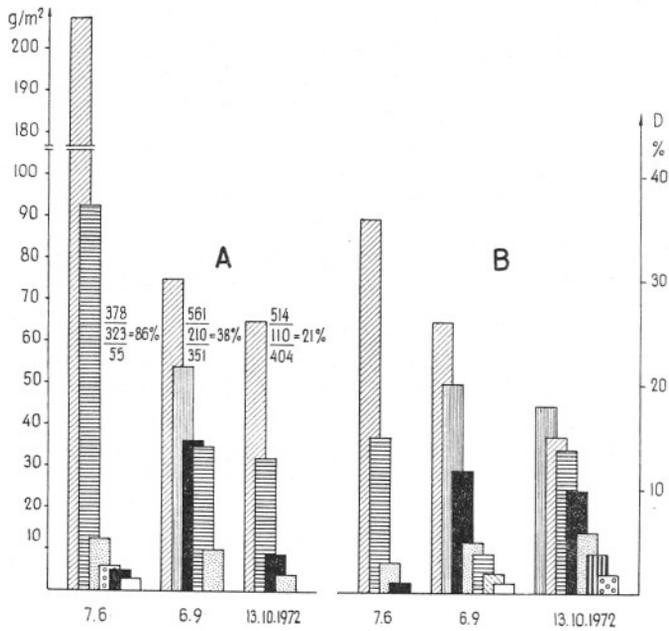


Fig. 1

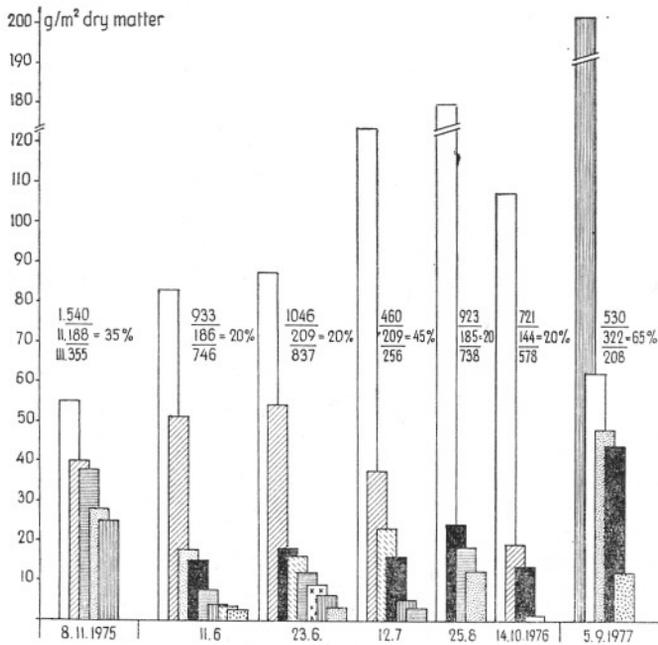


Fig. 2

The least change was shown by *Potentilla reptans* in the course of the growing season.

The ratio of the dead matter in the phytomass of the *Lythro-Alopecuretum* stands became in the course of the summer months six times as high as before. The flood-waves of the years between 1972 and 1977 are summarized in Fig. 2.

### Effect of the lasting water-covering

In the Spring of 1974, our experimental area was covered by the longest-lasting flood-wave. The stands of the original *Lythro-Alopecuretum* became devastated almost entirely. And after the flood had passed, no stagnant water was left behind either in the observed area or in areas at similar levels. The regeneration of association could only begin at the end of Summer and the total covering was as high as 10 percent only at the end of September. From among the five species to be found, leadership belongs to *Glycyrrhiza echinata*. From among the *Lythrum* species, a few individuals of *Potentilla reptans* could only be observed. Adventitious species are *Carex melanostachya* and *Juncus compressus*. The covering-conditions of the stand are summarized from the Autumn of 1974 to the Autumn of 1977 in Fig. 3.

