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WATER QUALITY OF THE TISZA RIVER AND THE ALPÁR BACKWATER

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Abstract

Authors review the hygienic water quality of the Tisza backwaters at Csongrád and Alpár on the basis of the results of studies performed over a period of seven years. The characterization of the sampling sites in given by means of dendrogram prepared on the basis of the Czekanovski similarity index.

The obtained results are as follows:

— The water quality of the Tisza river at Csongrád has become III., at places IV. class "Strongly polluted" in the recent years. During the course of the past seven years the water quality had fallen by one class, the causes of which are the great sewage-burden of the Tisza river and the building of the water barrages which changed the microbiological relations of the river's water.

— The water quality of the backwater at Alpár was of I., II. class, only rarely "polluted" in the majority of the study periods. The cause of the favourable water quality is that the backwater is not burdened considerably with sewage.

Authors demonstrate their results on Figures and summarize the isolated salmonella serotypes in a Table. They call attention to the preservation of the backwater's water quality as well as to the more enhanced protection of the Tisza's water by means of comparative microbiological studies.

Introduction

Several researchers have dealt with studies on the Tisza river during the past decades. The Tisza river and its tributaries have been investigated by PAPP (1961, 1964, 1965) who had determined that the river is subjected to rather considerable pollution at the mouth of the Sajó as well as at the regions below the cities Szolnok and Szeged.

At the Tisza reaches at Szeged, the places marked for bathing were studied by VETRÓ (1966) and he found the hygienic water quality to be favourable.

In the longitudinal section of the Tisza river the first detailed survey — extending both to bacteriological and biological parameters — was that performed by DEÁK (1975). On the basis of the results of their studies carried out in 1971—72 they called attention to the fact that the Tisza II. River Barrage being built at that time will probably change the microbiological relations of the river.

On the basis of his complex study results on the 1974—75 water quality of the Tisza river and its tributary currents, DEÁK (1982) demonstrated a rise in the average and maximum values of the bacteriological parameters indicating faecal pollution, however, this did not cause a fall in grade of the water quality compared to the results of 1971.

Hygienic bacteriological investigations of the surface waters in Csongrád county have been performed at the Public Health Station since 1975. The obtained results have been reported on in several publications (HEGEDŰS 1979, 1980, 1981, 1983, LANTOS 1982).

Authors joined the Tisza-research programme in 1975, during the course of which bacteriological studies were also started regarding the backwater of the Tisza not sampled yet.

The hygienic bacteriological relations concerning the backwater at Mártély and Körtvélyes have already been reported on (HEGEDŰS 1982).

The results of bacteriological investigations in respect to four backwaters of various utilization are comprised in a paper under publication (HEGEDŰS, under publication).

The present study gives a comparison of the water quality of the Alpár backwater and the Tisza section at Csongrád, with special regard to hygienic water quality problems, the majority of which were caused by the activities of man.

Materials and Methods

The Tisza section at Csongrád (246,0 riv. km) in current line and the Alpár backwater at the village Alpár were generally sampled monthly.

The water samples were taken by dipping about 20 cm below the surface, following which the samples were taken to the laboratory in cool condition and processed on the day of sampling or within 24 hrs the latest.

The hygienic bacteriological studies were performed on the basis of the standards "Methodological Guide" (1977) and "Bacteriological investigation of the drinking water" (1971), published by the Water Hygienic Department of the National Institute of Public Health. The study results were evaluated according to the end values of the Plan of Sectoral Normalization No. Eü. Sz. — OVHSZ 141 T/1972.

The detailed description of the study methods, the end values of the hygienic water qualification as well as the hydrography of the Tisza reaches at Csongrád county are found in the paper by HEGEDŰS, FODRÉ and ZSIGÓ (1980) published in volume XV. of the periodical TISCIA.

In this same volume, the publication of FEKETE and his co-workers contains the detailed description and physiognomy of the Alpár backwater.

Results and Discussion

The results of the bacteriological investigations performed between 1977—1983 are the followings.

At the Csongrád sampling site of the Tisza river a continuous fall in the water quality could be determined during the course of the seven years, on the basis of the changes in the coliform number/ml values.

From 84 water samples the coliform number surpassed the value above 100/ml in 42 cases, meaning that the Tisza river's water was "polluted" and "strongly polluted", respectively, in 50% according to this parameter (Fig. 1).

The hygienic quality of the Tisza river's water was particularly unfavourable in the year 1982, when the coliform bacterium number was below 100/ml only in two water samples and even orders above 1000/ml became frequent.

These bacteria were only present in low number in the water of the Alpár backwater (Fig. 2). Values above 100/ml were only found in three water samples. Continuous rise was also experienced here during the course of the seven years, yet this did not cause a fall in class regarding hygienic water qualification (not resulting assessable fall in water quality). The maximal values were registered in the Summer

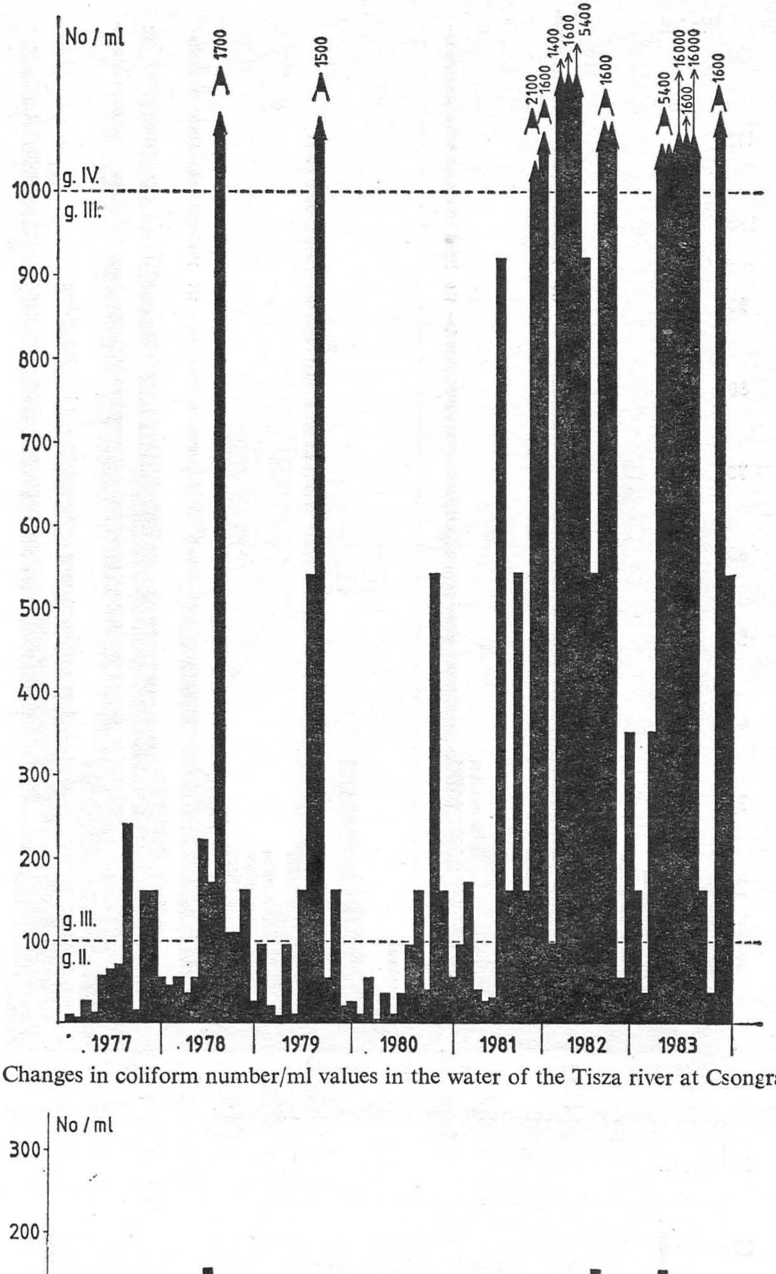

Fig. 1. Changes in coliform number/ml values in the water of the Tisza river at Csongrád.

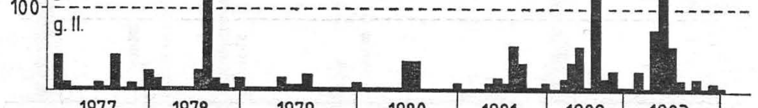

Fig. 2. Changes in coliform number/ml values in the backwater at Alpár

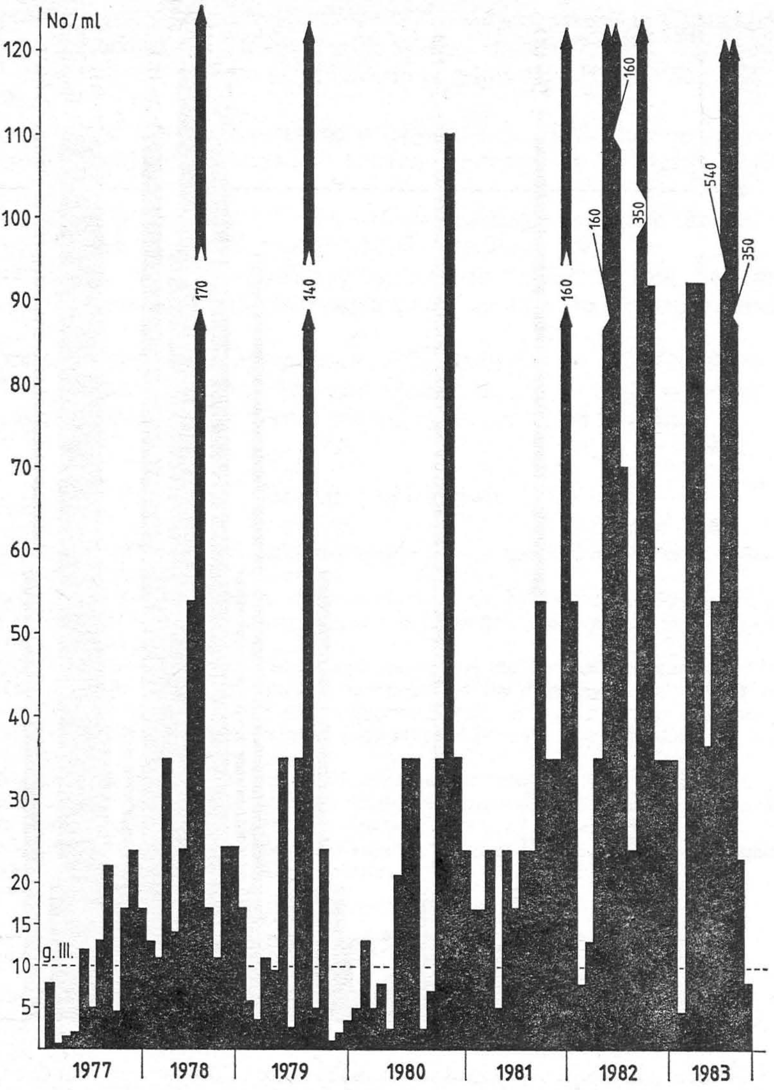

Fig. 3. Changes in faceal coliform number/ml values in the water of the Tisza river at Csongrád.

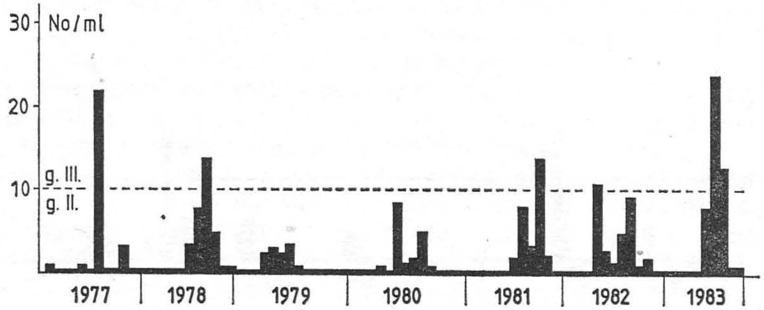

Fig. 4. Changes in faecal coliform number/ml values in the backwater at Alpár

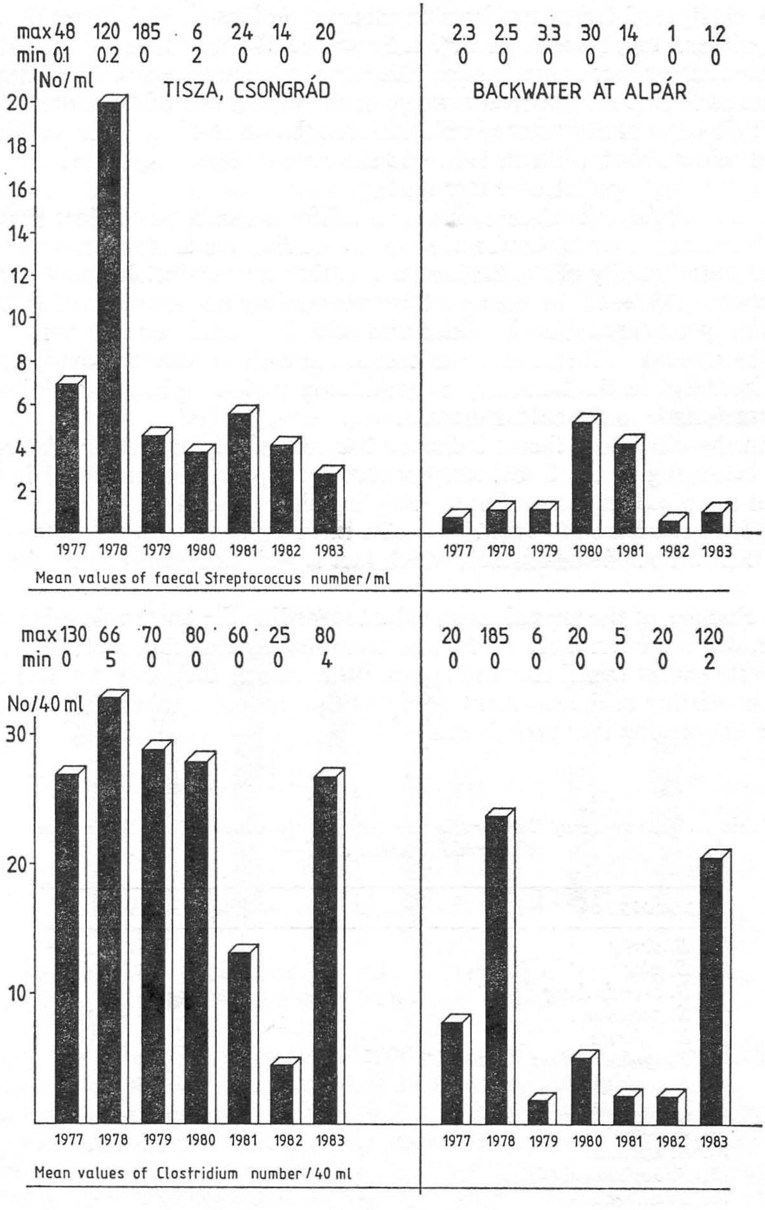

Fig. 5. Mean values of faecal *Streptococcus* number/ml and *Clostridium* number/40 ml. Mean values of *Clostridium* number/40 ml at the Alpár backwater

and late Autumn periods, which probably indicated the increased heterotrophic decomposition.

The changes in the degree of faecal pollution in surface waters are shown by the obligatory faecal indicator bacteria; the faecal coliform- and the faecal streptococcus bacteria.

The change of faecal coliform number/ml values in the Tisza river's water at Csongrád can be observed on Fig. 3. From the 84 water samples the value of the faecal coliform number surpassed the 10/ml end value in 69 cases. This unfavourable result means that the Tisza river's water at Csongrád was of "polluted" quality in 84%. In 1978 none of the water samples showed the value of the faecal coliform number to be below 10/ml, while in 1982—83 the orders above 100/ml became frequent, indicating "strongly polluted" water quality.

Fig. 4. comprises the changes in faecal coliform number/ml values for the water of the Alpár backwater in the function of the studied years. According to this parameter the water quality of the backwater is rather favourable. In the water samples taken between 1977—83 the faecal coliform bacterium number showed values above 10/ml in only six cases. Viewing the series of data it could be determined that the changes in amount of faecal coliform bacteria also show seasonal dynamism. Their number increased in the Summer, early Autumn periods, while the minimal values were characteristic to the colder months.

From the obligatory faecal indicator bacteria, the quantitative relations of the bacteria belonging to the faecal streptococcus group are demonstrated in the form of annual mean values, according to sampling sites (Fig. 5).

The Tisza reaches at Csongrád was also more polluted with faecal streptococcus bacteria than the Alpár backwater, which fact is well demonstrable by the maximal values.

The changes of the annual mean values regarding the anaerobic sulphyte-reducing Clostridia are observable on Fig. 5. according to sampling sites. These bacteria may indicate earlier faecal contamination, furthermore, they may get into the water area by the stirring of the sediment, too, and they may also mean that the anaerobic processes are coming into prominence.

Table 1. *Occurrence of Salmonella serotypes in the water of the Tisza river at Csongrád between 1976—1983*

Serotypes	Number
1. *S. derby*	17
2. *S. give*	13
3. *S. brandenburg*	8
4. *S. panama*	6
5. *S. infantis*	5
6. *S. typhi-murium*	4
7. *S. meleagridis*	3
8. *S. westhampton*	3
9. *S. hadar*	2
10. *S. anatum*	1
11. *S. bovis-morbificans*	1
12. *S. enteritidis*	1
13. *S. indiana*	1
14. *S. java*	1
15. *S. london*	1
16. *S. muenchen*	1
17. *S. mbandaka*	1
18. *S. paratyphi-B*	1
19. *S. saint-paul*	1
20. *S. thompson*	1
Total:	72

In the Tisza river the *Clostridium* number/40 ml values were also averagely higher than in the case of the Alpár backwater where higher values were only found in two years. These results were probably due to the washing in from the sediment.

From the enteral pathogens, it is the *Salmonella* bacteria which can be isolated the most frequently from the surface waters. From the Tisza river and the Alpár backwater 1000 ml water samples were concentrated for the detection of the *Salmonella* bacteria. During the study period the water of the Tisza river at Csongrád was strongly infected with *Salmonella* both in the utilized periods (V—VIII. months) and on the basis of the annual study series. The positivity % surpassed the 33% end value of tolerance, with the exception of the year 1981 (Fig. 6), therefore, bathing is not advisable in the water of the Tisza river at Csongrád. A summary of the isolated *Salmonella* serotypes in given is Table 1. During the course of the seven years 72 *Salmonella* bacteria were typified (classified according to types), belonging to 20 serotypes. The most frequent serotypes were the *S. derby, S. give* and the *S. brandenburg*. Till 1980 the S. derby was isolated the most frequently, then from 1981 to 1983 the *S. give* serotype became more frequent.

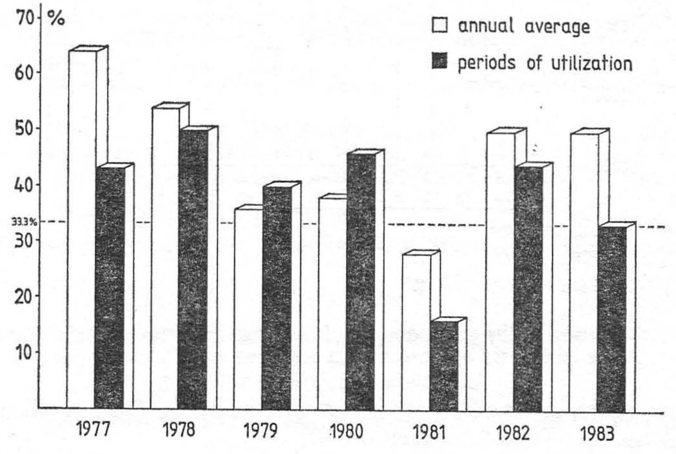

Fig. 6. Changes in Salmonella positivity in the water of the Tisza river at Csongrád. In annual average; in periods of utilization

During the past seven years, from 1000 ml water sample, bacteria belonging to the *Salmonella* genus were not isolated at all from the Alpár backwater.

As mentioned in the introduction, a dendrogram was prepared using the Czekanovski similarity index to characterize the water quality at the sampling sites and to register the changes occurring during the years (Fig. 7). The water quality of the Tisza river at Csongrád was labelled by "Cs", that of the Alpár backwater by the letter "A", indicating beneath the study years. It can be seen from the dendrogram that three groups were formed according to the water quality of the various years; a core in Csongrád, a core at Alpár and a mixed group. The Tisza river's water quality was rather similar in the years 1978—79 and 1981, the tight linkage of which was formed by the coliform numbers of the order of 100, the faecal coliform numbers of the order of 10 per ml and the faecal streptococcus numbers of lower value than 10.

The hygienic bacteriological water quality of the Alpár backwater was rather stabile between 1977—1981 and the independent group was formed by the coliform

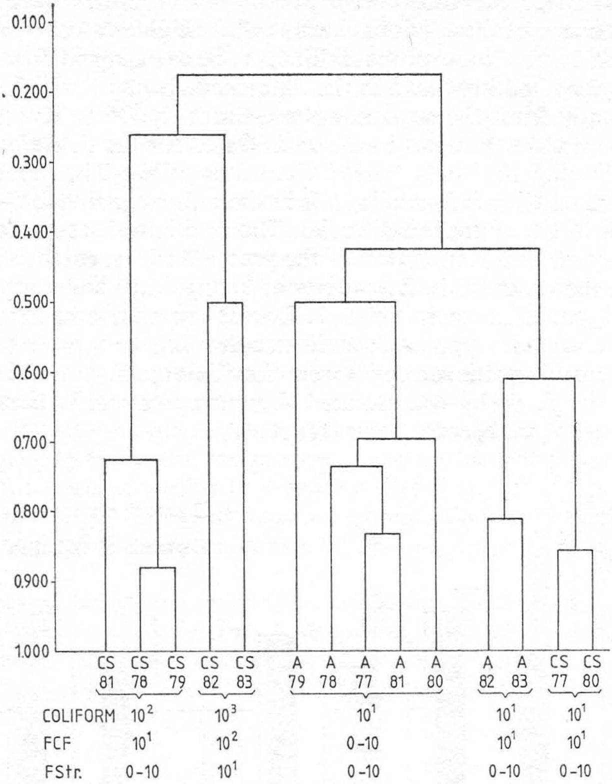

Fig. 7. Characterization of the water quality of the Tisza river at Csongrád and at the Alpár backwater by dendrogram prepared with "cluster"-analysis

number values of the order of 10 per ml as well as by the faecal coliform and faecal streptococcus number values between 0—10.

In the years 1977 and 1980 the coliform number was below 100/ml in annual average in the water of the Tisza river, i.e. of the same order as the 1982—83 years' water quality of the Alpár backwater. Therefore, these years and sampling sites formed the mixed core, producing a tight linkage.

As mentioned previously, the water quality of the Tisza river became polluted by the years 1982—83, which was characterized by the coliform numbers of the order of 1000, faecal coliform numbers of the order of 100, and faecal streptococcus numbers of the order of 10 per millilitre.

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A Tisza folyó és az Alpári holtág vízminősége

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Kivonat

A szerzők a hét éven át végzett vizsgálatok eredményei alapján a Tisza csongrádi és az Alpári holtág higiénés vízminőségét ismertetik.

A mintavételi helyeket Czekanovski hasonlósági indexe alapján készített dendrogrammal jellemzik. Eredményeik a következők:

— A Tisza folyó vízminősége Csongrádnál III. esetenként IV. osztályú „erősen szennyezetté" vált az utóbbi években. Az elmúlt hét év alatt egy osztállyal romlott a vízminősege, amelynek oka a Tisza nagymertékű szennyvízterhelése, a vízlépcsők megépítése, amelyek megváltoztatták a folyó vizének mikrobiológiai viszonyait.

— Az Alpári holtág vízminősége a vizsgálati időpontok többségében I. II. osztályú, csak ritkán „szennyezett". A kedvező vízminőség oka, hogy jelentős szennyvízterhelés nem éri a holtág vizét. Szerzők az összehasonlító mikrobiológiai vizsgálattal felhívják a figyelmet a holtág vízminőségének a megóvására, valamint a Tisza vizének fokozottabb védelmére.

Качество воды Тисы и Алпарской старицы

Гегедюш М., Каяри И.

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Резюме

На основании результатов 7-летних исследований авторы осветили гигиенические качества воды реки Тисы в Чонградской области и старицы Алпар. Пробы были взяты на основании сравнительных Цекановских индексов.

Были получены следующие результаты: качество воды старицы Алнар в богьшинстве местах I. II. кгассное, тогько изредка вода явгяется засоренной. Причиной благориятного состояния воды явıяется то, что эта старица не подвергается значитегьному засорению.

Путями сравнитегьных микробиогогических иссгедований авторами обращается внимание на необходимость улучшения качества воды старицы Алпар, а также на охрану воды Тисы.

Kvalite vode reke Tise i mrtvaje Alpár

HEGEDÜS MÁRIA i KAJÁRY IRÉN

Zdravstveno-epidemiološka stanica županije Csongrád, Szeged

Abstrakt

Autori, na osnovu rezultata sedmogodišnjih istraživanja, daju prikaz kvaliteta vode Tise u regionu Csongrád-a i mrtvaje Alpár, sa zdravstvenog aspekta. Uzorci su analizirani Čekanovskim dendogramom indeksa sličnosti.

Dobijeni su sledeći rezultati: Voda mrtvaje Alpár je u većini slučajeva po kvalitetu I i II razreda, samo je redje „zagadjena". S obzirom da se mrtvaja ne opterećuje značajnije otpadnim vodama, javlja se povoljni kvalitet vode.

Na osnovu rezultata uporednih mikrobioloških ispitivanja, autori ukazuju na potrebu očuvanja kvaliteta vode mrtvaje, kao i na znatniju zaštitu vode Tise.

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THE DEVELOPMENT OF STRIKING ALGAL MASS PRODUCTIONS AT THE ALPÁR-BASIN REGION OF THE TISZA-VALLEY*

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Abstract

The algal mass productions colouring the waters and soil surfaces at the Alpár-basin have been studied by author since 1975. Before 1984 at total of 25 water blooms and 25 algal mass productions colouring the soil were observed. On May 20, 1984, however, 70 algal mass productions colouing the soil and 10 water blooms were detected on the occasion of one single collection route.

As active component, the electric relations of the atmosphere and the atmospheric ionization, resp. were concluded. Krueger demonstrated in animal experiments that the effect of the monoamine oxidase is supported by small negative air ions, while the small positive air ions hinder this. The fact that auxin or one of its alterations may develop from serotonin in the case of the atmosphere's negative ionization partly explains the relationship between the algal mass production and the cyclonal weather conditions — particularly the showery Spring of the year 1984. Similarly, the large algal mass productions of the arctic areas are also explained by ionization effects. Here the radiation zone is missing and the particles arriving from the interplanetary space may deeply penetrate into our atmosphere. Photoperiodicism may also be a factor of mass production.

Introduction

The Tisza-III-River barrage and its large water-basin will be built in the future at the area located from the village Bokros till Tőserdő of the Tisza-valley lying North from the city Csongrád. Therefore, the safe handling and intensive utilization of this vast technical establishment necessitate the thorough as possible exploration of this area's natural relations. This necessity initiated the Tisza-Research Committee to include this section of the Tisza-valley into the researches carried out on the explorative studies of natural relations. This area is comprehensively called the Alpár-basin since its central region is formed by the relief of the backwater near the village Tiszaalpár and its environs, which relief originates from the beginning of the Holocene and has deep location. To the North of the Alpár backwater the Lakitelek back water is situated near Tőserdő, the Western side of which is joined by one of the processes of Little Cumania's sand land. The Southern section of the Alpár-basin is formed by the streamy meadow besides the village Bokros, called "cow-track" by the former inhabitants. The marshy water-flows here mostly reach the backwater and also carry the dungy soiling washed in from the meadow of the close "cow-track" into the

*Various parts of this paper have been presented by author at the Botanical Section of the Hungarian Society of Biologists on Nov. 5. 1984, at the XXVI. Meetıng of Hydrobiologists on Nov. 15, 1984, and at the XV. Tisza-Research Conference on Nov. 29, 1984.

backwater. Both backwaters are young formations, developing on the effect of cutting of large bends during the course of regulating the river Tisza.

The algological exploration of these two backwaters was performed by author from 1975 till nowadays, and will probably be finished by the time the building of the river-barrage and water-basin will commence, for the purpose of thorough as possible knowledge (Kiss 1978a, 1978b, 1979a, 1979b, 1979c). Our research objective is considerably of benefit to environmental protection, too, as our waters preserved in natural condition are in the danger of becoming eutrophized (eutrophicated?). The enrichment of these waters by anorganic and organic plant-nutrient solution brings forth the mass production of algae, especially the constituents of the phytoplankton. This not only indicates the degree of increase in trophity and saprobity, but also greatly unfavourably influences the possibilities of utilization. It is first of all this which gives reason for examining this area — based on the knowledge regarding the algae forming coloured mass productions in the water and on the soil surface — even according to the viewpoints of water protection and qualification within environmental protection. This work is also of nature conservancy concern since in significant length, the Western section of the Lakitelek—Tőserdő backwater's strong bend belongs to the nature conservancy area of the Kiskunság National Park, together with the elongated patches of the South-located marsh.

Materials and Methods

During the course of author's earlier studies the places of water sampling were determined with the consideration of the ecological fundamentals. At every site samples were also always taken from the algal mass productions colouring the waters and the soil surfaces. The largest amount of mass production appeared in the small shallow puddles and on the soil surfaces near the backwaters. This phenomenon was particularly striking in the showery Spring and early Summer of 1984, since the "water bloom" (flos aquae) and "soil flowering" (flos humi) caused by the algae appeared everywhere at about the same time, almost "accumulatedly". This simultaneously "accumulating" occurrence indicates the studies on the development of the mass productions not only from the viewpoint of nutritive substances, but also from that of the effect of the atmosphere. This also promises newer results for the knowledge on plant life. Besides the species composition of the algal flora, author also always turned attention to its vegetation forms (plankton, neuston, periphyton, psammon, lasion, benthos, krypto-vegetation). Taxonomic determination was carried out on living matter, thus at the time of bioseton-probes 1 litre water always remained unfixed and 1 litre was fixed with formalhedyde. On occasions the algal soil samples kept in Petri-dishes were also used for the preparation of aga-cultures. The quantitative studies were performed with the so-called "drop-method" elaborated earlier by author, with the use of Bürker-chambre. Physiological experiments were also performed occasionally. A few rare or characteristic species are shown on microscopic pictures.

The pH value of the water fluctuated between 7,2—7,8 in both backwaters till 1980, 8,0 pH value was only observed at one place of the Alpár backwater in the Summer of 1978. Recently during the Summers of 1983 and 1984 the waters of both backwaters showed pH values of 8,1—8,2 (This allows the conclusion of alkalinization). The water chemical analysis demonstrated the pH value of the water as being above 8,0 in the holiday resort district of the Alpár backwater. The waters of the so-called "cow-track" at the Bokros region showed pH values somewhat higher than 8,0, furthermore, in the Autumn of 1983 the striking pH value of 9,0—9,5 could be measured at two points of the marshy dip. Therefore, alkalization appears definitely patchedly at times here, too, due to which the chemism of the soil and water is of mosaic heterogenic nature, i.e. briefly: "pied".

Results and discussion

In the followings brief review is given of the algal mass productions detected in the waters and on the soil surfaces at the area of the Alpár-basin. The majority of the aquatic mass productions developed near the backwaters and at times in shallow puddles farther off, since mostly these could become more rich in anorganic and organic plant nutrient solutions.

Following this, the question is analysed how the atmosphere — apart from the favourable temperature and precipitation amount — may stimulate the flora for more enhanced life-functions, in the present case the algae for the development of mass productions. As a matter of fact, this has not been analysed so far in the field of ecology and plant physiology.

A) Water blooming mass productions (flos aquae)

The water blooms detected at three main areas of the Alpár-basin of the Tisza-valley were the followings in chronological order according to dates:

1. On June 15, 1975 the water in a deep puddle at the Northern coastal region of the Alpár backwater was pale green till a depth of cc. 10 cm. This vegetational colouring was caused by the production of the *Pediastrum Boryanum* REINSCH (Plate II. 4).

2. At the same time dark green mass production partly of neuston nature was produced by the A *Phacus pyrum* (EHR.) STEIN at the Eastern border of the village Tiszaalpár (Plate I. 3).

3. Also at this date the water bloom of the *Phacus pseudonordstedtii* POCHM. coloured the water of a deep pit dark green at Tiszaújfalu (Plate I. 1).

4. On June 15, 1975 the water of a deep pit at the Eastern border of Tiszaalpár was of pale yellowish-green colour. This mass production was produced by the *Schroederia rubusta* KORS. (Plate II. 1), the *Rhopalosolen cylindricus* (LAMB.) FOTT (Plate II. 8) and the *Rhopalosolen Sebestyenae* FOTT (Plate II. 3).

5. On June 22, 1975 the greenish-gray water bloom of the *Tétrachloris inconstans* PASCHER (Plate I. 5) could be detected in a digged pit beside the Northern section of the Tőserdő backwater. The water was coloured till the depth of about 0,5 m.

6. On May 18, 1976 the lasion-network of the *Spirogyra insignis* (HASS.) CZURDA hindered boating at the Southern, not protected section of the Tőserdő backwater.

7. On September 29, 1976 the bluish-gray water bloom of the *Microcystis aeruginosa* f. *aeruginosa* STARMACH and the *Microcystis aeruginosa* f. *flos aquae* (WITTR.) ELENK. was observable at the Northern section of the Tőserdő backwater (KISS 1978).

8. At the same date, somewhat East to here, the water bloom of the *Aphanizomenon flos aquae* (L.) RALFS coloured the water bluish-gray (KISS 1978).

9. Also on September 29, 1976 the green water bloom of the *Phacus tortus* (LEMM.) SKVORTZOV (Plate II. 5.) was found by author in a small dip containing polluted water at the Alpár backwater's flood area. The water was coloured in almost every layer.

10. On May 28, 1977 the yellowish-green water bloom of the *Dinobryon sertularia* EHR. was noticed at the Northern region of the Tőserdő backwater (KISS 1978).

11. At the same time, also here, the water bloom of the *Eudorina elegans* EHR. coloured the water patchedly bright green on several hundred m^2 (KISS 1978).

12. The *Phacus longicauda* (EHR.) DUJ. (Plate II. 2) caused the pale green water bloom in a pit besides the Southern section of the Tőserdő backwater. With small individual number, the *Euglena intermedia* (KLEBS) SCHMITZ (Plate II. 9) also participated in the formation of the mass production. Date: May 28, 1977.

13. On August 5, 1978 pale green water bloom was detectable in a deep pit beside the Alpár backwater which was caused by the *Scenedesmus acuminatus* (LAGH.) CHOD. (Plate I. 2, 4), the *Kirchneriella contorta* var. *lunaris* RICH. (Plate I. 7) and the *Oocystis socialis* OSTENF.

14. At the same time, dark green water bloom was observable in another pit of the Alpár backwater caused by the *Lepocinclis acuminata* DEFL. (Plate I. 6).

15. On August 5, 1978 the stagnant water of a channel at the Northern coastal section of the Tőserdő backwater was bluish-black by the masses of *Oscillatoria Boryana* (AGH.) BORY (Plate I. 9). This organism was probably not of termophyl biotype.

16. At the same time, the pale green water bloom of *Scenedesmus ecornis* (RALPH.) CHOD. (Plate II. 6) and *Scenedesmus securiformis* PLAYF. (Plate II. 7) was found in a shallow pit at the border of Tiszaalpár.

17. At the area of Bokros, in the water of the long dip of the "cow-track" the green water bloom of *Euglena polymorpha* DANG. was observable on June 1, 1982.

18. On June 12, 1982 the grayish-blue water bloom of *Microcystis aeruginosa* KÜTZ. was observable at the entrance of the beach section of the Alpár backwater.

19. At the same date the water bloom of the *Aphanizomenon flos aquae* (L.) RALFS coloured the water dark gray about 100 metres from the previous water bloom.

20. On August 4, 1982, the *Euglena Ehrenbergii* KLEBS coloured the water bright green with spectacularity at the Northern part of the Tőserdő backwater.

21. On October 25, 1982 the yellowish-green mass production of neuston-nature of the *Euglena sanguinea* EHR. was detectable in the water of the long dip at the area of Bokros.

22. At the same time, somewhat farther, the *Microcystis aeruginosa* KÜTZ coloured the shallow water bluish-gray.

23. Even farther, also at the same period, the dark-gray mass production of the *Aphanizomenon flos aquae* (L.) RALFS was observable.

24. On June 26, 1983 the mass production of the *Tribonema* species was found at the Tőserdő marsh. The most frequent were the *Tribonema vulgare* PASCHER, *T. minus* (WILLE) HAZEN, *T. elegans* PASCHER, *T. aequale* PASCHER, *T. subtilissimum* PASCHER.

25. On September 6, 1983 such mass production of the *Anabaena spiroides* KLEBAHN was observable in the agricultural co-operative fish pond established at the Alpár basin, in which the trichonomes divided into planococcus cells, and staying together they were remarkably like the *Microcystis* colonies.

On May 20, 1984 the algal mass productions were strikingly frequent in the waters of the Alpár basin. These were the followings:

26. At the Northern section of the Tőserdő backwater, the *Eudorina elegans* EHR. coloured the water green at a length of several hundred m^2.

27. More to the South, the *Aphanizomenon flos aquae* (L.) RALFS formed dark

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Plate I

1. *Phacus pseudonordstedtii* POCHM, 1500:1.
2. *Scenedesmus acuminatus* (LAGERH.) CHOD. (? forma) 1200:1.
3. *Phacus pyrum* (EHR.) STEIN 600:1.
4. *Scenedesmus acuminatus* (LAGERH.) CHOD. 1000:1.
5. *Tetrachloris inconstans* PASCHER 1000:1.
6. *Lepocinclis acuminata* DEFL. 1500:1.
7. *Kirchneriella contorta* var. *lunaris* RICH. 1200:1.
8. *Oocystis socialis* OSTENF. 1000:1.
9. *Oscillatoria Boryana* (AGARDH) BORY 1000:1.

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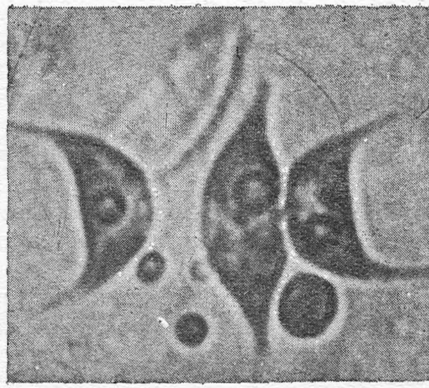

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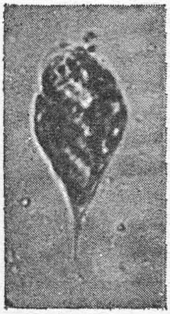

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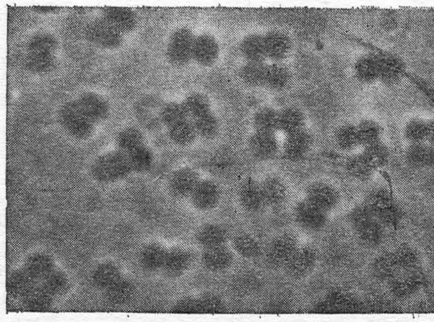

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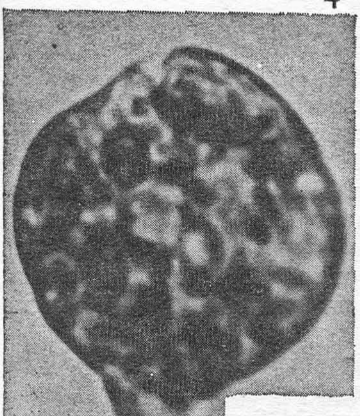

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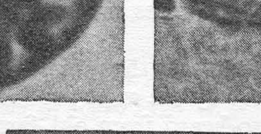

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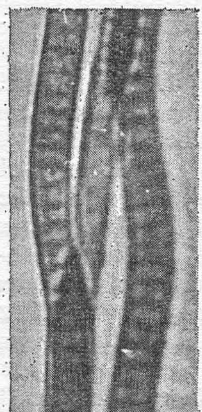

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gray water bloom. The vegetational colouring was even observable at a depth of 20 cm.

28. At the Northern part of the Alpár backwater the *Eudorina elegans* EHR. coloured the water.

29. At the Eastern border of Tiszaalpár the water of a pit was also coloured bright green by the *Eudorina elegans* EHR. The water bloom was starting to waste away.

30. At the central part of the Alpár backwater, the increased amount of the *Phacus tortus* (LEMM.) SKVORTZ. caused green colouring. This was also wasting away.

31. At the central branching of the Alpár backwater the bluish-gray water bloom of the *Microcystis aeruginosa* KÜTZ. coloured the water gray at an area of several hundred m^2.

32. Near the former, the *Euglena polymorpha* DANG. coloured the water green.

33. At the coastal region of the beach at Alpár, the partly neuston-like water bloom of *Euglena intermedia* (KLEBS) SCHMITZ coloured the surface of the water dark green.

34. At a section of this backwater more to the South, the *Euglena pisciformis* KLEBS produced dark green water bloom together with the *Euglena tripteris* (DUJ.) KLEBS.

35. At the Eastern border of the village Tiszaújfalu, the water of a pit was coloured dark green by the *Euglena polymorpha* DANG.

B) Soil-colouring algal productions, "soil blooms" (flos humi)

Many algal mass productions colouring the soil were found also at the area of the Alpár basin. Their amount surpassed 100 by far, therefore, only the most characteristic ones will be reviewed. The soil sampling had been started in 1975, and in 1976 this collection was expanded to the Nagyrét located between the two branches of the Tőserdő backwater, and also to the plough-lands at the area between Tőserdő and Tiszaalpár. In the followings, brief characterization is given of the algal mass productions colouring the various soil surfaces, as well as the layers beneath the surface:

1. The *Planophila asymmetrica* (GERN.) WILLE produced yellowish-green stripes at the soil surface near the bridge of the Tőserdő backwater. Time of observation: June 22, 1975.

2. Green patches of the soil surface were observable on June 22, 1975 at the Western side of the Tőserdő backwater. This was produced by the mass production of the *Planophila asymmetrica* (GERN.) WILLE.

3. Dark bluish-green soil patches were observable on June 15, 1975 at the Eastern border of Tiszaalpár. This was formed by the mass production of the *Gloeocapsa conglomerata* KÜTZ.

4. Bluish-green soil surface was detectable at the maizefield of the Nagyrét at Tőserdő on August 21. 1976. This was caused by the mass production of the *Phormidium floveolarum* (MONT.) GOM. It was also heard from old farmers by the author here, that the green coloration of the plough-lands is the sign of good crop.

5. On May 16, 1976, blackish-blue soil stripes were observable on the soil at the forest brim of Tőserdő. This was caused by the *Oscillatoria laetevirens* (GROU.) GOM. and by the *Gloeothece membranacea* (RABH.) BORN.

6. On September 29, 1976 palm-sized bluish soil surfaces could be detected at the Eastern border of Tiszaalpár, produced by the *Phormidium autumnale* (AG.) GOM.

7. At the same place, on the same date, bluish-green stripes were observable on humid soil surfaces caused by the mass production of the *Phormidium molle* (KÜTZ.) GOM.

8. On September 29, 1976 grayish-blue patches could be observed on humid soil surfaces at the border of the peatmarch at Alpár. This was formed by the *Symploca cartilaginea* (MONT.) GOM.

9. Dark green patches were observable on the plough-land between Tiszaalpár and Tőserdő on September 29, 1976. This was produced by the mass production of the *Plamella miniata* LEIBL.

10. On September 29, 1976 dark bluish-green soil stripes were found at the plough-land between Tiszaalpár and Tőserdő, formed by the *Phormidium autumnale* (AG.) GOM.

11. On September 29, 1976 wide yellowish-green stripes could be detected at the plough-land between Tiszaalpár and Tőserdő, caused by the *Coccomixa dispar* SCHMIDLE.

12. Kitchen-garden-like green patches were observable on the soil surface between Tiszaalpár and Tőserdő, developed by the *Palmella miniata* LEIBL. Time of observation: September 29, 1976.

13. At the same date green patches of the soil surface were observable at the Southern border of Tiszaalpár. This was produced by the *Chlorococcum humicolum* (NAEG.) RABH. The soil was also coloured beneath the surface.

14. At the same place, on the same date, bluish-green soil surface was observable developed jointly by the *Nostoc muscorum* KÜTZ. and the *Phormidium foveolarum* (MONT.) GOM.

15. On November 3, 1976 the surface of the plough-land at the Tőserdő Nagyrét was bluish-green at places caused by the *Phormidium molle* (KÜTZ.) GOM. and the *Oscillatoria tenuis* AG.

16. On November 3, 1976 the surface of the humid soil at the Southern border of Tiszaalpár was found to be dark green at an area of about 200 m^2. This was caused by the mass production of the *Palmella miniata* LEIBL.

17. On February 18, 1977 the cleftly steep loess-wall beside the church at Tiszaalpár was grayish-green. This kryoproduction was produced by the *Hormidium flaccidum* A. BR.

18. At the same place, on the same date, more to the South, the frosty surface of the loess-wall showed dark green stripes caused by the *Hormidium flaccidum* A. BR. and the *Chlorella miniata* (NAEG.) OLTM.

19. Also on February 18, 1977 blackish-bluish stripes were observable on the steep loess-wall near the beach at Alpár. The *Phormidium foveolarum* (MONT.) GOM., the *Phormidium molle* (KÜTZ.) GOM. and the *Nostoc muscorum* KÜTZ. could be determined in the alga-community.

20. On August 5, 1978 green or bluish-green coloring was found at 12 places on the clefty clayey-loessy wall of the Alpár backwater. The *Hormidium flaccidum* A. BR. was dominating in every case. Blue algae were rarer.

21. On the still damp and dark green soil surface of a dried up puddle at the Western side of the Tőserdő backwater the dark green "soil bloom" of the *Chlamydomonas Reinhardi* DANG. was wasting away. The cells proportioned to mostly protococcoidlike smaller units. Date: August 5, 1978.

22. Also on August 5, 1978 green soil surface was found in a length of cc. 10 m and width of 10—20 cm at the rim of the road at the Tőserdő Nagyrét. This was caused by the mass production of the *Palmella miniata* LEIBL. and the *Coccomyxa dispar* SCHMIDLE.

23. The soil surface of a dried up puddle at the "cow track" near the village Bokros was dark green, formed by the protococcoid forms of a *Chlamydomonas spec.* Date: June 1, 1982.

24. On June 26, 1983 the *Chlorococcum infusionum* (SCHRANK) MENEGH. caused a palm-sized dark green patch at the sodic meadow near the Tőserdő marsh.

25. At the same site, on the same date, light green patches could be seen. Only the *Coccomyxa dispar* SCHMIDLE was determinable from the alga-community. Dungy patch was observable earlier.

On May 20, 1984 a strikingly large number of soil surfaces showed algal mass productions at the area of the Alpár basin. These were caused by the followings:

At the area of Tőserdő:

26. The *Nostoc muscorum* (KÜTZ.) HARIOT caused bluish-green patches on the forest-road.

27. The paved bed and wall of the "Spring" was covered completely with blackish bluish-green periphyton layer. Such developed algal coating was not observed earlier here. It was caused by blue algae; the dominating species was the *Calothrix brevissima* G. S. WEST.

28. Dark green patches were formed by the *Coccomyxa dispar* SCHMIDLE at Nagyrét.

At the environs of Tiszaalpár:

29. Melted bluish-green soil patches were observed, caused by the *Nostoc muscorum* KÜTZ.

30. In a street, the *Coccomyxa dispar* SCHMIDLE formed large green patches.

31—58. Dark green patches appeared on the steep clefty loess-wall at 28 places (areas). In these the *Hormidium flaccidum* A. BR. was of dominant character.

59—95. At 37 areas of the steep clefty wall blackish bluish-green patches, stripes were found in which the *Nostoc muscorum* KÜTZ. was dominating.