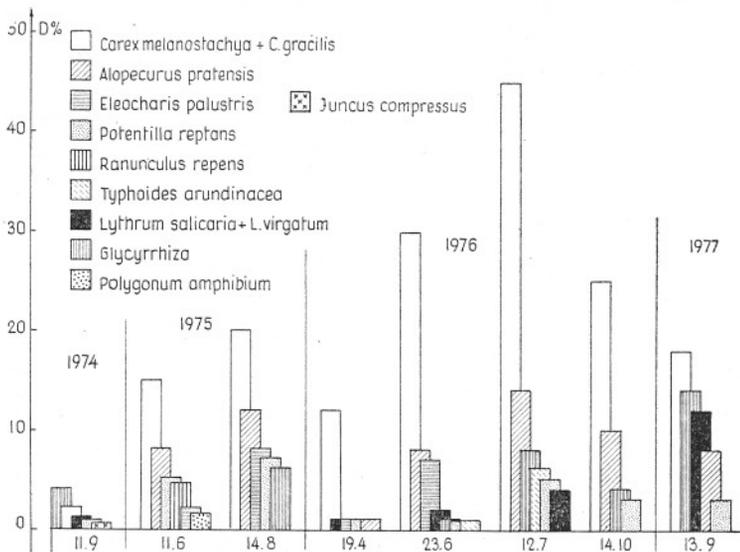


Fig. 3

In the growing season of the next year, our area was not touched by any lasting flood-wave (Fig. 2), the spreading of the species components of the marshy meadowland in the flood-plain therefore intensified. At any rate, within this the distribution of species, living and dead matters and the participation of these in covering showed a considerable change. In this way, *Carici (melanostachyae)-Alopecuretum* came about, forming a transition towards *Magnocaricion* in the flood-plain.

In spite of that the omission of the lasting water-covering is equally favourable for certain hygro-mesophilous species, like *Alopecurus pratensis*, *Ranunculus repens*, both in the spring and summer aspects, the helo-hygrophylous *Carex melanostachya* and *C. gracilis* have together reached even 20 percent D-value.

In the phytomass production of the developed phytocoenoses, the meadow foxtail has got, besides the Cyperaceae, the second place. *Glycyrrhiza echinata* is less sensitive to the damaging effect of a lasting water-covering. Its overground organic-matter production is therefore considerable.

The conditions of the growing period 1976 was investigated on four occasions, because the degree of the water-covering of the spring flood-wave was of high value and of shorter period. Its effect was the most striking in the spring period. Then the two *Carex* species suffered the least damage. On the other hand, the D-value of the other components was still insignificant (Fig. 3).

In the summer season, June and July, the habitat conditions were the most favourable for *Carex melanostachya* and *C. gracilis* and achieved even a covering participation over 40 percent. The spreading of *Alopecurus* did not show any major difference as compared with the similar period of the preceding year.

It was repeatedly proved that the increased covering participation of *Glycyrrhiza echinata* always falls on the late summer period. To know this may be important mainly for the practice. From among the *Lythrum* species, *L. salicaria* is the dominant one and *L. virgatum* only occurs one by one.

In the autumn aspect, the total covering of the species components, and partly also the productivity of species, decrease.

In 1977, in the Körtvélyes reaches of the Tisza, as well, the lasting water-covering, as the main environmental ecological factor of the flood-plain ecosystems, was missing. Consequently, in the marshy meadow-land zone of the investigated area, the hygromesophilous species have again come into prominence. As, however, the spreading of *Alopecurus pratensis* was of lower tempo than expected, the regeneration of the species components of *Lythro-Alopecuretum* took place in a longer time. The quality of hay to be expected in the hayland was, namely, so much vitiated by becoming sedgy as a result of the lasting water-covering in the previous second year that the regular mowing and mainly the cutting of the second crop were omitted. It may be due to this that the husks of some "weed species" of the flood-plain, first of all those of *Glycyrrhiza* and large numbers of the *Lythrum salicaria* seeds were spread uniformly in the area by the floods. In this way, the area left free by the *Carex* species, already driven back for the Autumn of 1977, and *Alopecurus*, not having yet a suitable spreading in that time, was occupied by these species. With this can be explained the high participation of *Glycyrrhiza*, *Lythrum* and *Polygonum amphibium* in the total phytomass production (Fig. 3).

### Practical relations of the results of investigation

It is a known fact that, as a result of the river barrages built in the Tisza successively, the water surface of the river-bed considerably increases. Consequently, the flood-plains get under a lasting water-covering more frequently. In the first place, the here and there extensive flood-plain grass-lands are mostly affected by the changing environmental effect.

The hayfields with speargrass and *Lythrum* have so far produced hay of acceptable quality and their cultivation has been profitable for the stock-breeding farmsteads. In the future, as a result of the more and more frequently returning lasting flood-waves, these hayfields will expectably become inferior in quality. Owing to the spreading of sedge species and other "weed species" requiring plenty of water, in

these flood-plain stretches sour hay will grow, unsuitable for foraging purposes. The multiplication of water mannagrass (*Glyceria maxima*), yellow iris (*Iris pseudocorus*), reed-grass (*Typhoides arundinacea*), wolf's milk (*Euphorbia lucida*) but mainly of *Glycyrrhiza echinata* and *Lythrum salicaria* is also to be expected.

The considerable loss owing to the deterioration of grass-lands can be reduced by draining the remained stagnant waters immediately and it can even be prevented by planning and carrying out canalizing systems for draining water.