Earlier the followings were written by author regarding the striking colorations on the clefty embankment of the Alpár backwater (KISS 1979c): "At times, the coloration caused by algal mass production offered particularly picturesque view at Tiszaalpár on the steep embankment of the backwater at the section falling to the former village Alpár. On occasions, the 6—8 m high wall surface was almost vertically coloured green or bluish-black by stripes or patches of several metres. The animating moisture was provided by the water flowing periodically on the rim of the cleft. In the development of these mass productions the primary role was mainly played by the representatives of the *Cyanophyta* phylum. Elderly farmers

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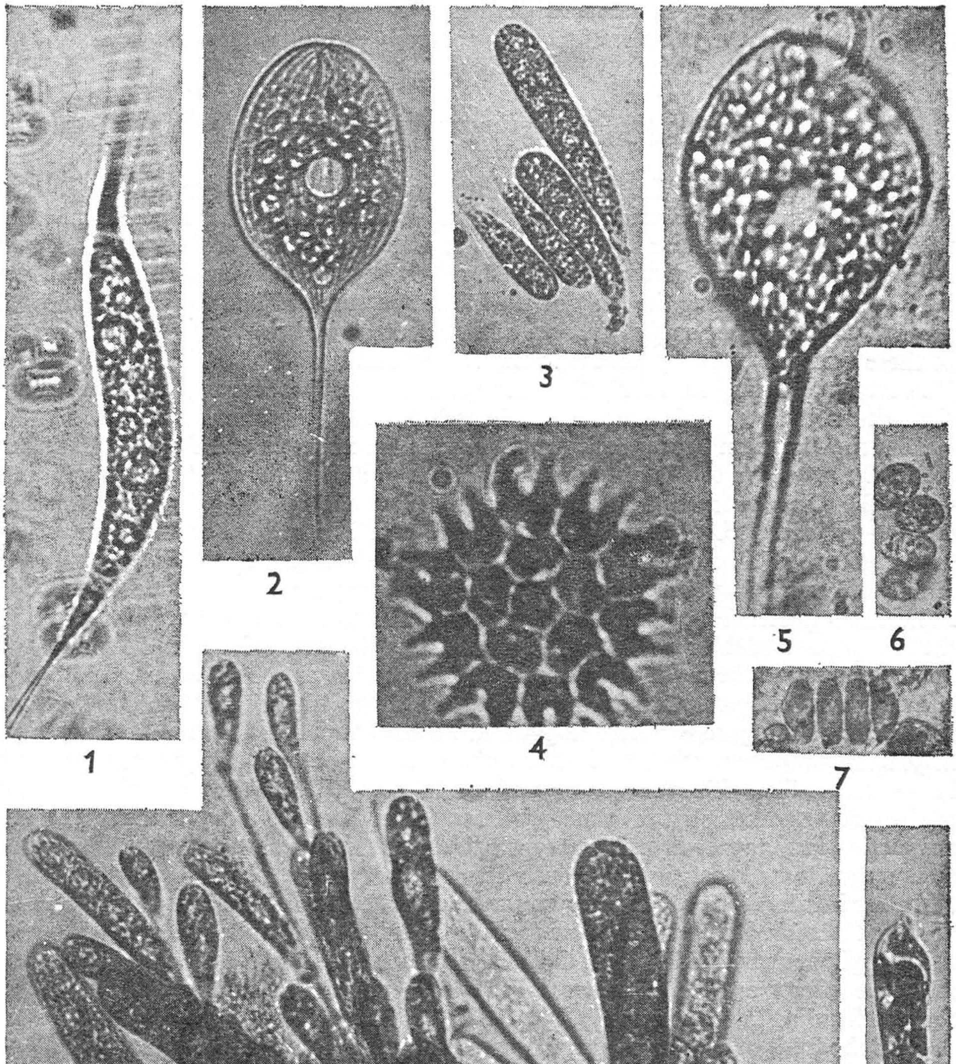
Plate II

1. *Schroederia robusta* KORS. 1000:1.
2. *Phacus longicauda* (EHR.) DUJ. 700:1.
3. *Rhopalosolen Sebestyenae* FOTT 500:1.
4. *Pediastrum Boryanum* REINSCH 400:1.
5. *Phacus tortus* (LEMM.) SKVORTZOV 900:1.
6. *Scenedesmus ecornis* (RALFS) CHOD. 400:1.
7. *Scenedesmus securiformis* PLAYF. 800:1.
8. *Rhopalosolen cylindricus* (LAMB.) Fott 400:1.
9. *Euglena intermedia* (KLEBS) SCHMITZ 400:1.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here, too, spoke of the phenomenon that the occasional sudden animation of these stripes are generally the indicators of rain or weather tending to rain. The meteorobiological basis of this will be discussed elsewhere".

The multitude algal colorations now definitely propound this question.

Meteorobiological bases of the algal mass productions of the waters and soils

The productivity in the waters and soils could not have been greater in 1984 than earlier, yet the colorations by mass productions were by far more frequent in the year 1984. At the Alpár basin a total of 25 water- and 25 soil-colourings appeared during the course of 6 years prior to 1984, nevertheless, 70 soil- and 10 water-colourings were found during the May of 1984. The soil surfaces and tree trunks showed greener coloration not only at the area of the Alpár basin, but everywhere. The marks of these were observed by author at the end of June, 1984 even in Transdanubia. However, the Spring and early Summer were unusually showery, which automatically turned the attention to the weather when seeking for the causes.

At the Northern border of Pusztaföldvár, in the Summer of 1930 author's father called the attention to the old Hungarian folklore about the weather, according to which the green coloration of the waters indicates the coming of rain or weather tending to rain. "The water is turning green, rain is coming", or "The water has turned green, we'll be getting some rain" — says the weather regulation. At that time author only smiled at the "prophecy", but by next day he began to suspect that the abundant experiences of sharp-eyed anonyms of centuries or millennia stand in the background of this regulation — since next day the rain arrived. In the followings author compared the mass productions of algae with accurate meteorological front- and air-mass analyses. Author should like to express his sincere thanks here, too, to the expert Hungarian meteorologists, L. Aujeszky and Z. Ozorai, for their kind help. It has been successfully verified that the mass productions of algae are connected in general outline with cyclonal-depressional phases of the weather. If the trophity of the water and the physical state of the organism in question is satisfactory, mass production may appear in such meteorological situation. In such a case mass productions may occur almost simultaneously in whole country regions. This accumulative character in a large space is similar to the so-called "weather-sensitivity" phenomena of man, therefore the algal mass productions could be regarded as the "weather-sensitivity" phenomena of the algae. Only the atmosphere is capable of displaying about the same effects on the living world of whole regions, by this means practically "comprehending" whole regions (Kiss 1957a, 1957b).

On the basis of the front- and air-mass analyses author first thought of the alga-feeding effect of the nitrogenoxids (N_2O, NO) (Kiss 1942), as these had been demonstrated in the descending air flows of the foehn-like weather. Author's work was promoted by knowledge of Kestner's theory which traced the "weather sensitivity" of man back to the descending air flow of the space before shower front (Böe) and to the ionization of the foehn wind's air, resp. (Kestner 1923, 1931a, 1931b). Here, only the followings are recalled in respect to author's first experiments of ionization: "In the knowledge of the foregoings I performed ionization experiments regarding the multiplication of a few unicellular green algae on several occasions from the end of the thirties. The algae proved to be rather sensitive to UV-light" (Kiss 1964). Accepting the existence of ionizational effects author wrote of the role of the foehn-wind at flat country as follows: "Therefore, despite the fact that the fronts and flat country-foehns are differing atmospheric happenings, they must contain such meteoric factors which are of the same effect; i.e. they equally call forth the phenomena of weather sensitivity. These common factors hould be searched for in the ionization and electric state of the air, resp." (Kiss 1964). Our ionization experiments were further continued in the second half of the sixties and first part of the seventies, mainly with the phylum species of the *Euglenophyta* and the *Volvocales* order. The ionized air of the sealed glass-cupboard activated the movement of the organisms to a certain extent, which was also evident in the more intensive flapping of the flagella. The cells treated in such manner sometimes perished sooner.

It is known from much earlier that at the time of foehn winds the predominance of the positive ions develops in the atmosphere, and this is by which the so-called annoying effect of the foehnweather on man is explained. The physiological role of the atmospheric ionization had been studied in detail by Csijevszkij (1937) on bacteria. It was Pech (1926) who first emphasized the fact that certain plants necessitate determined electric space; demanding either positive or negative electric space. In case they do not obtain this, they fall behind in development and even the harm of parasites may become enhanced. Krueger et al. (1962, 1964) studied the effect of the small ions in the air with great detail .These authors manifested cc. 50% enhancement of the growth rate of plants up to a density value of 10,000 ions/cm^3, especially in the case of barley, oat and lettuce. In ion-deficient air the plants' metabolism slowed down, their growth decreased and their vegetative parts fell to withered state (became withered).

The next question is, by what means does the ionized air cause (bring forth) the phenomena of "weather sensitivity" in man, animals, plants, and in our case, in the algae producing mass productions. Evidently, each one is "weather sensitive" according to its own character, thus their phenomena are rather divergent. Nevertheless, the atmospheric ionization finds "target" in every living plasma, to a large extent in the "leaders" ("managers") of life; the enzymes. Question marks are abundant in this field, but their obliteration promises fundamentally new knowledges. Thus the general question is: how does aeroionization display effect on the functioning of the enzymes? The most expedient is to analyse this basic question on the example of a very important biogenic amine wide-spread in the living-world; the serotonin 5-hydroxy-triptamine (5-HT). It has been known that serotonin is decomposed by the enzyme monoamine-oxidase (MAO): oxidating it to indole-acetic acid. The contradictory effect of the positive and negative air ions on the enzyme monoamine-oxidase has been demonstrated by Krueger with animal experiments. Together with his co-worker he wrote the followings (Krueger and Reed 1976): "In 1959 we found, by direct measurement, that negative air ions reduced the amount of free 5-HT normally present in the tracheae of mice and rabbits. When we exposed guinea pigs to negative ions and collected all the urine, we observed a considerable increment in the amount of 5-hydroxyindoleacetic acid, an inactive end product of the oxidation of 5-HT. These data suggested that negative ions lower tissue levels of 5-HT by accelerating this enzymatic oxidation process. Such a mechanism is consistent with the evidence of earlier experiments indicating that negative air ions can affect tissue oxidative reactions. When we exposed tissue homogenates in vitro to large doses of negative ions the rate of conversion of succinate to fumarate was notably increased. This demonstrates the ability of negative ions to promote one phase of the aerobic metabolism of carbohydrates in the Krebs cycle which produces the lionn's share of energy for all organisms that use oxygen in respiration. Similarly, treatment of the reduced form of cytochrome c with negative ions speeded up the formation of the oxidized form. Later it was observed in experiments with plants that air ions increased the uptake of iron. promoted production of cytochrome and other iron-containing enzymes, and enhanced oxygen consumption.

Many tissues contain the enzyme monoamine oxidase. Because the chief metabolic rouet for removing serotonin depends on oxidative deamination by monoamine oxidase, we advanced the hypothesis that small negative ions stimulate while small positive ions block monoamine oxidase action, thus producing, respectively, a drop or rise in the concentration of free 5-HT present in certain tissues and eliciting a corresponding physiological response. The probable validity of this hypothesis was established in extensive experiments conducted over a period of 16 years, with a genetically uniform strain of mice exposed at ground potential to preselected concentrations of small air ions in pollutant-free air under controlled conditions of temperature and humidity. High concentrations of positive ions raised blood levels of 5-HT, while high concentrations of negative ions had the opposite effect. We also found that the brain content of free 5-HT was responsive to the concentrations of air ions in the air. (In the course of this work, we have performed spectrofluorometric analyses on more than 12,000 brain and 36,000 blood samples from controls and ion-treated mice)."

These rather thorough and lengthy experimental results have also been strengthened by studies of others, therefore these can be regarded as the general mechanism of the atmospheric ionic effect. If the negative ion-overload appearing in the free atmosphere also acts stimulatingly on the enzyme monoamine oxidase, then we also gain a key for getting closer to the understanding of the algal mass productions and in general, the secrets of plant production. Serotonin is also known from the flora (*Lycopersicum esculentum, Gossypium hirsutum, Panacolus campanulatus,* etc.). Enzymatically, indole-acetic acid and 5-hydroxy-indole-acetic acid, resp. is formed from it, i.e. auxin or one of its alterations, in the case of atmospheric negative ion-overload. Auxin can also be found in algae, its effect is in relationship with the photosynthetic alimentary form. It has stimulating effect on the cell division of the green *Euglenophyton* species, but has no effect on their achromatic cognates. The formation of auxin, setting out from the triptophan amino acid, may perhaps even differ according to plant groups. *The fact that enzymatically auxin may develop from serotonin in the case of negative ion-overload, partially explains the relationship be tween the phenomena of algal mass production and the cyclonal atmospheric conditio ns, especially the showery Spring of 1984.* The problem range has been investigated by author for over 50 years, and here we can only refer to the most important stations in this respect (KISS 1942, 1950, 1952, 1953, 1955a, 1955b, 1957a, 1957b, 1958a, 1958b, 1959a, 1959b, 1960, 1961, 1964, 1969, 1979a, 1979b). Author's results proved to be new, and three objections were set forth to them. Namely:

1. Water coloration "forecasting" change in the weather is unfamiliar in ethnography. Author's answer: The following regulation from Veszprém county became known in 1949: "Rain will arrive by the third day if there is a watery moon (if the halo of the moon can be seen), the sun sets amidst coluds if the colour of the puddle, standing water is green" (SÜLE 1949).

2. Water bloom indicating change of weather is not known from the literature. For answer, such publications were searched for by author in which the time-point of the beginning of mass productions was also reported on. Such exact reports were given by SZABADOS (1936), SEBESTYÉN (1934), KOL (1949), 1968, GELEI (1950), PALIK (1955). These were analysed meteorobiologically and completely verified the reality of author's notion.

3. Why doesn't an alga culture always signal the change of weather? Answer: The algae are not instruments which could be handled to preference. Ontogenetic processes take place in their evolution, and the individual development is a process taking place only once, being suitable for signalling only one concrete atmospheric process.

It is also expedient to speak of the relationship between the water bloom of cold seas and aeroionization, Attempt was also made by author to interpret the rich phytoplankton production of polar regions on the base of enhanced aeroionization (Kiss 1979b). It was perhaps Darwin who first discussed this question (who first wrote about this question). He wrote the followings in his book about his trip around the world: "I can mention the remarks of Scoresby, according to which green water can constantly be found at certain parts of the polar seas, which are extremely rich in animals living in surface level". He wrote of their development as follows: "... it should be assumed that the organic bodies are produced at certain favourable places after which the water or wind carry them off (they are carried away by the water or wind). However, I must admit it is difficult to imagine such a place which serves as the place of birth of millions and millions of animals and algae: because how do the initial bodies get to such places?" Darwin himself also mentions the coloration of sea water in several parts of his book and lists several authors in footnotes, who spoke of the planktonic coloration of sea water (Darwin 1951). At the Antarctic Mirnij research establishment Bujnickij, the well-known antartic explorer, carried out experiments over a period of several years. In a brief report an account is given of his experiences as follows: "...the ice is practically engorged by the myriads of tiny, unicellular sea-plants, of which more than one hundred species live and develop on and under the ice — surviving the most coldest weather, too." According to his opinion: "... through the melting of the ice such a nourishing soup is gained by which numerous simple forms of life can subsist on" (Várhelyi 1975). In Hungary, Balogh (1980) writes on the rich living world of the polar regions in detail. He writes the followings in the chapter entitled "Sea currents": "A biologist named the plankton of the sea thin meat soup. This naming is very appropriate, and as the token of the previous scientific explanation it can also be added that this meat soup is the thickest in the cool (cold) seas. The Humboldt-current has probably been carrying up the plankton alongside the shores of South-America since millions of years".

The atmospheric ionization is presumably stronger at the polar regions, as here the particles, protons and electrons arriving from the direction of the sun are less hindered in penetrating to the lower parts of our atmosphere, and constantly maintain the considerable ionization of the air there. The great energy zone, the system of the van Allen-zone or Vernovrings has become known through space-researches. The cause of this great energy radiation zone is that the magnetic field of our planet captures and even holds on to the protons and electrons originating from the sun, being an actual trap for these. This radiation zone extends above the earth surface confinable by the polar circles on an average from 1000 kilometres height upwards till heights of several ten thousand kilometres (Nagy 1964). The radiation zone is practically missing above the areas beyond the polar circles, therefore the particles can penetrate down to the lower layers of our atmosphere. If at the polar regions it is also possible that in case of the negative ion-overload of the atmosphere, auxin or its mentioned alteration may develop enzymatically from serotonin, general in the living world, then partial explanation is obtained to the development of the rich algal mass productions at the polar regions, too. Naturally, photoperiodicism may also be of significance among other factors. If the spaces above the polar regions actually function as planet-sized ionizers, then in the more distant future these can be utilized for the big industrial establishment of organic matter production with algae. This would contribute to the complete utilization of the biomass and at the same time would also mean the setting of the polar regions into the production.

Despite the many showers, the Spring and early Summer of 1984 were droughty, which damaged (was harmful to) our cultivated plants. Nevertheless, the *Helianthus annuus* shot up suddenly at places, and the *Lycopersicum esculentum,* the *Armeniaca vulgaris (Prunus armeniaca)* and the *Prunus domestica* crops were also unusually high at places. It is presumable that the air-ionizing effect of the weather with lightnings and showers also played role in this.

We hardly have any knowledge on the effect of air ions on enzymes, thus further explorations in this regard may contribute much to physiological and ecological sciences. In any case, it must be considered that from the external conditions not only the temperature and pH-value have great effect on the enzyme functions, but also the character and degree of aeroionization.

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Feltűnő algatömegprodukciók kialakulása a Tisza-völgy Alpári-medencéje területén

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Szerző az algatömegprodukciók kialakulásának légköri tényezőit több mint 50 éven át kutatva azt állapította meg, hogy azok az időjárás ciklonális-depressziós helyzeteihez kapcsolódnak, s többnyire előre jelzik az időjárás megváltozását, eső közeledtét. Hatótényezőként a légköri ionizáció fokozódására következtetett. Az Alpári-medencében például 1975—1983-ig 25 esetben talajt és ugyanennyi vizet színező algatömegprodukciót talált, 1984. május 20-án pedig 70 talajt színező és 10 vizet színező algatömegprodukciót észlelt. Ez évben a tavasz szokatlanul zivataros volt, s a légkör jelentősen ionizálódott. Az a tény, hogy a serotonin (5-hidroxi-triptamin = 5-HT) biogén amin-ból jelentős negatív aeroionizáció esetén indolecetsav (auxin), vagy annak egyik módosulata képződik, részben magyarázza az algatömegprodukciók ciklonális időjáráshoz való kapcsolódását. Ionizációs hatásokkal magyarázza szerző a sarkvidékek gazdag algatömegprodukcióit is. Itt egyéb tényezők között a fotoperiodizmus szintén szerepelhet.

Заметное развитие водорослевой продукции на территории долины Тисы Алпарской котловины

Кишш И.

Рабочая группа исследователей Тисы, Сегед

Резюме

На протяжении 1975—1983 годов автор в 25 местах Алпарской котловины отмечал «цветение воды» и в 25 местах — «цветение почвы». Но в мае 1984 года только во время единственного выезда было обнаружено 70 случаев «цветения почвы» и 10 случаев «цветения воды». Причиной возникшего явления автор считает ранюю и бурную весну, то есть климатические условия. В этом направлении автор ведет наблюдения больше 50 лет. При метеорологическом анализе было обнаружено, что массовое развитие водорослей зависит от циклональной депрессии климатических условий. Большое значение в этой связи имеет атмосферное электричество и атмосферная ионизация, которая стимулирует у водорослей обмен веществ и тем самым ускоряет их размножение. Триптамина моноамин-оксидаз энзим оксидует на индолецет (ауксин). Кругер в своих работах показал, что отрицательные ионы стимулируют, а положительные тормозят влияние этих энзимов. Известно, что при бурных климатических условиях ионизация воздуха значительно изменяется. Тот факт, что под влиянием отрицательной ионизации может возникнуть ауксин, стимулирующий развитие водорослей, объясняет и массовое размножение их в 1984 году, вследствие бурных климатических условий.

Masovna produkcija alga na području basena Alpár u dolini reke Tise

Kiss I.

Istraživačka grupa reke Tise, Szeged

Absract

Autor je u periodu 1975—1983. godine registrovao ukupno 25 pojava „svetanja vode" u vodama basena Alpár, a takodje i 25 pojava masovne produkcije alga na tlu, „cvetanje tla". Takodje je 20. maja 1984. godine zabeležio 10 „cvetanja vode" i 70 „cvetanja tla".

Autor, uzročnu povezanost izmedju masovne produkcije alga i klime, izučava već više od 50 godina. Utvrdio je da se masovna produkcija alga obično javlja u vezi sa ciklonalnim depresivnim pojavama klime. Ukazao je na elektricitet i jonizaciju vazduha, kao uzročnike ove pojava. Naime, poznata je činjenica da se razlaganje serotonina (5-hidroksi-triptamin) u biljkama vrši pod uticajem enzima monoamino-oksidaze, koji ga oksidiše do indol-sirćetne kiseline, odnosno 5-hidroksi-indol-sirćetne kiseline. Poznata je pojava da se za vreme oluja jonski sastav vazduha često i značajno menja. Činjenica, da se pri povećanoj negativnoj jonizaciji vazduha iz serotonina može javiti indol-sirćetna kiselina, odnosno njegov neki derivat, delom ukazuje na zavisnost mesovne produkcije alga od ciklonske aktivnosti. Ova uslovljenost je naročito uočljiva u toku proleća 1984. godine sa čestim olujama. I fotoperiodizam može izazvati masovnu produkciju alga.

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STUDIES ON THE VEGETATION DYNAMICS OF NANOCYPERION COMMUNITIES I. CHARACTERISTIC INDICATOR VALUES AND CLASSIFICATION AND ORDINATION OF STANDS

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Abstract

The results of vegetation dynamic studies performed on cenoses of Nanocyperion nature, standing close to the *Cypero — Juncetum* and *Dichostylidi — Gnaphalietum* associations can well be interpreted with the help of the characteristic indicator values. The seasonal changes taking place in the cenoses are manifested in the decrease of the mean W-value as well as the relief-dependent development of the N-value. The decrease of the mean W-value of the cenoses is the consequence of the drying out of the biotope and the accomodation to this. The development of N-values is explaned by the varying succession types at the higher and lower reliefs.

The general statements of the present paper analyse the conditions of applicability of the characteristic indicator values. The application of the indicator values should be preceded by detailed preliminary investigations, however, the analysis of the causes of deviations of the indicator values from literary data makes possible the drawing of conclusions concerning the structural characteristics of the community in certain cases.

The demonstration of the deviations of the indicator value is made possible by statistic mathematical methods, in a given case by the reciprocal averaging ordination technique. The search for the causes of deviations is aimed at the exclusion of certain factors as possible causes.

Introduction

The Nanocyperion-like cenoses — owing to the fast changes taking place in them — are particularly suitable for vegetation dynamic studies. It is due to the adaptability to the short vegetation period that both the settlement and the penetration of foreign elements, and with this the decomposition of the Nanocyperion associations, take place rapidly. In our case (and in general) the short vegetation period was ensured by the long-lasting water-covering. While the slowly changing associations have to be moved from their relative stability with perturbations originating from drastic external influence, e.g. selective exstirpation with herbicides (FEKETE—VIRÁGH 1982), the river-bed Nanocyperion stands can also be studied under natural conditions from the viewpoint of vegetation dynamics. They are dynamic enough to be able demonstrate actual, mathematically evaluable changes within a short time and so perform quantitative vegetation dynamic studies, even without external influence. In the case of selective exstirpation populations, population groups fall out of the system, thus the direction of dislocation and the mode of regression may give rise to problems. The advantage of the dynamic studying of natural states is that the structure of the cenoses associations is free from external influence. The results obtained for the Nanocyperion cenoses may be adapted to slowly changing, perhaps even economically more important, other communities. In the interest of setting up the analogues for adaptation, the changes taking place in the Nanocyperion communities and the causes of the changes should be described.

The studied area is located in the channel of the Körös river, at a distance of one kilometre from the barrage at Békésszentandrás. The fluctuation of the water level is particularly great because of the barrage, and this creates favourable conditions for the development of mud vegetation. This section of the channel at Körös river has not yet been thoroughly investigated. Studies on areas located closest to this region include a report on the vegetation at Tiszazug (TÍMÁR—BODROGKÖZY 1959). The area section where vegetation dynamic studies have been performed is about 100 m².

In general, it could be said that such areas are the most suitable for studies of this nature, the parts of which are discrete, well separeted from each other, and there is no specific direction in cenoses belonging to various plots, at the same time the succeeding plots can be arranged in a continuous row along some continuous variable, e. g. humidity gradient determined by relief. It can be seen from the map of the area that these conditions are given with good approach (Fig. 1).

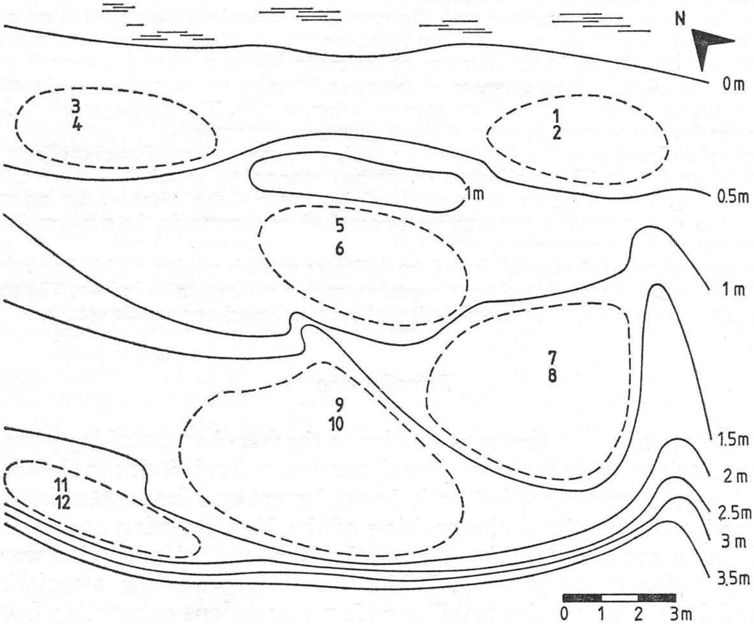

Fig. 1. The studied area on September 6, 1982. The complete area is 250 m². 100 m² of which is a section processed in vegetation dynamic studies. The plotted areas are mostly horizontal, divided from each other by steep berms. The probable cause of the reliefs' formation is the uneven sinking taking place due to the effect of the undermining following the landslip of the steep bank

The six plotting areas marked by dotted lines on the map are found at five differing reliefs. The various plots are separated from each other by steep berms, and of reliefs being almost horizontal. Therefore, the vegetation on these is of even cover and composition. The relief-distribution also implies a certain kind of shift in time, as regarding the main lines similar processes take place at the various reliefs, however, the divergency of the transformations is of determinative significance in the ordination studies of the stands. The relevés were taken at two times: September 6, 1982, the level lines refer to this date; and October 30. Earlier stands are indicated by odd numbers. Between the two points of time, the level had dropped consistently by one metre.

Materials and Methods

The cenologic table gives the relative partial-covering of the species in percentage. The traditional A—D values are not of acceptable accuracy from viewpoint of the further calculations. Considerable differences can be experienced in the total covering of the various relevés, thus it is expedient to use the values referring to 100% in the ordination and classification techniques. Since the studies firstly tend towards shifts of proportions, these are best emphasized by supplementing to 100%.

In the cluster analysis, the combination of the similarity values calculated with the CZEKANOWSKI-index was performed by weighted average method. The CZEKANOWSKI-index is:

$$S_{jk} = \frac{2 \sum_i \min \left\{ x_{ij}, x_{ik} \right\}}{\sum_i x_{ij} + x_{ik}}$$

where S_{jk} is the similarity of two — j and k-objects, stands
x_{ij} and x_{ik} are the concrete values in j and k stands referring to the adequate, i^{th} attribute; partial coverings of species.

The ordination of the cenoses was accomplished by the reciprocal averaging method. The method belongs to the correspondancy analyses, the basis of which is that "the species-scores are averages of the stand-scores and reciprocally the stand-scores are averages of the species-scores" (HILL 1973). Therefore, as the end result of an ordination process the species and the stands also become ordinated. The joint ordination does not mean logical advantage for either of these. The causes of the method selection become evident in the second half, as the main advantage of the method is that, contrary to the PCA-ordination, it gives the "markedly meaningfull' ordination of the species, while the ordination of the stands does not give essentially better results. Compared to other ordination techniques, it could be determined that in the case of reciprocal averaging the end result of the ordination only depends on the data of the contingence table, while, for example in the case of polar ordination (PO), the extremity is subjectively determined in the case of FCA various results are obtained with the application of differing transformations and transformation-combinations (GAUCH—WHITTAKER—WENTWORTH 1977).

The methods applied in the soil proceedings were the following: the determination of the soil fractions refer to the mechanic composition of the soils, performed by the hydrometric method. The binding of the soil could be concluded by determining the restriction number of ARANY and the hy values. The measurings of pH and $CaCO_3$ belong to the investigations concerning chemical reaction, the former was performed with the use of electric pH meter, the latter by calcimetre of SCHLEIBLER. The humus was determined with dichromatic method with photometric evaluation. The total salt content of the soil was demonstrated on the basis of measuring the electric conductivity (BALLENEGGER-DI GLÉRIA 1960).

Vegetation of the area

In the beginning, the predominance of the Nanocyperion character-species was characteristic to the cenoses occuring in the area. These formed the following associations:

— *Cypero-Juncetum bufonii* Soó et CSŰRÖS (27) 44,
— *Dichostylidi-Gnaphalietum uliginosi* (*Horvatić* 31) Soó et TÍMÁR 47.

Later, the coverings by the Bidentetea character-species relatively increased, as the consequence of which certain cenoses transformed into Bidentetea associations:

— *Echinochloo-Bidentetum* Soó 71,
— *Polygono-Bidentetum* (FELFÖLDY 43),
— *Dichostylidi-Chenopodietum rubri* (TÍMÁR 47) Soó 71

Owing to the favourable living conditions rapidity is the decisive role in becoming populous, therefore mixed plant associations develop; the different relevés — especially at the later point of time — can only be identified with various associations with difficulty.

The changes in the composition of the vegetation are observable on Table 1.

Results

Classification of stands according to species coverings

The most direct manner of comparing the changes experienced in the cenoses is the classification according to species coverings.

According to the dendrogram of the classification (Fig. 2), the relevés situated at deeper relief, taken at the earlier date, are well separated, and also well separated on high similarity level. In their later state the stands show greater similarity to the higher reliefs' earlier and each others later state, resp., than to their own earlier state. This fact shows the fast transformation of the cenoses developing at the areas just becoming dry. In the case of the cenoses on higher relief, apart from the slighter simi-

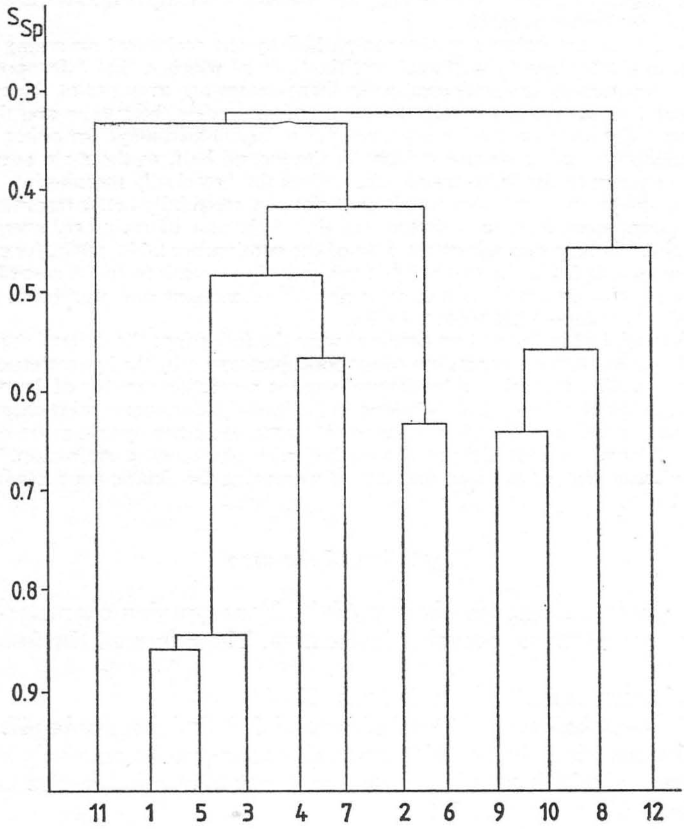

Fig. 2. Dendrogram of the cluster analysis according to species composition. Intensive changes take place at the lower relief, the changes in species composition slow down at higher relief

larity, the phenomenon also occured that the stand was the most similar to its on later state. The changes were less intensive at the higher areas.

The causes of the changes could not be concluded merely on the basis of the cenoses. Considering Table 1, it could be determined that the process taking place on the lower relief manifested in the repression of the Nanocyperion elements. The slower changes of the cenoses found at higher relief are mainly the consequences of the long-lasting occurence of the Chenopodio-Scleranthea, within this the Bidentetea species.

Table 1

CIV W	CIV N	Species (Number of stand:)	01	02	03	04	05	06	07	08	09	10	11	12
10	6	*Cyperus fuscus*	20	2	17	10	20	4	11	+	17	+	58	+
10	5	*Dichostylis micheliana*	36	2	43	6	38	+	11	+	9	+	2	+
9	5	*Gnaphalium uliginosum*	8	5	5	17	6	9	8	+	3	+	1	5
6	5	*Rumex stenophyllus*	4	21	2	7	2	17	1	4		4		2
9	6	*Veronica anagallis-aquatica*	2	3	1	+	+		3	2				
7	5	*Potentilla supina*		5		2		4		1		2		
9	6	*Polygonum hydropiper*								8	+	6		
8	4	*Rorippa sylvestris*	4	9	4	22	5	34	8	3	9	10	6	1
7	6	*Plantàgo major*	8	9	9	3	10	9	4	6	9	10	17	4
9	6	*Echinochloa crus-galli*	2	3	2	2	3	3	1	14	13	13	6	20
2	7	*Portulaca oleracea*					1	+			3	2		
5	8	*Amaranthus lividus*	+	4	+	1	2	7	2	+	3	+	2	3
5	9	*Chenopodium album*		1		+			+	4	4	8		2
7	8	*Chenopodium polyspermum*			+		2		2		3			+
7	9	*Chenopodium rubrum*	5	2	2	17	3	4	12	4	5	7	+	2
9	7	*Polygonum lapathifolium*	2	+	1	+	3	+	15	26	3	4	+	3
9	5	*Lythrum salicaria*	7	17	7	4	4	3	8	8	7	10	+	8
8	5	*Lythrum virgatum*		+	1	+		+	3	2	4	3		
7	6	*Tanacetum vulgare*		4		1	1	3	1	5	+	4		+
8	5	*Agrostis stolonifera*		+		4		1		+	+	6	+	10
9	8	*Bidens tripartita*		1		1	+	2	1	6	+	1	+	15
8	7	*Xanthium italicum*		2	3	+			8	6	1	1	3	10
10	6	*Salix triandra (juv.)*		1	1				+	+	4	4	3	+
		Total covering (%)	20	85	20	75	60	95	30	90	70	85	85	80

Alisma lanceolatum 8+; *Amaranthus retroflexus* 2+, 4+, 10.2, 12.2; *Atriplex hastata* 2+, 4+, 8+; *Chenopodium chenopodioides* 3.3, 4+, 9.1, 10.1; *Ch. ficifolium* 7.1, 8.1, 9.1, 10.1; *Ch. glaucum* 9+, 10+; *Chlorocyperus glomeratus* 2+, 4+, 5+, 6+; *Cirsium arvense* 11+, 12.5; *Heleochloa alopecuroides* 5+; *Juncus bufonius* 4.1; *J. effusus* 2.1, 4+; *Limosella aquatica* 2+, 4+; *Lycopus europaeus* 6+, 10+; *Malva neglecta* 10+; *Matricaria maritima* ssp. *inodora* 2+, 4+, 8+, 10+; *Oenanthe aquatica* 1+, 2.4, 7+, 8+, 10+; *Ranunculus sceleratus* 4.1; *Sonchus asper* 8+, 10+; *Typhoides arundinacea* 11.2, 12.5; *Urtica dioica* 6+, 10+; *Veronica beccabunga* 1.2, 2.4, 3+, 4+.

CIV — Characteristic indicator value
W — Water (Moisture) figure
N — Nitrogen figure

Classification according to the W-characteristic indicator value

The indicator values determined by ZÓLYOMI and his co-workers serve as the base of classification (ZÓLYOMI et al. 1967). The cluster analysis is performed according to the combined partial covering values of the plant species characterised by identical indicator value.

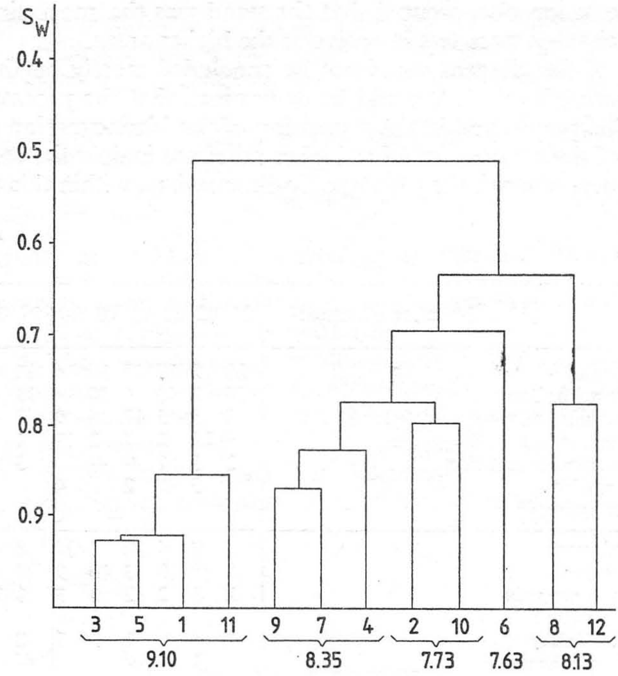

Fig. 3. Dendrogram of cluster analysis of species groups formed after the combination of speces with identical W-indicator values. The mean indicator values are higher in the groups of the earlier stands

The stands can be divided into two groups by classification on the basis of indicator value according to water demand, or rather hygrofrequency (Fig. 3).

The groups of stands, as well as their smaller units, can also be characterized numerically with the average of the mean indicator values reckoned for the stands. Mean indicator value for one stand:

$$W_j = \frac{D_1W_1 + D_2W_2 + \ldots + D_nW_n}{D_1 + D_2 + \ldots + D_n} = \frac{\sum_{i=1}^{n} D_{ij}W_i}{\sum_{i=1}^{n} D_{ij}}$$

where W_j is the mean indicator value of the j^{th} stand
W_i is the indicator value of i^{th} species
D_{ij} is the weighting of the indicator value of the i^{th} species on the basis of the dominancy value
n is the number of species

The cenoses standing mainly of Nanocyperion elements can be well separated: 1, 3, 5, 11. Compared to the rest of the groups the average of the mean indicator values is also essentially higher: 9, 10. Comparing the results of the classification according to species covering and W-value, a number of substantial deviations can be found besides the similarities, referring to the fact that apart from the appearence of species with less water-demand (less hygrofrequent) and the repression of those with greater water-demand, other factors also play a role in the transformation of the cenoses.

Ordination of stands on the basis of the covering values of species

Another way of comparing the changes in the characteristic indicator values and the abundancy-dominancy of the species is the ordination performed on the basis of the covering values of the species. The search for such a line in the ordination figure along which the mean indicator values as environmental gradient labels — belonging to the corresponding stand, arrayed at the foot-end of the perpendicular projection of the stand — can be ranged in order of a certain direction. (The direction of the searched straight line does not necessarily correspond to the direction of the axis.)

The ordination of the cenoses was performed with the reciprocal averaging technique (Hill 1973). The results of the ordination can be seen on Fig. 4. It is observable that the early stands labelled with circles can be found at small axis values. In contrast to the dendrogram according to species, the 11th relevé is in good connection with the rest of the earlier stands. The early stands of lower relief and the 11th relevé are grouped at the rather low values of the 1. axis, and the 7th and 9th from the early relevés at medium values. In the case of the later ones, at least the axis values is high, one of thus considerable separation is detectable in the situation of the early and late cenoses, but differentation is also great according to which axis value is high; this divides the later cenoses into two groups: the 2., 4., 6. are found at the lower areas of sampling, and the 8., 10., 12. at the higher ones.

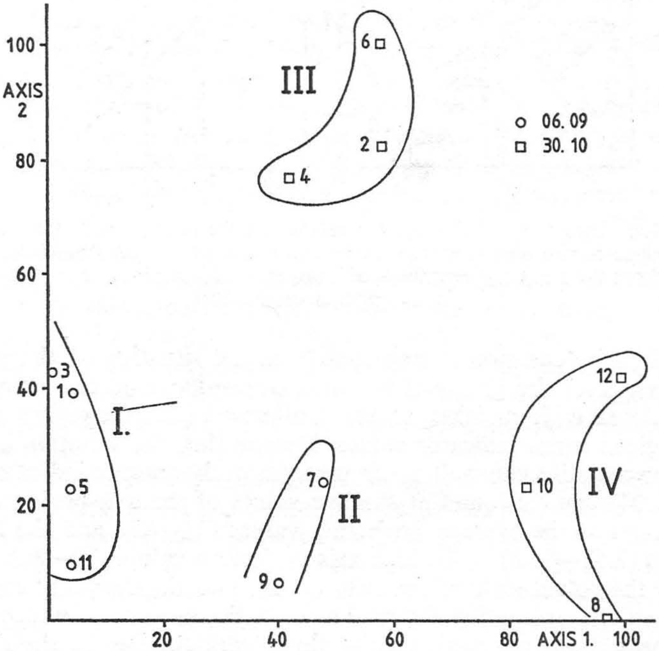

Fig. 4. Reciprocal averaging ordination of the stands. I. early stands of lower relief and stand 11. II. early stands of higher relief. III. later stands of lower relief. IV. later stands of higher relief

On the ordination figure, in the bisector of the axis, a straight line (labelled with W) is drawable, on which perpendiculars from the points representing the cenoses can be drawn. The foot-ends of the perpendiculars are situated on W-straight line approximately in the order of the mean W indicator values of the cenoses in hand (Fig. 5).

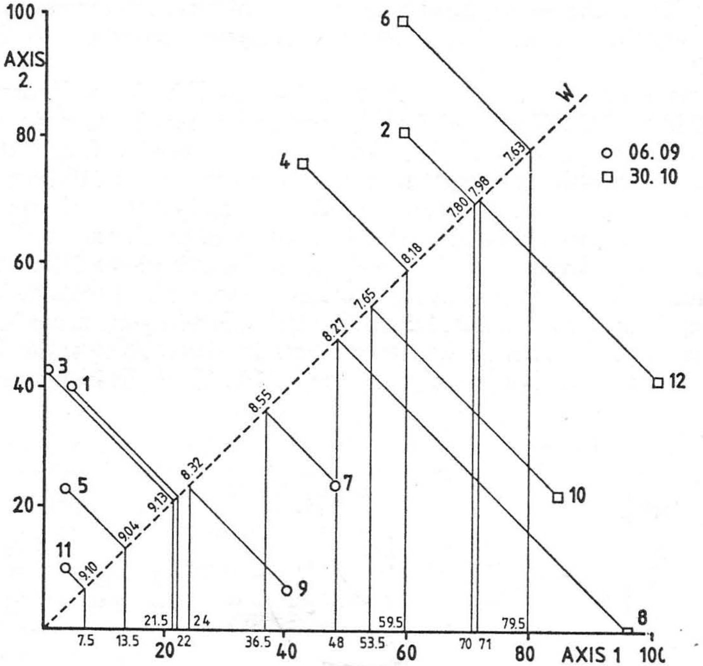

Fig. 5. Connection between W mean indicator values and the ordination I. The average indicator values characteristic to the object, written to the foot-ends of the perpendiculars falling on the W-straight line from the point representing stand, can put in order along the W-straight line, which is the principal component

Perfect linearity can not be expected from the situation of the points on the W-straight line, since the giving of the indicator values and the estimation of the cover are burdened with mistakes, and this influences both the results of the ordination and the given mean indicator values. Despite this, the situation of the various indicator value domains can well be circumscribed: the greatest indicator value averages (9.30—9.04) can be found at the low values of the axis-projection (7.5—22), the medium ones at the average projection values (24—60), and the low indicator value averages (7.63—7.98) at the high axis-projection values (70—80).

Not only the actual state of the cenoses, but also the degree of changes can be concluded from the ordination figure. Dividing the cenoses' distance of the foot-ends of the projections perpendicular to the W-straight line by the change in the calculated mean indicator values, a constant value is obtained with slight dispersion; besides the differentation of the prominent value (SVÁB 1981).

Table 2

	A	B	A/B	$\bar{x}$ - A/B
1—2	4.12	1.33	3.10	+0.47
3—4	3.24	0.95	3.41	+0.16
5—6	5.61	1.41	3.98	-0.41
7—8	1.00	0.28	3.57	0.00
9—10	2.55	0.67	3.81	-0.24
11—12	5.48	1.12	(4.89)	

$$\bar{x} = 3.57$$

$$s = \sqrt{\frac{\sum(\bar{x} - A/B)^2}{n-1}} = 0.34$$

$$V = \frac{s}{\bar{x}} = 9.52\%$$

A — relative distance on W-straight line
B — difference of mean indicator value between the early and later stands
s — dispersion
V — dispersion coefficient

The relationship between the ordination figure and the indicator values could be made more expressive by demonstrating the foot-ends' projection perpendicular to the axis (W-projection) in the function of the indicator values (Fig. 6).

From the 12 relevés, 10 fall to one straight line with good approach and 2 to a straight line close to parallel with the former. The two prominent relevés are the early and later cenoses of the same area. This fact gives rise to certain problems.

It can be seen from the comparison of Fig. 6 and Table 2, that in the 9—10 transitions the dispersion of the values compared to each other of the degrees of the changes (the change in the mean indicator value and the change readable from the ordination figure) is a low value, at the same time the changes is attained at lower level of almost half an indicator value than expectable. It could be determined on the base of the species' covering values that there is no such species, the faulty indicator value of which would be responsible in itself for the lower mean values.

Presuming that the ordination of the 9th and 10th stands was performed at the place determined by the actual indicator values — this could be decided by a similar study according to nitrogen-demand, which, however, is not exact — it could be assumed that in the two stands the selected indicator values are in general lower by half a unit than the actual W-indicator values. It seems as if the plants of the 9th and 10th relevés are greater water-demand than presumed, by the traditional interpretation of the indicator values.

On the other hand, it is striking that the values of the perpendicular projections of the points representing the mentioned stands, falling directly to the 1. axis, fit well to the drawn straight line in the CIVw-W projection system of co-ordinates. Moreover, in such way the fit to the N-straight line is also more exact. (cp. point 6).

All these are warnings for the circumspect use of the indicator values. Concerning this, it could be mentioned that in a hyroecological system of greater disintegration (Bodrogközy 1982) a definite shift is demonstrable between the W-indicator values described for various species on the basis of the Ellenberg-type (Central-West-European) as well as Hungarian studies (Ellenberg 1979). Such difference

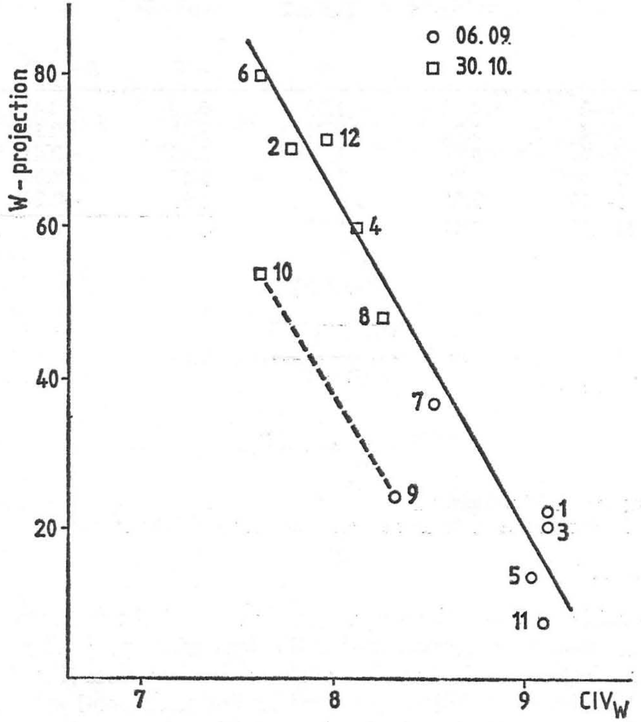

Fig. 6. Connection between W mean indicator value and the ordination II. The points representing the cenoses fall to one straight line, with the exception of one site of plotting. The dispersion coefficient of the tangents of the straight lines connecting the early and later stands — with the separation of the prominent value (11—12 stands): 9.76%. The deviation from the dispersion coefficient of the distance — mean indicator value difference is due to the errors of measuring of the relative distance in the ordination figure. CIV_w is W mean characteristic indicator value, W projection: the objects' projection falling to the axis of the foot-ends of the projections perpendicular to the W. The exact values of both can be read from Fig. 5.

may also develop within small areas. Regarding large areas, the probable cause of the indicator value-deviations is the adaptation due to abiotic differences, the cause of which can be experienced within small areas may also be owing to the role played by inter-, or intraspecific effects arising between the plant individuals.

Nevertheless, the abiotic factors also have be taken into consideration. Because of the small distances the differences of the microclimate are negligible, and similarity, the parameters connected with the soil's economy of water supplies do not show essential variations. The results of the studies in respect to the soil are observable on Table 3.