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### Tartós áradás hatása a Tisza hullámtéri mocsárrétek fajösszetételére és szervesanyag produkciójára

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#### Kivonat

A Tisza árvédelmi töltései közé szorított hullámtéri kaszálókon két asszociáció különíthető el. A magasabb térszínű szakaszokon a *Lythro (virgatae)-Alopecuretum pratensis* BODROGK. 77 és az alacsonyabb térszínű szakaszokat uraló s a hullámtéri Magnocaricio felé átmenetet mutató *Carici (melanostachyae)-Alopecuretum pratensis* Soó 71. Tartós vízborítás hatására a hygro-mesophil környezeti életfeltételeket igénylő fajkomponensek alkotta réttársulás helohyrophil jellegű hullámtéri kaszálóvá alakul át. Tartós árhullámoktól mentes esztendőkből megindul a *Lythro-Alopecuretum* regenerálódása. Közbeeső stádiumként elgyomosodott rét alakul ki. Kialakulását a rendszeres kaszálás elmaradása gyorsíthatja. Ennek következtében a *Glycyrrhiza echinata*, *Lythrum salicaria*, *Iris pseudocorus*, *Glyceria maxima* és más fajok magvait az áradások szétterítik ezáltal gyors elszaporodásuk az *Alopecurus pratensis* térhódítását gátolja.

Hat éven át tartó rendszeres vizsgálatok választ adtak a két réttársulás fajkomponenseinek dominancia viszonyai, szervesanyag produkciójára, valamint az élő- és a holtanyag arányainak változására.

# Uticaj dugotrajnih poplava na floristički sastav i organsku produkciju plavnih područja i ritskih močvara reke Tise

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## Abstract

Na livadama između odbrandbenih nasipa reke Tise javljaju se dve asocijacije. Na višim staništima ne nalazi *Lythro (virgatae)* — *Alopecuretum pratensis* BODROGK. 77, a na staništima nižeg nivoa *Garici (melanostachyae)* — *Alopecuretum pratensis* Soó 71, kao prelaz ka *Magnocaricion plavnih područja*. Pod uticajem dugotrajnih poplava, umesto ritske asocijacije koja zahteva higro-mezofilne uslove života, javlja se helohigrofilna livada plavne zone. U godinama bez dugotrajnih poplava uspostavlja se regeneracija *Lythro-Alopecuretum* asocijacije. Kao međustadijum javlja se zakarovljena ritska zajednica. Njeno pojavljivanje ubrzava izostanak redovnog košenja. Poplave obezbeđuju raseljavanje semena *Glycyrrhiza echinata*, *Lythrum salicaria*, *Iris pseudacorus*, *Glyceria maxima* i drugih vrsta i njihovo brzo osvajanje sprečava rasprostiranje *Alopecurus pratensis*.

Ispitivanja u toku šest godina dala su odgovor na uslove dominacije florističkog sastava vrsta ritskih zajednica, na organsku produkciju, kao i na odnose promena organskih i neorganskih materija.

## Влияние продолжительного разлива на видовой состав болотистых лугов и продукцию органических веществ

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## Резюме

На сенокосных лугах, лежащих между сооружёнными на Тисе дамбами по защите от наводнения, можно разграничить две ассимиляции. На участках с более возвышенным рельефом — *Lythro (virgatae)* — *Alopecuretum pratensis* BODROGK. 77. и господствуют на участках с более низким рельефом и представляющую собой переход к *Magnocaricion Garici (melanostachyae)* — *Alopecuretum pratensis* Soó 71.

Под влиянием длительного покрытия водой луговые сообщества, состоящие из видовых компонентов, требующих гидромезофильных жизненных условий, преобразуются в сенокосные луга пойм гелогидрофильного характера. В годы, когда не наблюдается длительный разлив, начинает регенерировать *Lythro — Alopecuretum*. В качестве переходной стадии формируется дернистый луг. Процесс его формирования убыстряется в случае отсутствия систематического кошения. При этом разлив способствует переносу семян *Glycyrrhiza echinata*, *Lythrum salicaria*, *Iris pseudacorus*, *Glyceria maxima* и других видов, быстрое размножение которых препятствует распространению *Alopecurus pratensis*.

Проведенные нами в течение шести лет систематические исследования дали ответ на вопросы относительно доминирующих отношений видовых компонентов двух луговых сообществ, их органической продукции, а также изменения соотношения живого и мёртвого вещества.

Весенние паводковые волны систематически затопляют пойму Тисы. Редко бывают голы, когда нет разлива. Однако длительность и сила наводнений различны. Различны и местные климатические условия в период наводнения. Под их влиянием заливающая растительный покров вода может в значительной степени или согреться, или охладиться, в силу чего «видо-селективирующее» влияние наводнения либо слабеет, либо повышается.

В случае длительного полкрытия водой изменяется видовой состав сообществ болотистых лугов, их продукция в фитомассе и зональная система. Вместо мезогидрофитных видов появляются гелофитонные компоненты.

В ходе своих многолетних исследований мы пытались дать ответ на вопрос о качественном и количественном размере фитоценозных изменений, наступающих под влиянием безразливных их периодов, а также периодов длительного водного покрытия, сменяющего непродолжительные разливы с незначительным поднятием уровня воды.