The demonstration of the inter-, or intraspecific competition requires thorough studying, mainly in connection with niche segregation (FEKETE—PRÉCSÉNYI 1976). The performance of such studies encounters difficulties on Nanocyperion-like associations, at least under natural circumstances, due to the low stability.

In a given case the average indicator value deviation most likely arises from the frequency character of the indicator values. The basic mass of the relevés considered during the determination of the various species' — mainly Chenopodio-Scle-

Table 3

Cenoses	Depth of soil (cm)	Soil fraction Sand	Silt	Clay	$CaCO_3$ (%)	pH	Humus (%)	Total salts	hy	K_A
1—2	0—10	30	35	35	1.57	7.25	3.11	0.078	1.404	54
	10—20	25	35	40	1.44	7.38	2.81	0.078	1.684	54
	20—30	15	41	44	1.30	7.30	3.41	0.080	1.843	55
7—8	0—10	18	42	40	1.56	7.23	3.03	0.094	1.764	58
	10—20	25	35	40	1.62	7.28	3.11	0,094	1.731	58
	20—30	21	36	43	1 80	7.38	3.20	0.092	1.901	56
9—10	0—10	21	38	41	1.56	7.24	2.94	0.106	1.714	54
	10—20	28	32	40	1.28	7.32	2.94	0.090	1.714	54
	20—30	28	32	40	1.28	7.35	2.51	0.085	1.689	53

ranthea elements — indicator values does not represent the section mass of the relevés originating from the Nanocyperion associations. The frequency of the section mass is maximal at an indicator value differing from that of the basic mass.

Classification according the N characteristic indicator value

On the basis of the deviations of the W characteristic indicator values and the dendrograms of the cluster analysis according to species coverings, it can be assumed that the species component-transformation taking place due to the effect of drier conditions does not explain complately the changes developing in the cenoses, although this is without doubt the most important. Therefore the studies should be extended to the further indicator values. Under flood-plain, watercourse conditions the R-value, the parameter indicating the reaction-tolerance of the plants has no importance, this is referred to by the large partial covering of the populations indifferent from this point of view. A similar situation can also be determined concerning the T-value, the indicator value referring to temperature demand.

However, classification according to the N characteristic indicator value, i.e the parameter indicating nitrogen demand, is effective (Fig. 7). The applied N-values were established with the adequate modification of the values given by Soó (Soó 1964—80).

The cluster analysis according to the N-value divides the cenoses into two groups. The stands 1—6 are characteristic of the small ratio of the nitrofrequent species, stands 7—10 and 12 can be characterized by high mean indicator values. Stand 11 can be contrasted with the rest on low similarity level in the dendrogram. Comparing the dendrogram prepared according to the N characteristic indicator values, with the dendrogram prepared according to species coverings, they manifest a similarity of high degree. The group of less nitrofrequent cenoses are also separated on the dendrogram according to species. The separation is only partly explained by the great similarity in covering of the various species (cp. classification according to W). Stand 11 shows slight similarity at both places with the rest of the stands. The nitrofrequent cenoses also separate during the course of cluster analysis according to species. It is characteristic that both earlier and later cenoses belong to the various groups.

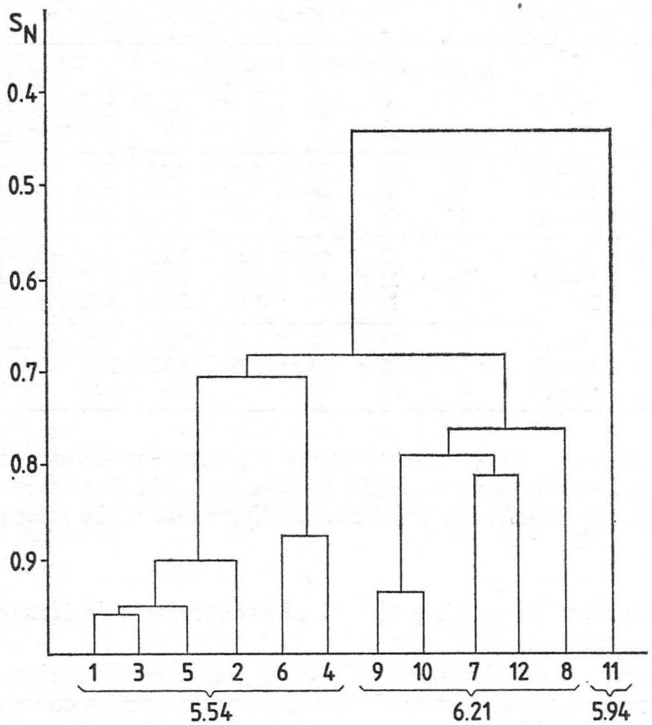

Fig. 7. Dendrogram of cluster analysis according to species combined on the basis of identical N-values. The combination does not change significantly the structure of the dendrogram of classification according to species covering. Besides the general effect caused by drying out, the dendroram of the classification regarding species covering is formed by the differentiating effect of the appearing nitrofrequent plant species

N-value and the ordination

In the ordination figure, a straight line can be drawn perpendicular to W, along which the cenoses can be divided into three groups on the basis of the mean N-values belonging to the various stands (Fig. 8). Elements of these groups correspond to the results of the classification according to N. The N-values are less exact than the W-values, thus it cannot be expected that the projections of the foot-ends of the perpendiculars falling on the N-line from the objects would give such a well definable straight line on the axis in the function of the indicator values (cp. point 4). Nevertheless, the separation of the various groups is striking. The first group belongs to small axis-1 projection of the N-straight line (20—40 intervals), the average of the mean indicator values belonging here is 5.54. The other large group of the stands belongs to high projection — value (60—100 intervals), the average here is 6.21. The 11th stand is found between the two mentioned groups in respect to average indicator value as well as on the ordination figure.

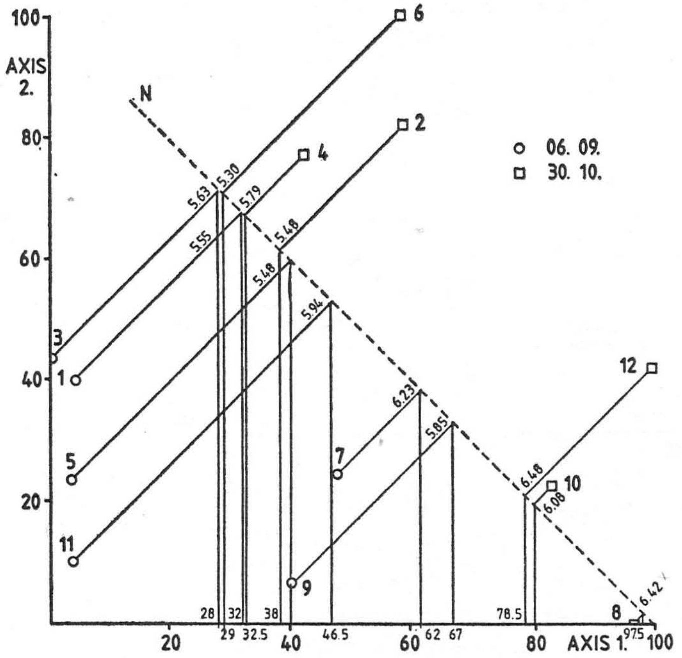

Fig. 8. Connection between the N mean indicator values and the ordination. The cenoses' N mean indicator values (analogously with the W-value) form groups arranged according to size along the N-straight line, as second principal component

Conclusions

The changes in the species component ratios of the cenoses reflect the draining of the area well (Fig. 9). While every earlier stand is found at the higher values of the W straight line, the later ones shifted towards the lower values. From the viewpoint of the appearence of the nitrofrequent species the cenoses can sharply be divided into two groups. The ratio of the nitrofrequent species hardly changes in those of lower relief (interior primary succession — change in aspect), intensive nitrofrequent inflow is manifest into those of higher relief (exterior primary succession — primary succession taken in the traditional sense). The transitional state is represented by the 7^{th} and 9^{th} stands, it is presumable that an earlier sampling brought closer these cenoses to the rest of the cenoses taken on September 6.

It can be established that in their early state the cenoses of the studied area were composed of hygrofrequent, less nitrofrequent, mainly Nanocyperion elements. Parallel with the progress of the vegetation period and the draining of the area the hygrofrequent species are repressed, their expansion slows down, thus there is an increase of species which are more tolerant to drier conditions. On higher relief a significant percentage of these are nitrofrequent species, mainly Bidentetea elements. On lower relief the proportion — increase is typical of the non-nitrofrequent, mainly later appearing, less hygrofrequent Nanocyperion species, the non Bidentetea species belonging to the Chenopodio-Scleranthea division as well as the species classable both among the Nanocyperion and Bidentetea association-groups.

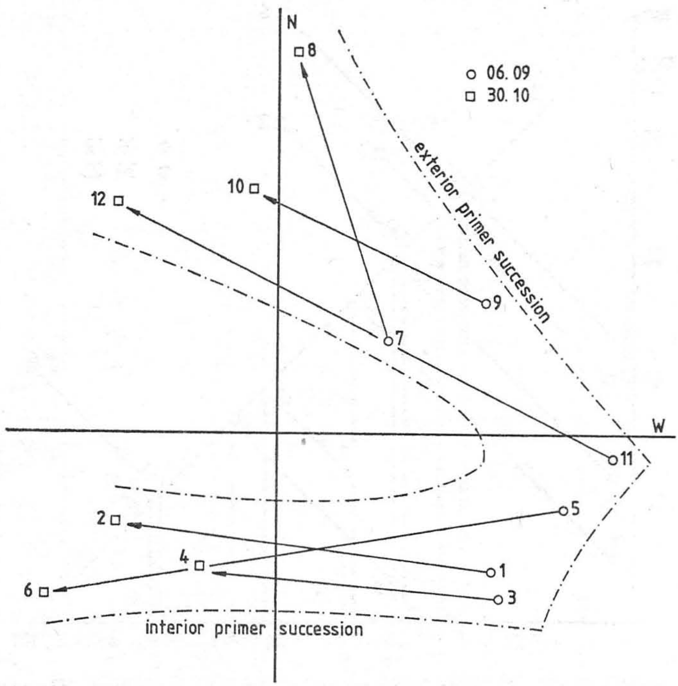

Fig. 9. Interpretation of the transformation of the cenoses in the function of the principal components. W: the vegetation accomodates to the continuous draining in composition. N: the succession types of the higher and lower reliefs are divergent

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Vegetációdinamikai vizsgálatok Nanocyperion jellegű növénytársulásokban I.

A felvételek klasszifikációja és ordinációja, valamint a karakterisztikus indikátor értékek

I. BAGI

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Nanocyperion jellegű, *Cypero-Juncetum* és *Dichostylidi-Gnaphalietum* asszociációkhoz közel álló cönózisokon végzett vegetációdinamikai vizsgálatok eredményei a karakterisztikus indikátorértékek segítségével jól értelmezhetők. A cönózisokban bekövetkező szezonális változások az átlagos W-érték csökkenésében, valamint az N-érték térszintől függő alakulásában nyilvánulnak meg. A cönózisok átlagos W-érték csökkenése a biotóp kiszáradásának a következménye, az N-értékek kialakulását a magasabb és az alacsonyabb térszín szukcessziójának eltérő típusa magyarázza.

A dolgozat általánosítható megállapításai a karakterisztikus indikátorértékek alkalmazhatóságának feltételeit elemzik. Az indikátorértékek alkalmazását számos részletre kiterjedő elővizsgálatnak kell megelőznie, viszont az indikátorértékek irodalmi adatoktól való eltérése okainak elemzése egyes esetekben lehetővé teszi a társulás strukturális sajátosságaira vonatkozó következtetések levonását.

Az indikátorérték eltérések kimutatása statisztikus matematikai módszerekkel, adott esetben reciprocal averaging ordinálási technikával lehetséges. Az eltérések okainak keresése egyes faktoroknak mint lehetséges okoknak kizárására irányult.

Вегетационно динамическое исследование над раститеьными сообществами Nanocyperion I.

Рийомы их классификации и ординации, а также оценки характерных их индикаторов

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Резюме

Результаты вегетационнодинамических исследований над Nanocyperion: *Cypero-Juncetum* и *Dichostylidi-Gnaphalietum* становятся хорошо понятными при оценке их характерных индикаторов.

Сезонные изменения в сообществах сокращение средней *W*-цены, а также И-цены, зависят от формирования рельефа.

Снижение средней *W*-цены в сообществах является причиной высыхания биотопа, причем образование И-ценов находитсяв зависимости от сукцессии на более низком и высоком рельефе.

В основном работа анализирует основные условия возможностей использования характерных индикаторов.

Ispitivanje dinamike vegetacije sa karakteristikama Nanocyperion zajednice I Klasifikacija i ordinacija uzoraka kao i vrednosti karakterističnih indikatora

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Abstrakt

Rezultati ispitivanja dinamike vegetacije *Cypero-Juncetum* i *Dichostylidi-Gnaphalietum*, asocijacija sa bliskim karakteristikama Nanocyperion zajednici, moguće je uspešno vrednovati pomoću karakterističnih indikatornih osobina. Sezonske promene u zajednicama se javljaju u opadanju W vrednosti, kao i na promenama N vrednosti u funkciji prostora. Opadanje W vrednosti zajednica je posledica isušivanja biotopa. N vrednosti su uslovljene tipovima sukcesija na različitim nivoima.

U radu se analiziraju uslovi primenljivosti uopštenih konstatacija karakterističnih indikatora. Analiza uzoraka odstupanja vrednosti indikatora u odnosu na podatke iz literature, u izvesnim slučajevima omogućuje donošenje pretpostavki o strukturalnim osobenostima zajednica. Prikaz odstupanja vrednosti indikatora matematičko-statističkim metodama je u datom slučaju bio moguć ordinacionim „reciprocal averaging" tehničkim postupkom. Traganje za uzrocima odstupanja je usmereno ka elimisanju pojedinih faktora, kao mogućih uzročnika.

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PHYTOCENOLOGY OF WOLFFIETUM ARRHIZAE MIYAW. ET J. Tx. 60. ELEMENT CONTENT OF ITS SPECIES COMPONENTS AS WELL AS SEDIMENT-AND WATER SAMPLES

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Abstract

At the Hungarian lowlands, at one of the backwaters of the Alpár basin in the Tisza-valley the *Wolffietum arrhizae* plant community is again beginning to spread. At this studied site correlation was demonstrable between the changes in the element contents of the sediment-, water- and plant samples taken within the association. Apart from studing the element content of the water- and sediment samples, the element contents of the community's character species, the *Wolffia arrhiza* (water grits) as well as of the species still occurring at this site in relatively large masses — as the *Ceratophyllum demersum, Potamogeton crispus* and *Stratiotes aloides* — were studied by radiographic fluorescence spectrophotometry (RFS). During the course of analysing the element content of the plant samples it was determined that strongly positive correlation was demonstrable betweens the Fe—Mn elements ($r=0.867$), while weakly positive correlation between the Ca—K elements ($r=0.168$). Both in the case of Fe—Mn, and Ca—K, the correlation between the element content of the sediment and vegetation was weakly negative.

Analysing the obtained results with statistical methods, the element contents of the sediment-water and plant samples were well separable. The mechanism of element-uptale of the certain species and possibly their element-selectivity were well demonstrable within a cenosis during the course of the analysis.

Introduction

There is a large amount of literary data on the phytocenology of water macrophyton cenoses. However, the alimentary types, relations and alimentary dynamics of these species located within communities, the transport processes between sediment-, water- and vegetation have hardly been dealt with; the literary background is scanty in this regard. The questions arise that within a community, how and from where do the certain species take up their nutriment, how does their element transport process develop; as a consequence, what effect(s) do certain biotic and abiotic factors, have on the development or expansion (spread) of various communities? The element content analysis of the phytomass of the suspended and submerse species found in the *Wolffietum arrhizae* community, as well as of the backwater's sediment and water can be regarded as a preliminary step in respect to the processing as such of the associations of the Tisza-valley belonging to the Lemnetea and Potamogetonetea classes, and their smaller units.

Its cenological relations, place in the cenosystematic order is as follows:
Lemno-Potamea Soó 68.
Hydrochari-Lemnetea OBERD. 67.

Hydrocharietalia RÜBEL 33.
Lemnion minoris W. KOCH et TX ex OBERD. 57.
Wolffietum arrhizae MIYAW et J. TX. 60.

The main component of the *Wolffietum arrhizae* community, the *Wolffia arrhiza* (water grits) — as the smallest representative of the macrophyton — is rather widespread regarding its occurence, since in respect to the European spread of this species being of subtropical origin, it could be found at every lowland-area till the North latitude 55° and till the 18 °C isotherm line, (FINTA 1979, PRISZTER 1962, SOÓ 1980, BODROGKÖZY 1982, etc.). Besides Europe, concerning its spread it can also be found in certain areas of Africa, North America, South-West-Asia (LANDOLT 1982).

Materials and Methods

Its cenological and the elements' seasonal studies were started in the years 1983—84 in Alpár basin of the Central Tisza Valley, in the backwater situated at the border of the village Bokros. Due to the dry weather the water depth of the 200 m long, 30 m wide bed section did not exceed 60—40 cm. The water level gradually decreased from July till October. At the studied area the stand's phytomass and the backwater's sediment-and water samples were simultaneously collected in June and October, 1983 and July, September, 1984. Following sample collection the material was analysed in air-dry state. Methods used for sediment studies: the humus content was determined with bichromate (KCr_2 O_7) method by photometric evaluation (SZÉKELY 1964). The study of the sediment's physical state was characterized by the restriction number of ARANY. The measurements concerning chemical reaction were performed on the basis of conductivity (BALLENEGGER 1957) and by applying pH gauge.

The element content of the semident- and water samples from the phytomass was analysed with radiographic fluorescence spectrophotometric method (RFS) (BERTALAN 1984); (EMG, RFA, NZA type 8500).

Results

Cenological characterization of the area

On the basis of the phytocenological sampling of the *Wolffietum arrhizae* it could be observed that the stand on the surface of the backwater, which could be considered as typical, closed at the beginning of June. Besides the *Wolffia arrhiza* of dominating character, the species components gaining ground were the *Lemna minor, Lemna trisulca* and *Spirodella polyrrhiza* belonging to the floating reed- grass. Directly alongshore the Wolffia a. formed clear stands with a total covering quota of 90—100%. In the initial phase of the Spring and early Summer aspect the individuals of the *Ceratophyllum demersum, Potamogeton crispus, P. pectinatus* and *Stratiotes aloides* were still observable.

The zonation of the various cenoses developing in such manner was well distinguishable. In the Autumn aspect a vast decrease in the individual number of the *Ceratophyllum, Potamogeton* and *Stratiotes* species was detectable since the spreading of the *Wolffia- Lemna* and *Spirodela* species in thick layer on the water surface created unfavourable light conditions for the submerse plants living in the lower water layer.

Environmental biological relations

On the basis of the environmental biological relations of the backwater channel it could be determined that the rather high restriction number of ARANY (93—94) referred to very fine granular, rather evenly distributed sediment. From the viewpoint of aliment supply the sediment's organic matter amount was measured as high (4,13—4,54%) — being characteristic to eutrophized waters. Measured on the basis of conductivity, the salt dynamic of the bottom could be regarded as turning into solonchak. The sodium salts — searching for their origin regarding accumulation in the sediment — presumably came from the cast-ground meadow circumscribing (surrounding) the backwater's environs, becoming turning into solonetz — on the basis of their vegetation. Seasonal changes were detectable in respect to the pH values of the sediment and the water sample (Table 1).

Table 1

	Humus	Total salts	Restriction no. of ARANY	pH
	%	%		
Sediment sample:				
I. (VII. 14.)	4,13	0,14	93	6,22
II. (IX. 6.)	4,21	0,14	94	6,32
III. (X. 16.)	4,54	0,16	93	7,11
Water sample:				
I. (VII. 14.)				7,62
II. (X. 16.)				8,25

The analysis of the element content of the sediment — water and plant samples was carried out with radiographic fluorescence spectrophotometric method (RFS) from simultaneously collected sediment-water and plant samples. The peaks of the analysed elements Si, P, S, Cl, K, Ca, Ti, Mn, Fe, Sr — deriving from the method — appeared in order of succession with the increase in stimulus. The place of appearance and height of the various peaks were characteristic of the element and its quantitative

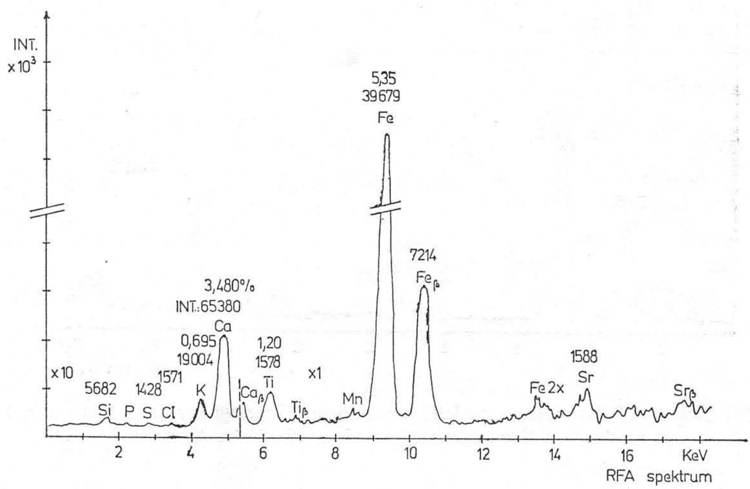
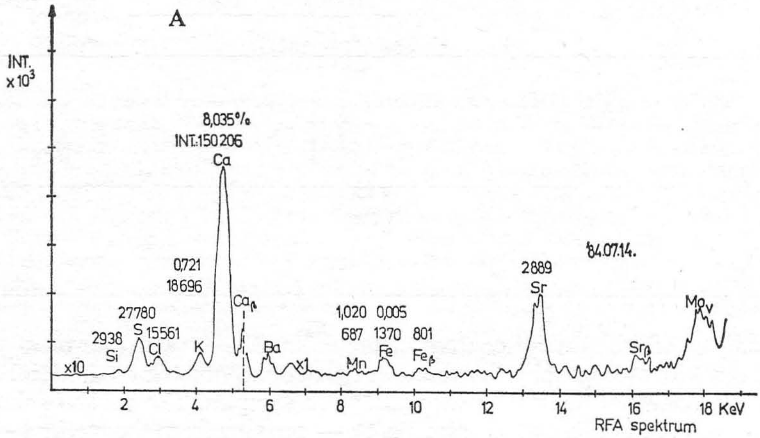


Fig. 1. RFS analysis of the sediment sample of *Wolffietum arrhizae* community. The percental value of the various elements could be determined from the calibration straight line drawn on the basis of the measured integral (INT.) value

Table 2. *Rlysis RFS analysis of the sediment-, water- and plont samples of the Wolffietum arrhizae communitv*

		K	Ca	Mn	Fe %
Potamogeton crispus	(1)	2,1205	3,310	1,500	0,742
Wolffia arrhiza	(2)	2,105	3,385	2,050	1,015
Sediment sample	(3)	0,695	3,480	1,020	5,350
Stratiotes aloides	(4)	3,540	3,380	1,340	0,357
Ceratophyllum demersum	(5)	2,280	3,420	1,830	0,695
Water sample I. (VII. 14.)	(6)	0,755	8,025	0,830	0,085
Water sample II. (X. 16.)	(7)	0,721	8,035	1,020	0,005



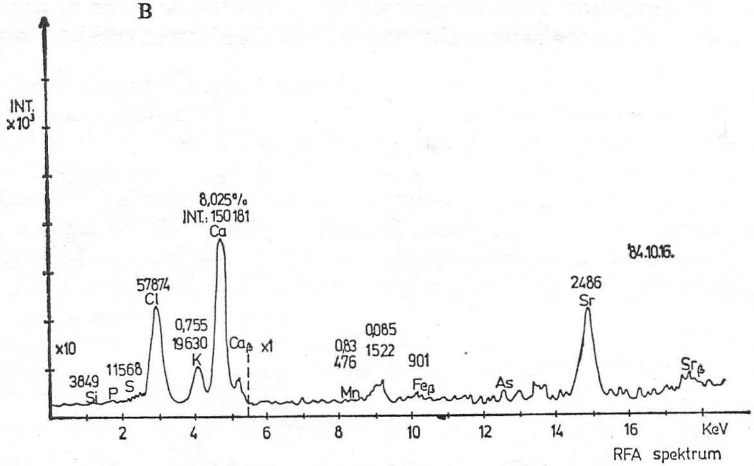
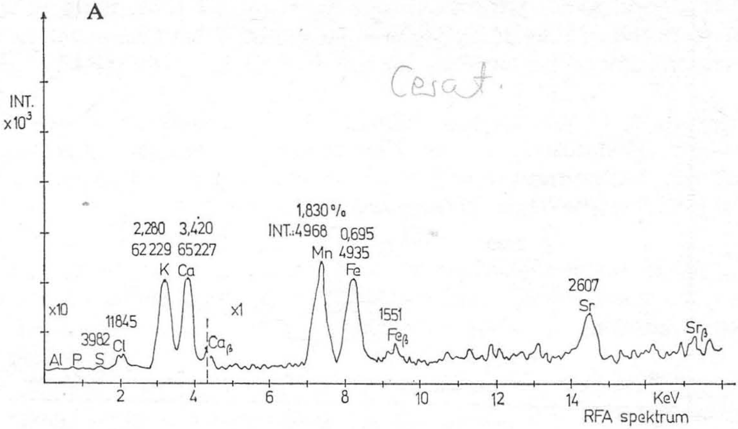
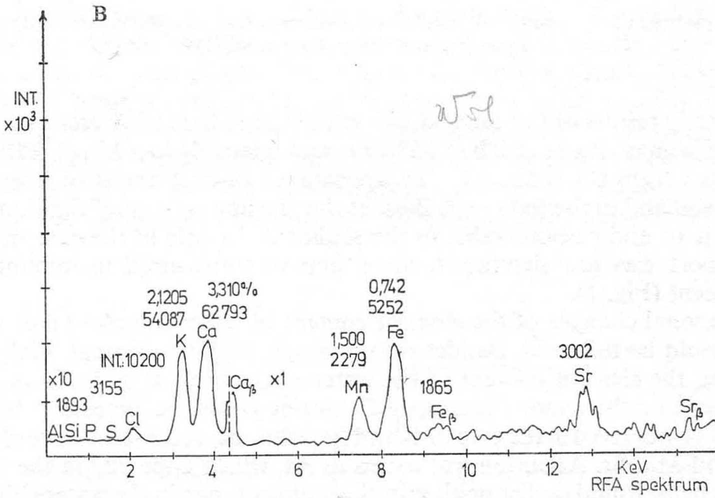
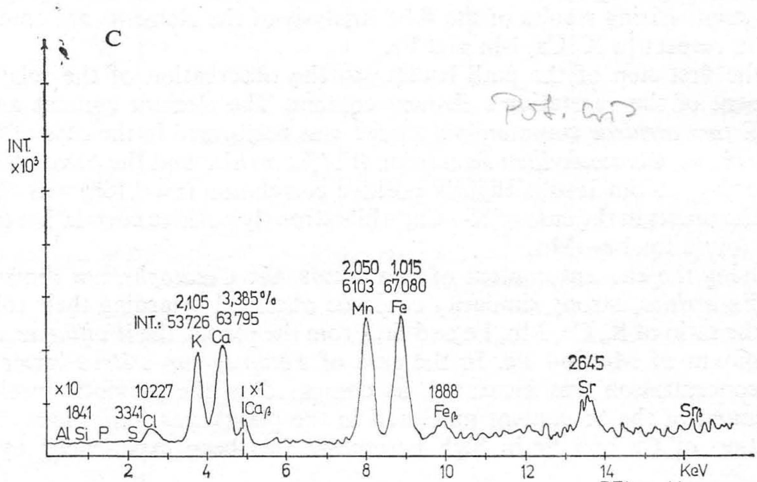


Fig. 2/A. RFS analysis of the water sample I. taken from *Wolffietum arrhizae* community. 2/B. RFS analysis of the water sample II. of *Wolffietm arrhizae*


A
INT.
x10³
1,830 %
INT.:4968
2,280 3,420
62229 65227
K Ca
0,695
4935
Mn Fe
2607
Sr
x10
11845
3982 Cl
Al P S
x1
Caβ
1551
Feβ
Srβ
2 4 6 8 10 12 14 KeV
RFA spektrum


B
INT.
x10³
3,310 %
2,1205
54087
62793
K Ca
0,742
5252
Fe
1,500
2279
Mn
INT.10200
x10
3155
1893
Al Si P S
Cl
ICaβ
x1
1865
Feβ
3002
Sr
Srβ
2 4 6 8 10 12 KeV
RFA spektrum


C
INT.
x10³
2,050 1,015
6103 67080
Mn Fe
2,105 3,385 %
INT.: 53726 63795
K Ca
x10
10227
1841 3341 Cl
Al Si P S
I x1
ICaβ
1888
Feβ
2645
Sr
Srβ
2 4 6 8 10 12 14 KeV
RFA spektrum

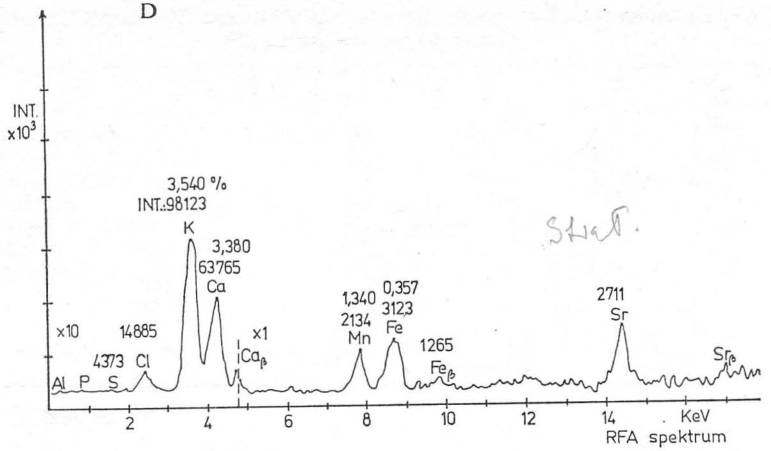


Fig. 3. RFS analysis of the plants *Ceratophyllum demersum* (A), *Wolffia arrhiza* (B), *Potamogeton crispus* (C) and *Stratiotes aloides* (D)

data. The study results of the element content of the sediment's water and vegetation were the followings. Rather high (5,35%) Fe, and relatively low Mn (1,020%) amount was measured from the sediment. The appearance of such trend of iron is natural both in the soil and in the sediment. Besides this the appearance of titanium was only characteristic of and demonstrable in the sediment, its role in the case of plant element transport was not significant. Strontium was measured in minimal amount in the sediment (Fig. 1).

The seasonal changes of the element content of water samples taken on several occasions could be followed. Besides outstandingly high Ca-content, high S-content characterized the element content of the water at the beginning. Later on, from the occuring elements the sudden increase of chlorine could be detected. Minimal increase could be observed in the case of K and Fe, while decrease in value could be found for S, Ca and Mn, Sr. Attention was called to As, which appeared in the later water sample, not being found earlier neither in the sediment, nor in the water (Fig. 2/A, B.)

The summarizing results of the RFS analysis of the elements are comprised in Table 2, in respect to K, Ca, Mn and Fe.

As the first step of the path leading to the observation of the relations and development of the vegetation's element content. The element content analysis of the *Wolffietum arrhizae* community's species was performed in the case of the *Potamogeton crispus, Ceratophyllum demersum, Wolffia arrhiza* and the *Stratiotes aloides.*

According to our results slightly positive correlation (r=0,168) was observable between the plants in the case of K—Ca, while strongly positive correlation (r=0,867) could be found for Fe—Mn.

Studying the element content of two plants, the *Ceratophyllum demersum* and the *Wolffia arrhiza,* strong similarity could be observed regarding their values considering the ratio of K, Ca, Mn, Fe and Sr. From the plants, the *Wolffia* accumulated higher amount of Mn and Fe. In the case of *Potamogeton crispus* lower Ca, Mn and Fe concentration was measured, as compared to the previous species, while the maximum of the Sr content measured in the plants was found here. The joint participation of Ca and Sr in high percentage has been experienced by authors earlier, too, in other, also *Potamogeton* species. During the course of the analysis of element contents of the *Stratiotes aloides* the great accumulation of potassium was striking (3,54%), while the Fe and Mn values were the lowest here from all the studied plants.

On the basis of the measurements it could be determined that the plants accumulated potassium, magnum and strontium from the environment, while they repressed the uptake of iron, calcium and chlorine. The correlation between the element contents of the sediment and vegetation was weakly negative (r=0,194) both in the case of Fe—Mn and Ca—K (Fig. 3/A, B, C, D).

Tight connection could be found between the development of the sediment's water- and plant element content, the development of which connection is natural (FELFÖLDY 1979, HUTCHINSON 1975). The evaluation of the relationships between these were performed with classification (FEKETE 1981).

As the result of cluster-analysis, on the basis of the dendogram it could be determined that three separate groups could be distinguished (1 5 2) (3) (6 7). On the basis of their separable element contents the vegetation (1 5 2 4), the water (6 7) and the sediment (3). The similarity value was the highest for the water samples taken at two different periods (0.983). From the viewpoint of similarity value correlation was found between three plants; *Potamogeton crispus* (1), *Ceratophyllum demersum* (5) (0.959) and *Wolffia arrhiza* (2) (0,949). The *Stratiotes aloides* (4) differed from these with a lower similarity value (0.855), well supporting the assumption that the element transport of the plants shown on the dendogram (1 5 2) took place from the water in the case of K, Ca, Fe, and Mn uptake, their similarity values stood the clor sest to each other. Regarding its similarity valus, the *Stratiotes aloides* (4) was smalle-

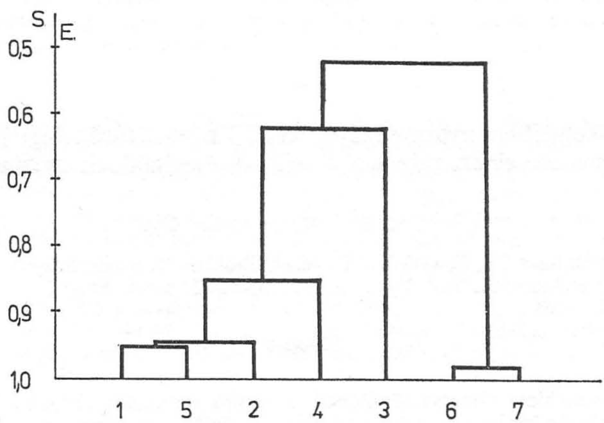


Fig. 4. Dendogram of the sediment, water and plant samples of the *Wolffietum arrhizae* on the basis of the relationship between element content

1. — *Potamogeton crispus*
2. — *Wolffia arrhiza*
3. — Sediment
4. — *Stratiotes aloides*
5. — *Ceratophyllum demersum*
6. — Water sample I.
7. — Water sample II.

than the previous three plants, indicating that element transport could take place both from the water and from the sediment, with the help of the root-system.

It could be determined that on the basis of the dendogram the mechanism of element uptake, and perhaps the element selectivity of the different plant species can well be separated within a cenosis (Fig. 4).

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A Wolffietum arrhizae Miyaw et J. Tx. 60. fitocönológiája, fajkomponenseinek, valamint üledék- és vízmintáinak elemtartalma

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Kivonat

A Wolffietum arrhizae társulás cönológiai és elemek szezonális vizsgálatait 1983—84. évben végeztük Bokros község határán elterülő holtágban. Az üledék- és vízminták elemtartalmának vizsgálatán túl a társulás karakterfajának *Wolffia arrhiza* (vizidara), és ezen a termőhelyen előforduló fajok, mint a *Ceratophyllum demersum, Potamogeton crispus* és *Stratiotes aloides* elemtartalmának vizsgálatát végeztük el energia diszperzív röntgenfluoreszcencia spektrofotometriás (RFS) eljárással. A növényminták elemtartalmának analízise során megállapítható volt, hogy a Fe—Mn elemek között erősen pozitív korreláció, (r=0,867), míg gyengén pozitív korreláció volt kimutatható Ca—K elemek között, (r=0,168). A növények a környezetből a kálciumot, mangánt és stronciumot akkumulálják, míg a vas, kálium és klór felvételét visszaszorítják. Statisztikai módszerrel elemezve az eredményeket, az üledék-, víz és növényminta elemtartalma egymástól jól elkülöníthető. Egy cönózison belül az egyes fajok elemfelvételi mechanizmusa, esetleg elemszelektivitása az analízis során kimutatható volt.

Фитоценология содержание элементов видовых компонентов, подонков, а также водных образцов Wolffietum arrhizae Miyaw. et J. Tx. 60.

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Резюме

Изучение растительных сообществ и сезонных элементов *Wolffietum arrhizae* были проведены в 1983—84 годах в старице реки Тисы вблизи села Бокрош. Кроме изучения подонка и видового состава водных растений было проведено также изучение состава ассоциации *Wolffia arrhiza*, а также другие произрастающие здесь растения: *Ceratophyllum demersum*, *Potomageton crispus*,. *Stratiotes aloides* Исследования проводили при помощи дисперсионной энергии, рентгенофлюоресценции и спектрофотометрического метода (RFS). При анализе растительных элементов установлено, что между элементами Fe—Mи существует значительная корреляция (P=0,867), более сниженная позитивная корреляция возникает между Ca—K элементами (P=0.168). Растения аккумулируют из окружающей среды калий, манган и стронций, причем аккумуляция железа, кальция камищелья калих.

Анализируя статистическим методом полученные результаты приходим к выводам, что содержание элементов подонка, воды и растений от себя далеко отделяются. Внутри раститель содержание элементов подонка, воды и растений от себя далеко отделяются. Внутри растительных сообществ при анализе хорошо освещается механизм приема элементов отдельных видов, пожалуй также селекционности элементов.

Fitocenologija i sadržaj elemenata u biljkama, uzorcima vode i sedimentima zajednice Wolffietum arrhizae Miyaw. et J. Tx. 60.

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Abstrakt

Ispitivanja cenotičkih odnosa i prisustva elemenata u zajednici *Wolffietum arrhizae*, vršena su u sezonskom aspektu u toku 1983—84. godine, u mrtvaji na području sela Bokros. Pored utvrdjivanja prisustva elemenata u uzorcima sedimenata i vode ispitivane zajednice, analiza je izvršena i na karakterističnoj vrsti ove zajednice *Wolffia arrhiza,* kao i na ovom biotopu prisutnim vrstama: *Ceratophyllum demersum, Potamogeton crispus i Stratiotes aloides,* rentgenfluorescentno-špektrofotometrijskom metodom, na bazi disperzije energije. Na osnovu analize uzoraka sadržine elemenata u biljkama, utvrdjeno je, da je izmedju elemenata Fe—Mn pozitivna korelacija jaka ($r=0,867$). I izmedju elemenata Ca—K se javlja još slaba pozitivna korelacija ($r=0,168$). Biljke iz sreidin akumuliraju Ca, Mn i St, dok primanje Fe, K, i Cl potiskuju. Sadržaji elemenata, uzorkovanh iz sedimenata, vode i biljaka, jasno se odvajaju pri statističkoj analizi. Pri analizi utvrdjen je mehanizam selektivnog primanja elemenata od strane pojedinih vrsta date biocenoze.

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HYDROECOLOGY OF THE PLANT COMMUNITIES AT THE MIDDLE TISZA-VALLEY I. AGROPYRO-RUMICION

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Abstract

From the grazing- and treading-tolerant semi-ruderal Plantaginetea grasslands, the clarification of the composition and hydroecological relations of the Agropyro-Rumicion pasture communities exposed to periodical inundations was firstly the objective, at the area and environs of the prospective four thousand hectares large Tisza-Alpár Storage Tank belonging to the central region of the Hungarian Tisza-valley. During the course of this the species components of 7 associations: *Rumici-Alopecuretum geniculati, Rorippo sylvestri-Agrostetum, Trifolio fragiferi-Agrostetum stoloniferae, Lolio-Potentilletum anserinae, Lolio-Alopecuretum pratensis, Rorrippo austriacae-Agropyretum* and the *Lolio-Festucetum pseudovinae* as well as their units within association were classed among 24 subgroups within 8 hydroecological categories, taking their soilecological relations into consideration. Their diagrams drawn on the basis of their total covering quota are suitable for revealing the relationships. Possibility was also present for comparison with study results from other areas

Introduction

The nitrophilous ruderal vegetation stands of the treading-and grazing-tolerant Plantaginetea (TX. et PRSG. 50) grouped into the cenosystematic unit have long since been the scenes of phytocenological, synecological studies throughout Europe: TÜXEN und PREISING (1942, 1950), TÜXEN (1950, 1970), OBERDORFER (1954), ELLENBERG (1963), GUTTE (1966), SISSINGH (1969), MÜLLER und GÖRS (1969), PHILIPPI (1971), EHRENDORFER (1973), BORNKAMM (1974), LOHMEYER (1975), GUTTE und HILBIG (1975) and others. The Agrostietalia OBERD. et al. 67: Agropyro-Rumicion NORDHAG. 40 pasture communities among river-bed, littoral and other humid site relations are known all over Europe (MÜLLER 1961, ELLENBERG 1963, KRIPPELOVA 1969, MARKOVIĆ 1969, 1973, 1978).

In the Hungarian relation FELFÖLDY (1942) excelled in the comparative succession analysis of the humid-soiled grasses at the Great Hungarian Plain: Debrecen and Transdanubia, resp.: Mór, Tihany; UBRIZSY (1950), mainly the river-bed grasses at the Körös regions. From territories falling closer to the area studied by us, the reports of RAPAICS (1927) from the Maros—Tisza and Körös valleys are of value for us. Later on reports were published by UJVÁROSI (1940), TÍMÁR (1947, 1950), TÍMÁR and BODROGKÖZY (1959), in the recent years by BODROGKÖZY (1982) from the Mártély Environmental Protection Area alongside the Tisza river, by BAGI and BODROGKÖZY (1984) and BAGI (1985) from the Körös-valley. In respect to the Danube basin, the relevant results of KÁRPÁTI—V. KÁRPÁTI (1963, 1965) gave good comparative ground.

The present studies expanded to the Tiszaalpár-basin located North to Csongrád, the dead channels in the environs and the periodically inundated pastures along the banks of the living river. The majority of the basin is taken up by the planned four thousand hectares large Alpár Storage Tank, receiving about 150 million m^3 of water. The inflow of the Danube—Tisza main canal is also planned here, which will considerably contribute to the ensured water supply of the Storage Tank. Therefore, the exploration and recording of the basin's biocenoses could not be postponed.

The developed site relations here are extremely manifold. The Northern section of the Basin belongs to the Kiskunság National Park, and is given variety by fenwoods, marsh-meadows and plough lands. However, the middle, Tiszaalpár section is irrigation-like meadow ground and at the same time the Southern area in the region of the village Bokros has meadow ground of slightly alkalinizing sub-soil. Although the river-bed of the Tisza has so far been blocked up by dam of temporary character, the Basin served as a relief waterreservoir on occasions of critically high water level. Complex studies on the area's ecosystems and environmental-biological, firstly hydrological hydrobiological relations have been performed regularly in seasonal dynamic regard as well since 1982. Prior to this, similar complex studies were carried out in the long run with the same objective at the Mártély Environment Protection Area of the Tisza. Reports on the study results in this regard appeared in Volume XVII. (1982) of the Tiscia.

Materials and Methods

During the course of the biogeocenological studies at the Tiszaalpár Basin and its environs, investigations were conducted between 1982—1984 on the semi-ruderal communities recruited from species components well enduring treading and grazing, exposed to periodical inundations by the river; thus covered by water for longer-shorter periods. The main task was the clarification of the cenological-, soil and hydroecological relations, resp., of their phytocenoses found at this area. In the course of the cenosystematic analysis of their cenological relations their character- and differential species were also defined. Their curve of moisture demand was also drawn in the interest of both the more detailed determination of the moisture demand of the species components of the various pasture communities and the definition of their classification into sub-groups within the different hydroecological categories. On the figures, the farther the minimum point(s) of the curve are from each other and the more categories they comprise, the wider the adaptability is of the relevant species and species group, resp. As a consequence their culmination point (s) also show low percental values. The "F" value appearing in the flora handbook of Soó as well as the "W" value determined by Zólyomi et *al.* (1967) are also indicated in the Tables referring to the various associations. The data of covering quotas appear on the basis of the averages of 5-5 recordings.

For the generalization of the regularities revealed at our area the comparative analysis and graphic representation of the data referring to the Agropyro-Rumicion communities reported from alongside the Danube and the Sava were also achieved. Since the moisture demand of the various plant species is in tight connection with the physical and chemical composition of their soil, the soil profile explorations and laboratory analyses of the various associations were continued at the Tiszaalpár Basin, too. During this course six soil fractions could be distinguished using hydrometric method. For determining the moisture supply of the explored soil profiles, parallel with the definition of the weight-percentage of the humid and dry soils, the value of the litre water/dm^3 soil could also be concluded with the help of the undisturbed sample. At the studied area the accumulation of sodium salts in different layers of the soil had to be taken into consideration at places, too. Their amount could be determined on the basis of their electric conductivity. Their percental value, as well as the amount of $CaCO_3$ and organic matter content were also specified. Just as in the case of the previous reports, it was expedient to draw complex diagrams for the sake of the complex lucidity of the obtained study results.

Discussion

The cenosystematic order of the treaded and grazed humidsoiled grass communities processed at the middle section of the Tisza-valley, compiled on the basis of the Soó-system:

AGROPYRO-RUMICION NORDH. 40.

1. *Rumici — Alopecuretum geniculati* TX. (37) 50

(Syn.: *Ranunculus repens — Alopecurus geniculatus* ass. TX. 37
Rumex crispus — Alopecurus geniculatus ass. TX. (37) 50
Alopecuretum aequalis SOÓ 47)

— — *alopecuretosum geniculati* (typicum)
— — *echinochloëtosum*
— — *agrostetosum stoloniferae*

2. *Rorippo sylvestris — Agrostetum stoloniferae* (MOOR 58) OBERD. et TH. MÜLL. 61

(Syn.: *Rorippo (sylvestris) — Agrostetum albae* (MOOR. 58) OBERD. et TH MÜLL. 61)

— — *agrostetosum stoloniferae*
— — *rorippetosum sylvestris* (typicum)
— — — *Mentha pulegium* fac.

3. *Trifolio fragiferi — Agrostetum stoloniferae* MARK. 73

(Syn.: *Trifolio — Agrostetum stoloniferae* MARK. 73)

— — *potentilletosum anserinae*
— — — *Heleochloa schoenoides* fac.
— — *agrostetosum stoloniferae*
— — *trifolietosum fragiferi* (typicum) MARK. 73
— — *trifolietosum repentis*

4. *Lolio — Potentilletum anserinae* KNAPP 46

(Syn.: *Potentilla anserina* ass. RAPCS. 27
Potentilletum anserinae FELF. 42
Juncus bufonius — Potentilla anserina ass. FELF. 42
Lolietum perennis plantaginosum UBR. 49)

— — *potentilletosum anserinae*
— — *trifolietosum fragiferi*
— — *lolietosum* (typicum)
— — *poëtosum angustifoliae*

5. *Lolio — Alopecuretum pratensis* BODRK. 62

(Syn.: *Alopecuretum pratensis*)
— — *agrostetosum stoloniferae*
— — *plantaginetosum lanceolati*
— — — *Plantago major* fac.
— — *lolietosum perennis* (typicum)
— — *cynodonetosum*

6. *Rorippo austriacae — Agropyretum repentis* (TIM. 46) TX. 50

— — *agrostetosum stoloniferae*
— — *heleochloëtosum alopecuroidis*
— — *rorippetosum austriacae*

7. *Lolio — Festucetum pseudovinae* nom. nov.

— — *lolietosum perennis*
— — *plantaginetosum lanceolati*
— — *festucetosum pseudovinae*

Characteristics, biogeocenological and hydroecological relations of the studied pasture communities

1. *Rumici — Alopecuretum geniculati* TX. (37) 50

Occurence. It is of zonal appearance at the deeper reaches alongside the river and backwater at the Tiszaalpár Basin. At the Southern section of the Basin, however, at the area of the village Bokros, it showed mosaic-like arrangement along the stagnant-watered dips of flood remains. It is not a frequent pasture community.

Cenological relations. It is of similar species composition as those found alongside the Hungarian Middle-Danube I. KÁRPÁTI and VERA KÁRPÁTI (1963) and as can be concluded from the description of the stands found along the Sava in Yugoslavia (MARKOVIĆ 1978).

1.1. *Ru.—A. g. alopecuretosum geniculati* (typicum)

The species forms the cenogeni systematic unit within this association at the basin--like dips filled with long-standing stagnant water, which are located further from the river and backwaters. Its differential species are the *Rorippa amphibia, Elatine triandra, Alopecurus geniculatus, Ranunculus sardous, Xanthium italicum.* Its stands are somewhat similar to the grass stands of the so-called saved flood solonetz irrigation ground dips found farth erat the Tisza-valley; for the *Alopecurus geniculatus* of dominant character also endures well the presence of sodium salts under humid site conditions. It is charactristic of its cenological relations that in the initial stage of its frequently short vegetation period mainly annual old species, then apart from the denominator, the *Agrostis stolonifera* became of more significant covering quota. The *Rorippa sylvestris* which too, can be regarded as Agropyro-Rumicion species, also increased, practically forming a transition towards the next 2 associations (Table 1.1).

Hydroecology

On the basis of their total covering quota the dominant species are the hydatohelophyton. The culmination point of their drawn curve appeared at *hhg2*. With the late Summer expansion of the *Rorippa sylvestris* and with the association of the *Ranunculus repens* and *R. sardous* the total value of the *hg2* species is also significant (Figs. 1, 3). Comparing it with the data originating from the Sava-valley, it shows similarity to the *Ru. —A. g. trifolietosum* described at that area (Fig. 2).

1.2. *Ru.—A. g. echinochloëtosum*

This appeared under similar ecological conditions as were for the development of the previous species described under 1.1. Its development can be attributed as the consequence of the more enhanced devastating effect of the more intensive treading of the grazing cattle herds. In the cracks of the broken up grass cover cut by the

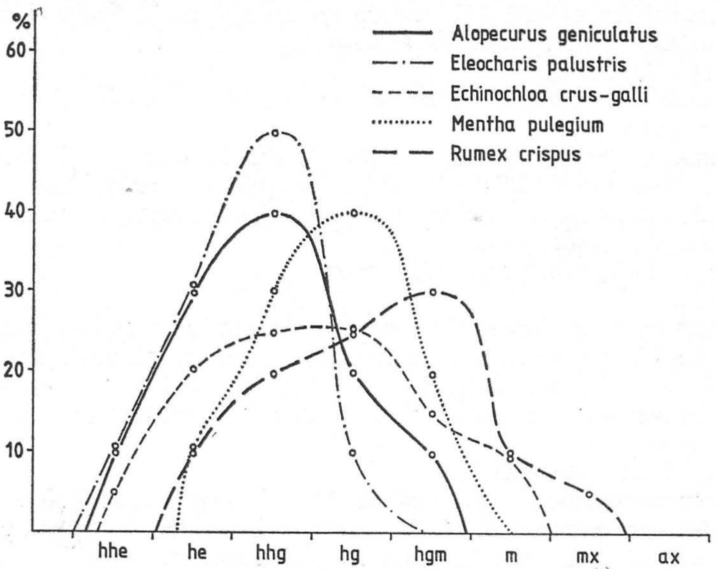

Fig. 1. The curves drawn on the basis of the moisture demand of the first association's more important species

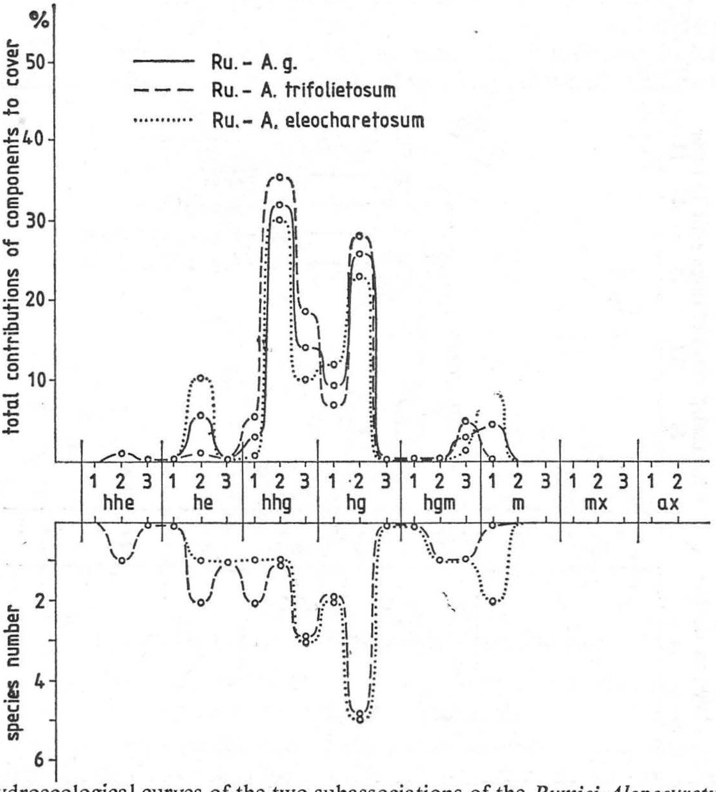

Fig. 2. The dydroecological curves of the two subassociations of the *Rumici-Alopecuretum geniculati* drawn on the basis of the data reported by MARKOVIĆ from the Sava-valley

treads Nanocyperion as well as Bidention species also multiplied besides the *Echinochloa crus-galli* of wide ecological adaptability.

Differential species

Gnaphalium uliginosum, Eleocharis acicularis, Bidens tripartita, Potentilla supina.

Hydroecology

Compared to the general view of the *Rumici-Alopecuretum* the quota of the hhel and *hhe3* sub-groups of the hydato-helophyton showed deviation. Regarding the distribution of its species components it showed consistently downward tendency towards the hygro-mesophytons.

1.3. *Ru.—A.g. agrostetosum stoloniferae*

Spreading

In respect to its development it firstly appeared at the intensively grazed littoral zone of the Basin's backwaters. It most frequently developed through the degradation of the *Caricetum vulpinae* and the *Agrostio-Alopecuretum,* but at a somewhat higher relief than the previous two sub-associations. By this means it formed the third zone within the association.

Cenological relations

From cenosystematic point of view the Molinio-Juncetea, Molinietalia, in slighter degree the representatives of Molinio-Arrhenatherea dominated and played role, resp., in its stands, besides the Agropyro-Rumicion species.

Differential species

Carex vulpina, Gratiola officinalis, Alopecurus pratensis

Hydroecology

The helo-hygrophyton continue to be the dominant species. The *Alopecurus geniculatus* and the *Gratiola officinalis* belonging to the *hhg2* sub-group have outstand-

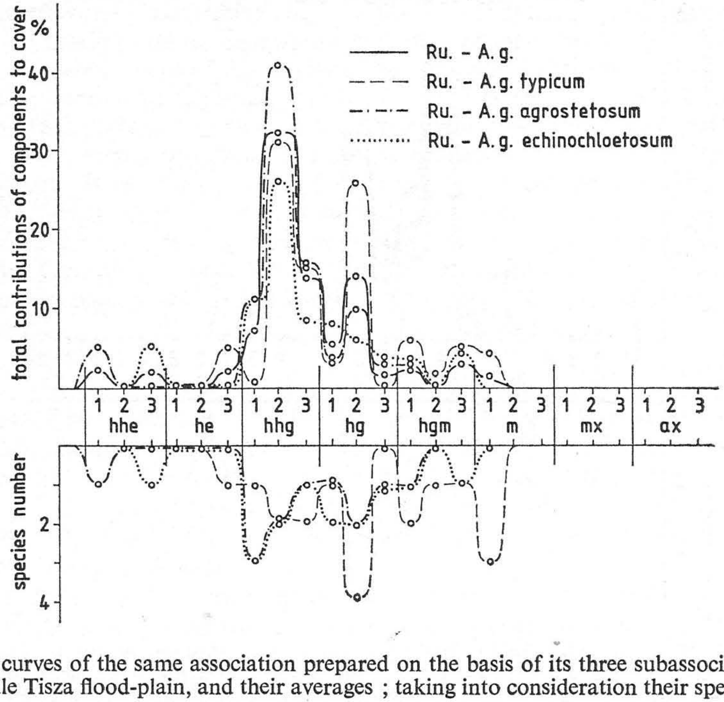

Fig. 3. The curves of the same association prepared on the basis of its three subassociations found at the Middle Tisza flood-plain, and their averages ; taking into consideration their species number

ing total covering quota. From the *hhg3*-s, with the increasing closure of the denominator of the unit within the association — the *Agrostis stolonifera* —, the ephemeral species are squeezed out from its stands: by which means it practically showed a transition towards the *Rorippo-Agrostetum* claiming almost the same moisture demands (Fig. 3).

Soil ecology

Concerning its physical composition its siltable fraction reached 65 per cent, thus it can be regarded as considerably hard irrigation-like meadow soil. Its moisture supply is favourable. In the Spring aspect 0,45 l water content per dm³ soil was measurable in the root zone. The water seepage into the deeper layers of its soil profile is moderated by its fine matter colloid reaching even 50%. Despite the intensive grazing this Agrostis-varietal grass stand produced such a phytomass that the annual disintegration of this resulted a near to medium organic matter accumulation in the root zone. The accumulation of the harmful salts is not even considerable in the B-level. Further details in this respect are shown in Fig. 4.

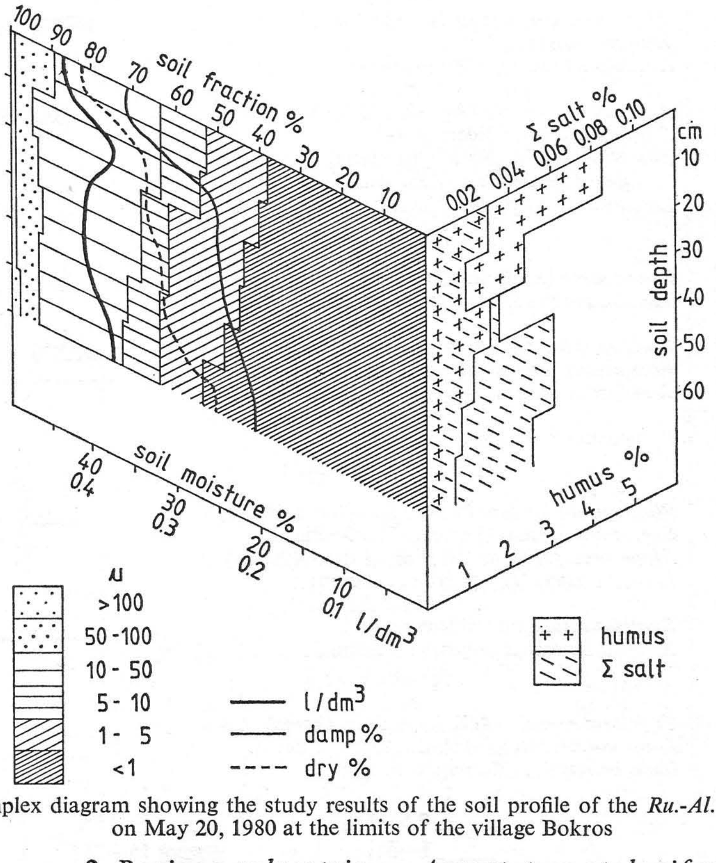

Fig. 4. Complex diagram showing the study results of the soil profile of the *Ru.-Al. agrostetosum* on May 20, 1980 at the limits of the village Bokros

2. *Rorippo sylvestris — Agrostetum stoloniferae* (Moor 58) Oberd. et Müll. 61

If we wish to get an overall view of the zonation system and succesion course of the Agropyro-Rumicion at the Middle Tisza-valley, then its pasture communities form the II. zone. It most frequently developed near the banks of the backwaters

Table 1. *Rumici — Alopecuretum geniculati*
1. alopecuretosum geniculati (typicum) 2. echinochloëtosum 3. agrostetosum stoloniferae

F	W	Subassociation:	1	2	3
		Hydato-helophyta:			
		hhel			
5	11	*Oenanthe aquatica* (Phragmitetea)		——	━━
4—5	.	*Glyceria fluitans* ssp. *poiformis* (Beckmannion)			━━
		Helophyton:			
		he 1			
4—5	10	*Rorippa amphibia* (Phragmitetea)	━━	······	
		Helo-hygrophyta:			
		hhg 1			
3—4	9	*Gnaphalium uliginosum* (Nanocyperion)		━━	
4—5	10	*Eleocharis acicularis* (Nanocyperion)		━━	
3—4	8	*Lysimachia nummularia* (Molinio-Juncetea)			━━
4	9	*Carex vulpina* (Molinio-Juncetea)	······		━━
4—5	10	*Eleocharis palustris* (Molinio-Juncetea)	······	······	━━
		hhg 2			
4	9	*Alopecurus geniculatus* (Puccinellietalia)	███	███	███
4—5	.	*Elatine triandra* (Nanocyperion)	——	······	
4	2	*Gratiola officinalis* (Molinietalia)			——
		hhg 3			
3	8	*Agrostis stolonifera* (Agr.-Rumicion)	███	███	███
3—4	9	*Bidens tripartita* (Bidentetea)		━━	
5	7	*Potentilla supina* (Nanocyperetalia)		——	
4—7	.	*Epilobium tetragonum* (Alopecurion pratensis)	······		
3—4	9	*Echinochloa crus-galli* (Chenopodio-Scleranthea)		███	
		Hygrophyta:			
		hg 1			
3—4	7	*Carex hirta* (Molinio-Arrhenatherea)	━━	━━	
4	8	*Mentha pulegium* (Agropyro-Rumicion)		——	——
		hg 2			
3—4	8	*Rorippa sylvestris* (Agropyro-Rumicion)	███	━━	━━
4—5	8	*Ranunculus repens* (Molinio-Arrhenatherea)	━━	━━	━━
4—5	8	*Ranunculus sardous* (Agropyro-Rumicion)	——		
		hg 3			
3—4	9	*Polygonum hydropiper* (Bidentetea)		······	━━
		Hygro-mesophyta:			
		hgm 1			
2—3	7	*Plantago major* ssp. *intermedia* (Plantaginetea)	━━		
2—4	.	*Cerastium dubium* (Festuco-Puccinellietea)	——	······	
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)			——
2—3	5	*Rumex crispus* (Agropyro-Rumicion)	━━	━━	
		hgm 2,3			
3	.	*Xanthium italicum* (Bidentetea)	······	━━	
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)			······
		Mesophyta:			
		m 1			
0	5	*Trifolium repens* (Molinio-Arrhenatherea)	——		
0	4	*Lotus corniculatus* (Molinio-Arrhenatherea)	——		
3—4	6	*Inula britannica* (Plantaginetea)	······		

Symbols (Table 1—7): D value

······ 0,5—1 % ━━ 5—15 %

—— 1—5 % ███ 15—25 %

or in the dips of the flood-plain, following the subsidence of the floods. It often showed transition towards the previous association.

Comparing the results of Kárpáti et al. (Figs. 6 and 7) from the Middle-Danube and Marković, resp., from the Yugoslavian Sava-valley with the results from

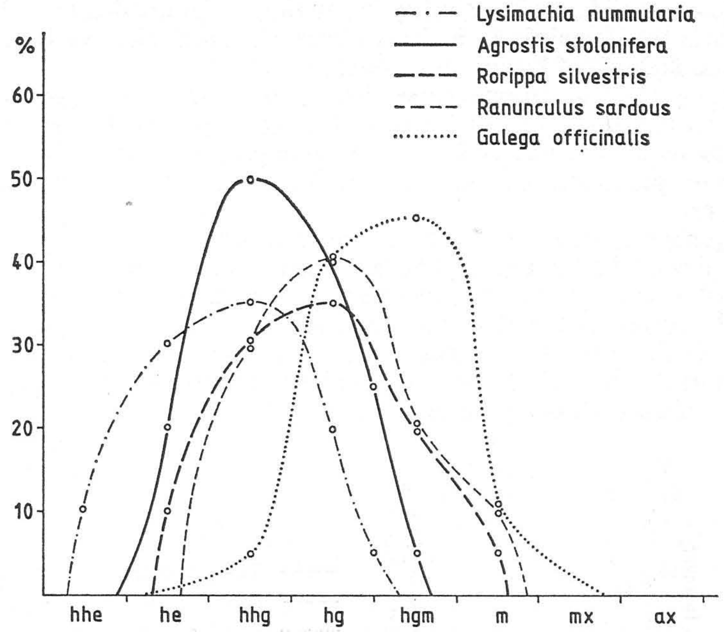

Fig. 5. Curve reflecting the moisture demand of the association's five species

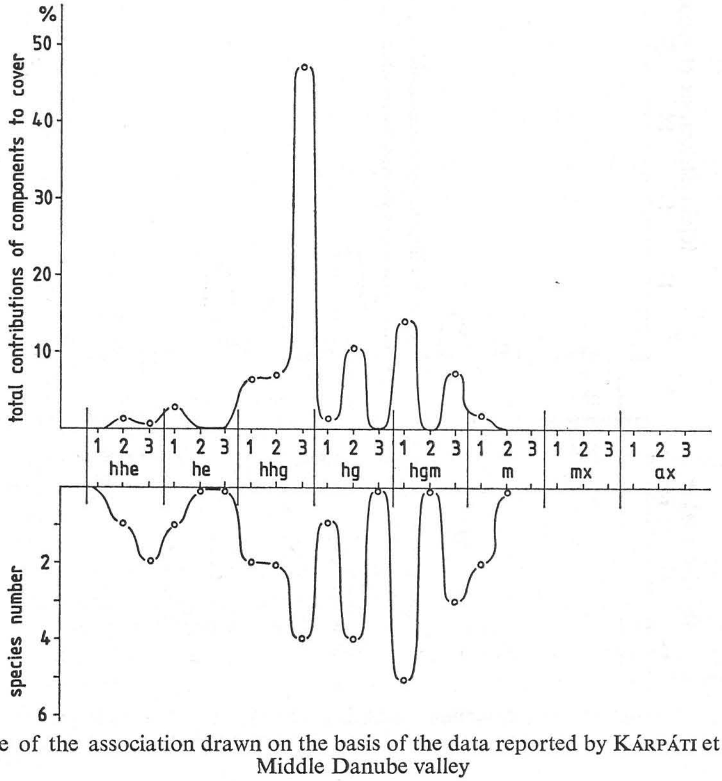

Fig. 6. Curve of the association drawn on the basis of the data reported by KÁRPÁTI et *al.* from the Middle Danube valley

the pastures at the Middle Tisza-valley, many similarities are demonstrable (Fig. 8.) At our area in the Tiszaalpár Basin the influence of the periodical, variant, often long-lasting Tisza floods is of further species-selecting effect.

Analysing the association-composition of the *Rorippo-Agrostetum* three units within association could be distinguished: the *Agrostis stolonifera* and the *Rorippa sylvestris* subassociations as well as the *Mentha pulegium* facies. Apart from their divergence of species composition these can also well be separated in respect to their site relations.

As a general hydroecological characteristic, it could also be determined that the pasture stands of the Danube- and Savavalleys as well as alongside the Tisza river, all belonged to the helo-hydrophyton category. Nevertheless, while the culmination point of the curves for the *Rumici-Alopecuretum* was found in the *hhg2* sub-group in the case of this association it was found in the *hhg3* sub-group reflecting slightly drier moisture demand. The highest percental values appeared on the diagram drawn on the base of the table compiled by Marković (Fig. 7).

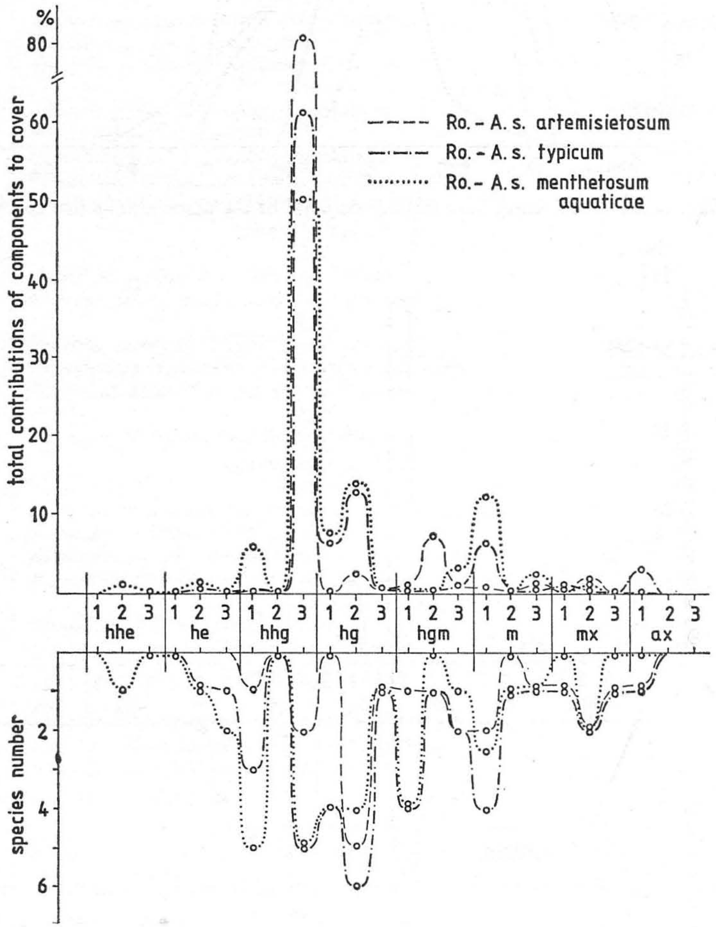

Fig. 7. Curves of the association drawn on the basis of the data by Marković pertinent to the three subassociations found at the Savavalley

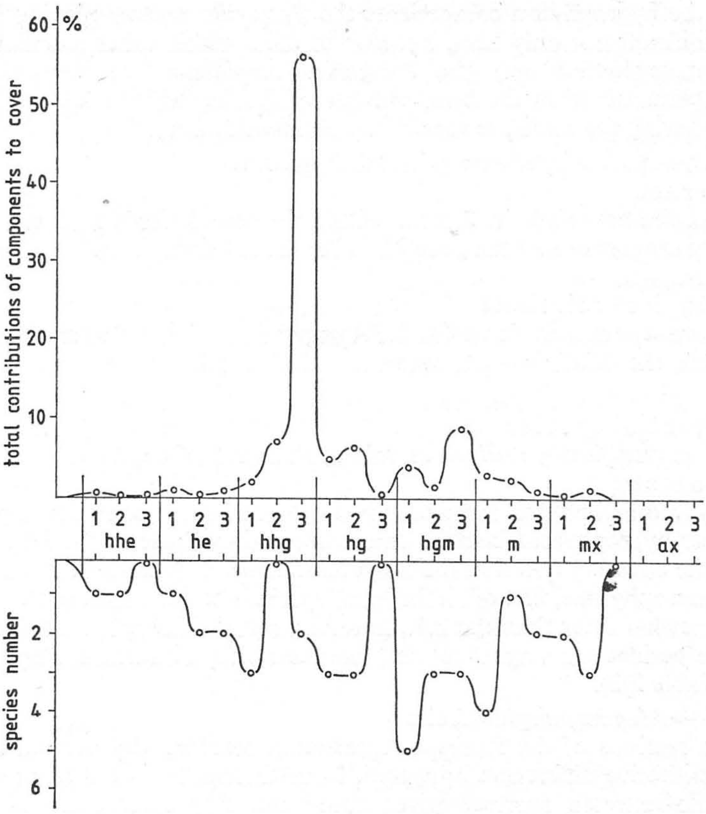

Fig. 8. Curve of the association reflecting its hydroecological condition from the Middle Tisza-valley

2.1. *R.s.—A.s. agrostetosum*

Occurence

This species developed either above the zone of the previous 1. association, or directly at the somewhat higher riverside sector of the backwaters. It was more frequent at the latter.

Differential species

The cenosis compiled on the basis of 10 recordings, forming the 1. column of Table 2 is segregated by the following species: *Butomus umbellatus, Alisma lanceolatum, Eleocharis palustris.*

Hydroecology

Even hydato-helophyton and helophyton species — like the Phragmitetea — were capable of survival at the grasses near the riverside. It could be concluded from this that this subassociation developed from various Magnocaricion associations prior to the water regulation of the Basin, as the consequence of devastating effects. Accordingly, the *Carex melanostachya* of *hhg2* character could be regarded as a relic species. Regarding their total dovering quota the dominant species components were the Molinio-Arrhenatherea from the *hhg3* sub-group as well as the Agrostion representative *Agrostis stolonifera* and the *Rorippa sylvestris.*

From the hygrophyton components the *Potentilla reptans* playing leading role is more significant not only here, but also in units within other associations. From the hygro-mesophytons only the *Polygonum amphibium* var. *terrestris* and the *Alopecurus pratensis* from the *hgm1* sub-group, having wider adaptability were capable of enduring the moisture conditions dominating here.

2.2. *R.s.—A.s. rorippetosum sylvestris* (typicum)

Occurence

This species occupied the 2. zone within the association's area of spreading. It came on dry ground sooner than the 2.1. after the subsiding floods, and even grazing starts earlier.

Cenological relations

From cenosystematic viewpoint the Agropyro-Rumicion elements are dominant, beside which the Molinio-Arrhenatherea, Molinietalia species had greater significance.

Differential species

Trifolium fragiferum, Rorippa austriaca, R. austriaca x *sylvestris*

Hydroecology

The hydato-helophyton representatives did not have time to develop, thus here, too, the helo-hygrophytons became dominant, mainly those of the *hhg3* sub-group. However, the covering quota of the *Agrostis stolonifera* decreased. At the same time the hygro-mesophytons, first of all the hgml species obtained role. In the zone having habitat somewhat drier than the 2.1., however, certain mesophytons also came into prominence besides some *hgm3* species, like the *Rorippa austriaca, Polygonum lapathifolium* (Table 2/2).

2.2. —— *Mentha pulegium* facies

At the sections of the Rorippo-Agrostetum reaching dry ground the soonest, mostly quantitative differences appeared. Nevertheless, it should be noted that certain Molinio-Juncetea representatives could not find their essential conditions. The considerable decrease in species number is detectable on Table 2/3 prepared on the basis of the 5 recordings; in comparison with the other two Tables.

These pastures show similarity to the *Artemisia vulgaris* subassociation of the association along the Drava reported by Marković.

Table 2. *Rorippo sylvestris — Agrostetum stoloniferae*
1. *agrostetosum stoloniferae*, 2. *rorippetosum sylvestris* (typicum), 3. *Mentha pulegium fac*

F	W	Subassociation:	1	2	3
		Hydato-helophyta:			
		hhe 3			
5	10	*Butomus umbellatus* (Phragmitetea)	....		
5	10	*Alisma lanceolatum* (Phragmitetea)	....		
4—5	10	*Iris pseudacorus* (Phragmitetea)	——		
		Helophyton:			
		he 1			
4—5	10	*Rorippa amphibia* (Phragmitetea)	━━	——	
		Helo-hygrophyta:			
		hhg 1			
4—5	10	*Eleocharis palustris* (Molinio-Juncetea)	━━		
3—4	8	*Lysimachia nummularia* (Molinio-Juncetea)	━━	——	
		hhg 2			
4	.	*Carex melanostachya* (Caricion gracilis)	━━	——	
4—5	7	*Potentilla anserina* (Plantaginetea)	....	━━	

F	W	Subassociation:	1	2	3
		hhg 3			
3	8	*Agrostis stolonifera* (Molinio-Arrhenatherea)			
3—4	9	*Bidens tripartita* (Bidentetea)			
4	7	*Leucojum aestivum* (Salicion albae)			
		Hygrophyta:			
		hg 1,2			
3—4	.	*Rorippa sylvestris* (Agrostion)			
4	8	*Mentha pulegium* (Agropyro-Rumicion)			
3	.	*Rumex obtusifolius* ssp. *transiens* (Calystegion)			
3—4	6	*Potentilla reptans* (Molinio-Arrhenatherea)			
4—5	8	*Ranunculus sardous* (Agropyro-Rumicion)			
3—4	9	*Echinochloa crus-galli* (Chenopodio-Scleranthea)			
		Hygro-mesophyta:			
		hgm 1			
3—5	8	*Polygonum amphibium* var. *terrestris* (Agropyro-Rumicion)			
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)			
3—4	7	*Trifolium fragiferum* (Festuco-Puccinellietalia)			
3—4	8	*Galega officinalis* (Molinietalia)			
		hgm 3			
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)			
4—5	8	*Rorippa austriaca* x *sylvestris* (Agropyro-Rumucion)			
3—4	9	*Polygonum lapathifolium* (Bidentetalia)			
		Mesophyta:			
		m 1			
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)			
3—4	6	*Inula britannica* (Plantaginetea)			

Hydroecology

From the viewpoint of moisture demand it showed variation from the 2.1. and the 2.2. in that the place of the *hhg1* and *hhg2* was filled by the expansion of the *Inula britannica* and the *Taraxacum officinale m1* species. Further details are shown in column 3 of Table 2; Fig. 9 demonstrates the soil relations.

3. *Trifolio fragiferi — Agrostetum stoloniferae* MARK. 78

A pasture community developing at the Tiszaalpár Basin in the case of varying soil conditions from flat meadow ground to irrigation-like meadow grounds, but on identical biogenic effect. Till now it was mostly known from the Sava-valley (MARKOVIĆ 1978) (Fig. 12), it is of frequent occurrence at the Hungarian Tisza-valley, too. At our area, we were successful in clarifying both its cenological as well as environmental biological relations. By means of analysing its pasture stands well separable units within association can be distinguished.

3.1. *T.f.—A.s. potentilletosum anserinae*

Spreading

It can firstly be found at meadow- and irrigation-like meadow grounds being considerably hard, thus having high siltable fraction. Its expansion was the most frequent at the fresh grounds of the Tisza flood-plain's basin-like dips eroded by inundations.

Cenological relations

Mostly Agropyro-Rumicion and Molinio-Arrhenatherea species, resp., are dominating. Examples for the former are the *Potentilla anserina* and the *Trifolium fragiferum;* and the *Carex hirta, Potentilla reptans, Trifolium repens* for the latter.

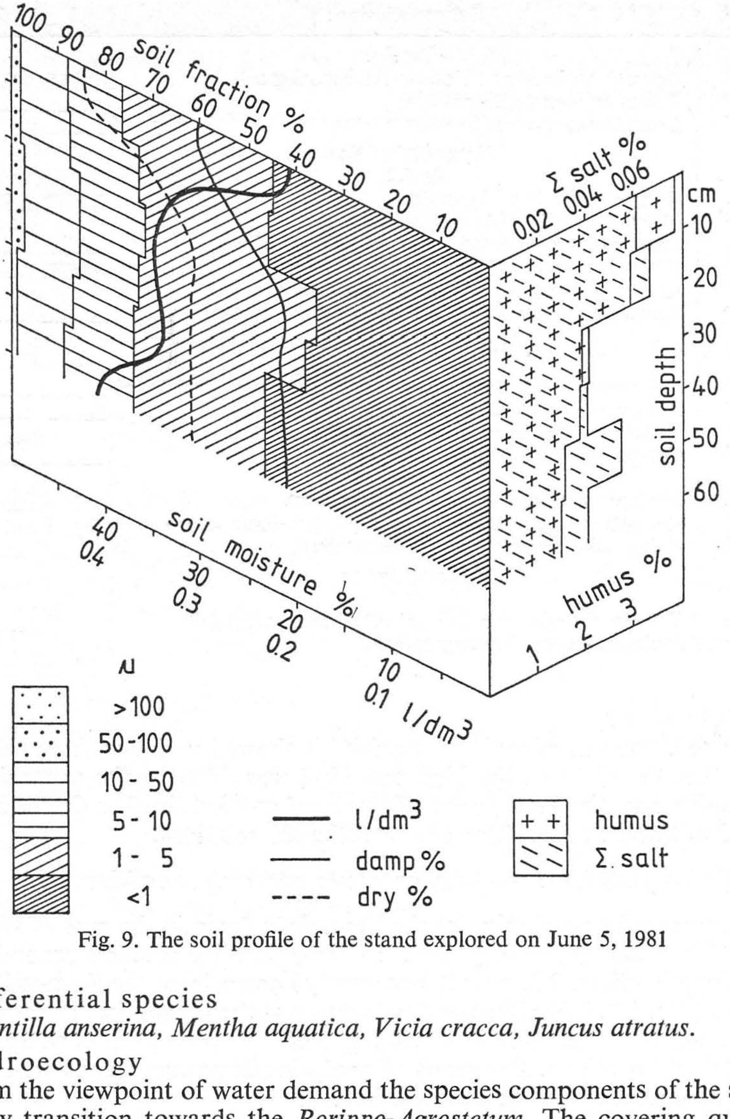

Fig. 9. The soil profile of the stand explored on June 5, 1981

Differential species

Potentilla anserina, Mentha aquatica, Vicia cracca, Juncus atratus.

Hydroecology

From the viewpoint of water demand the species components of the subassociation show transition towards the *Rorippo-Agrostetum.* The covering quota of the helo-hygrophytons is significant, namely the *hhg2* Potentilla anserina and the *hhg3 Agrostis stolonifera.* However, from the viewpoint of both species number and covering quota, those belonging to the hygrophyton category came into the foreground. Accordingly, the *hg1 Carex hirta* and the *hg2 Potentilla reptans* are worthy of note. The mesophytons had only appeared in blades (Fig. 11). Further details are found in Table 3.

3.1.1. — — *Heleochloa schoenoides* fac.

The moderately sodium salt-tolerant *Heleochloa schoenoides* regarded as a Cyperio-Spergularion species, as well as the *Bidens tripartita* as Bidentetea representative, frequently appeared and multiplied at the stagnant water sections of the

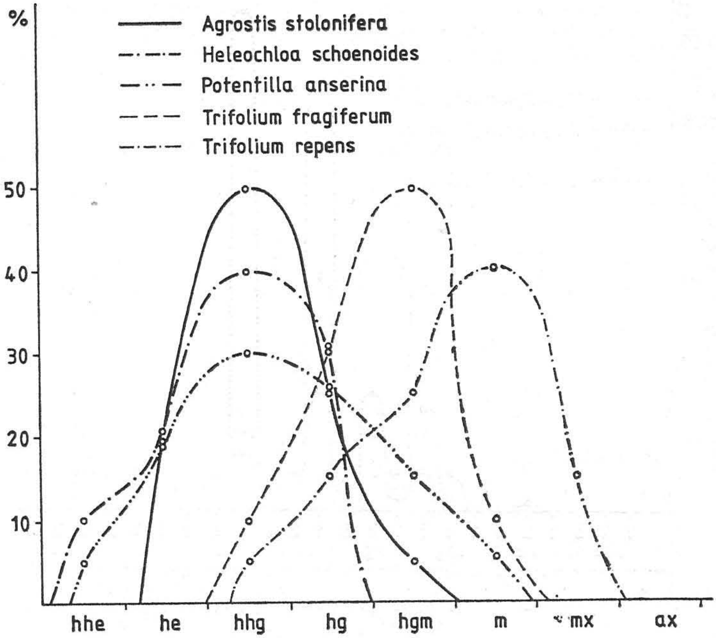

Fig. 10. Diagram representing the moisture demand of the more important species components of the *Trifolio-Agrostetum*

Potentilla anserina stands. Both belong to the *hhg3* sub-group of the hydato-helophyton category.

3.2. *T.f.—A.s. agrostetosum stoloniferae*

Similarly to the previous ones, its stands appeared at the zone of deeper relief. At our area these are meadows which have become degraded after the drainage of the earlier marshmeadows found at the Western part of the Basin, in the neighbourhood of the village Alpár. Their marsh-ground has turned into flat meadow ground through the oxidation of rapid course. Their organic matter content in the A-level has reached 6% even nowadays. Although the sodium salts could be demonstrated, their amount was not found to surpass the lowest level (0,01%) of the alkalinity degree even in the root zone. Its water supply was favourable in the Summer aspect, too, despite the high stagnant water content of its segment (Fig. 13).

Differential species

Lythrum virgatum, Lotus tenuis, Lysimachia vulgaris,

Cenological relations

The high covering quota of the *Agrostis stolonifera, Xanthium italicum, Trifolium repens, T. fragiferum* is characteristic (Table 3.3).

Hydroecology

The distribution of the species components from the viewpoint of moisture demand is similar to those reported in the case of 3.1. Accordingly, the total covering quota of the helohygrophyton species, mainly the high percental value of the *hhg3 Agrostis stolonifera* showed similarity to that of the hygro-mesophytons. In the case of the latter the *Trifolium fragiferum* of the hgml sub-group continues to play the leading role. The *Xanthium italicum* of the *hg2* sub-group, which could be regarded

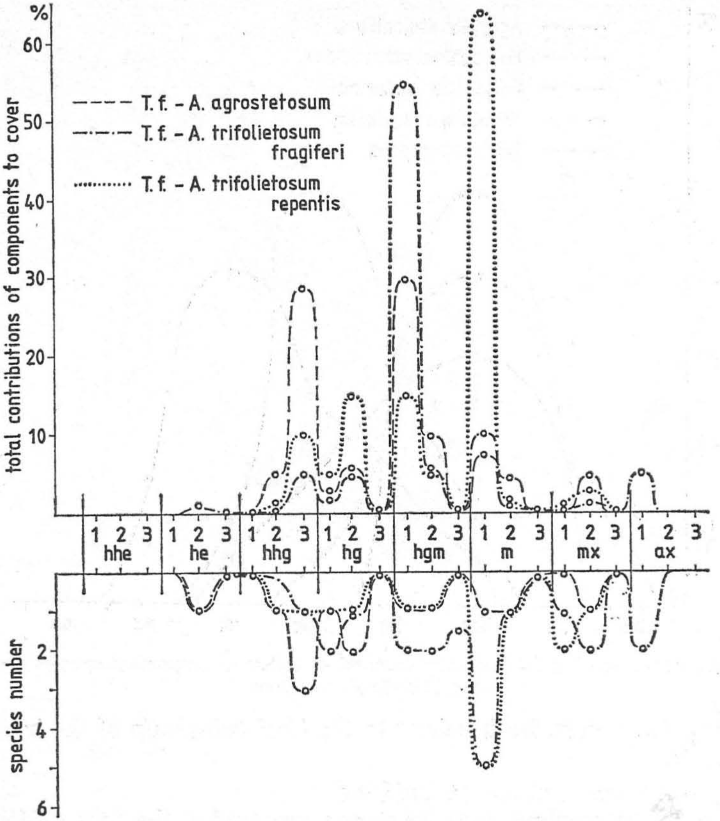

Fig. 11. Hydroecological curves of the three subassociations of the *Tr.-Agr.* drawn on the basis of their data from the Middle Tisza-valley

as a Bidentetalia species, became systematically inhabited into the grass stands pouched up by the animals during grazing (Fig. 11).

The previously discussed three units within association of the *Trifolio fragiferi-Agrostetum* occupied the more humid zone-section, where these do not have to reckon with scarcity of water even in the Summer aspect.

3.3. *T.f.—A.s. trifolietosum fragiferi* (typicum)

Occurrence

It most often develops at hard irrigation-meadow grounds of massive structure, with colloid-like fine granular fraction reaching 50%. Its zone is the pasture community located within the expansion of the association, one degree higher than the previous 3.2. The treading prints of the animals doing harm in its confined stands were rapidly covered up by the expansion of the *Agrostis*.

Differential species: *Rumex crispus, Daucus carota, Plantago major* ssp. *intermedia.*

Cenological relations

From cenosystematic viewpoint it is similar to the previous species with the difference that Chenopodietea and Festuco-Bromea representatives may also appear. The leading role was played by the *Trifolium fragiferum* which can be regarded as an Agropyro-Rumicion species. This could be determined on the basis of the pro-

Table 3. *Trifolio fragiferi — Agrostetum stoloniferae*
1. *potentilletosum anserinae* 2. *Heleochloa schoenoides* fac. 3. *agrostetosum stoloniferae*
4. *trifolietosum fragiferi* (typicum) 5. *trifolietosum repentis*

F	W	Subassociation	1	2	3	4	5
		Hydato-helophyton: *hh 3*					
4—5	10	*Iris pseudacorus* (Phragmitetea)	----	----			
		Helophyta: *he 3*					
3—4	9	*Lysimachia vulgaris* (Phragmitetea)			—	—	
4	9	*Cirsium palustre* (Phragmitetea)	—				
4—5	9	*Mentha aquatica* (Molinio-Arrhenatherea)	—	—			
		Helo-hygrophyta: *hhg 1,2*					
4—5	7	*Potentilla anserina* (Agropyro-Rumicion	▬		—		
2—4		*Heleochloa schoenoides* (Cyperio-Spergularion)	—	▬			
4	8	*Juncus atratus* (Molinietalia)	----	—			
		hhg 3					
3	8	*Agrostis stolonifera* (Agropyro-Rumicion)	▬	▬	▬	—	▬
4	8	*Lythrum virgatum* (Alopecurion pratensis)			—		
3—4	9	*Bidens tripartita* (Bidentetea)		—	----		
		Hygrophyta: *hg 1*					
3—4	7	*Carex hirta* (Molinio-Arrhenatherea)	▬			—	—
2—3		*Lotus tenuis* (Festuco-Puccinellietea)	—	—	—		
4	8	*Mentha pulegium* (Agropyro-Rumicion)	—	—		—	
		hg 2					
3—4	6	*Potentilla reptans* (Molinio-Arrhenatherea)	▬	▬	—	—	▬
4—5	8	*Ranunculus repens* (Molinio-Arrhenatherea)	—		—		
3—4	5	*Sonchus arvensis* ssp. *uliginomus* (Calystegion)	—	—			
		hg 3					
2—4	4	*Vicia cracca* (Molinio-Arrhenatherea)	—				
		Hygro-mesophyta: *hgm 1*					
3—4	7	*Trifolium fragiferum* (Agropyro-Rumicion)	▬	▬	▬	▬	—
2—3	7	*Plantago major* ssp. *intermedia* (Plantaginetalia)				—	
		hgm 2,3					
3	.	*Xanthium italicum* (Bidentetalia)			▬		—
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)	—			----	—
3—4	6	*Prunella vulgaris* (Plantaginetea)	—			—	
2—3	5	*Rumex crispus* (Agropyro-Rumicion)				----	
		Mesophyta: *m 1*					
0	5	*Trifolium repens* (Molinio-Arrhenatherea)	----	—		—	▬
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)		—	—	—	—
3—4	6	*Inula britannica* (Plantaginetea)					
2—3	6	*Centaurea pannonica* (Molinio-Arrhenatherea)				—	—

F	W	Subassociation	1	2	3	4	5
2—3	5	*Centaurium erythraea* (Molinio-Arrhenatherea)	-----	-----			-----
		m 2,3					
2—3		*Lolium perenne* (Plantaginetea)			━	━	
0	6	*Trifolium pratense* (Molinio-Arrhenatherea)	-----			—	—
0	5	*Daucus carota* (Molinio-Arrhenatherea)	-----			—	
		Meso-xerophyta:					
		mx 1					
2—3	4	*Polygonum aviculare* (Chenopodio-Scleranthea)		—			—
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)				-----	-----
		mx 2					
2—3		*Ambrosia elatior* (Chenopodietea)			━	—	
2—3	4	*Plantago lanceolata* (Festuco-Bromea)				━	
1—2	.	*Cuscuta epithymum* (Festuco-Brometea)					—
2—3	3	*Carduus acanthoides* (Festuco-Brometea)				-----	
		Asteno-xerophyton:					
		ax 1					
2	3	*Cynodon dactylon* (Chenopodio-Scleranthea)				━	-----

cessed 10 cenological recordings (Table 3.4) On the light-absorptive effect of the leaf-rosettes of the individuals spreading on the ground the *Agrostis* also fell into the background to a certain degree, together with most of the species components.

Hydroecology

On the basis of the average values of its studied pasture stands, compared to the previous ones, a significant change could be detected. The covering quota of the hygro-mesophyton species increased by leaps. The culmination point of their drawn curves surpassed 50%, despite their low species number. On the contrary the species number of the mesophytons was significant, however, judging from their quota they were still not competitive, as opposed to the previous ones. Naturally the *Trifolium fragiferum* of the *hg1* sub-group played the leading role (Fig. 11).

3.4. *T.f.—A.s. trifolietosum repentis*

Compared to the previous species, this occurred at drier zone-sectors of the hard, irrigation-like meadow grounds, firstly at the more shallow parts of the basin-like dips eroded by the flood-plain overflows at Tiszaalpár. Its site is also treaded and grazed to a greater extent, therefore more significant grade differences within its various stands did not occur here, either. The various aspect differences also became indistinct. This mostly took place in the flood periods when the area occupied by this grass stand was covered by stagnant water for longer-shorter periods.

Species composition

In this regard, from the Molinio-Arrhenatherea components having wider environmental-biological adaptability, the *Trifolium repens* which could be considered as an Agropyro-Rumision species, is also characteristic, apart from the denominator species of the association. Furthermore, the *Taraxacum officinale* and the *Centaurea pannonica* also multiplied — overwhelmingly the Molinio-Arrhenatherea representatives.

Differential species

Trifolium repens, Cuscuta epithymum, Trifolium pratense, Alopecurus pratensis (Table 3.5).

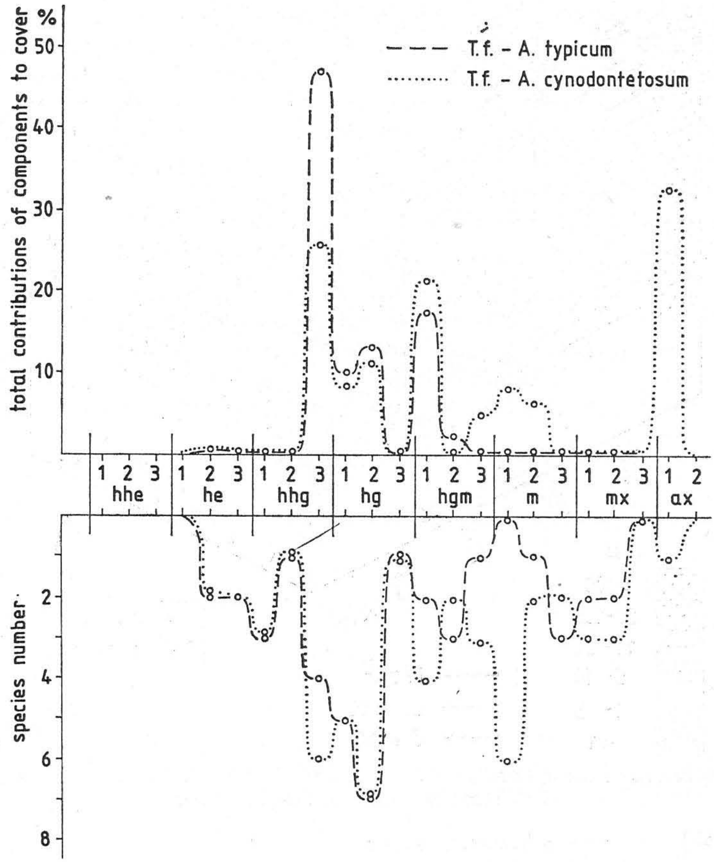

Fig. 12. The diagram of the association drawn on the basis of the data by MARKOVIĆ reported from the Sava-valley

Hydroecology

Since its occupied area is exposed to shorter periods of floods, regarding the total covering quota of the species components, they showed mesophyton character. The culmination point of their drawn curve appeared at the value above 60%. At the same time the *Cares distans, Potentilla reptans, Xanthium italicum* having moisture site demands, but with wider adaptability continued to be the components of these pasture grasses.

The *Polygonum aviculare* of mxl character as well as the *Cynodon dactylon* of axl character also increased at the sectors most intensively exposed to treading, in the direct neighbourhood of the village Tiszaalpár, mainly along the resting place of the animals. This, however, is not reflected on the global chart prepared according to the values averaged on the base of 10 recordings (Fig. 11).

4. *Lolio — Potentilletum anserinae Knapp* 46

This developed at the flood-plain of the Tisza-valley periodically exposed to inundations at a somewhat higher relief compared to the previous three pasture associations. It occupies a wider territory at this area — mainly at the Basin's Sout-

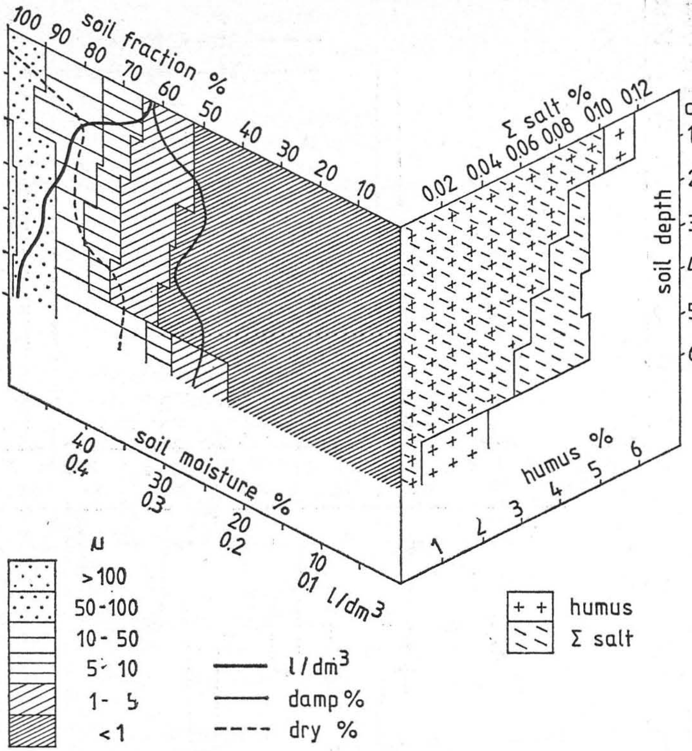

Fig. 13. Study results of the soil profile of the association's *Agrostis* variant explored on August 13, 1980 from the regions of the village Alpár

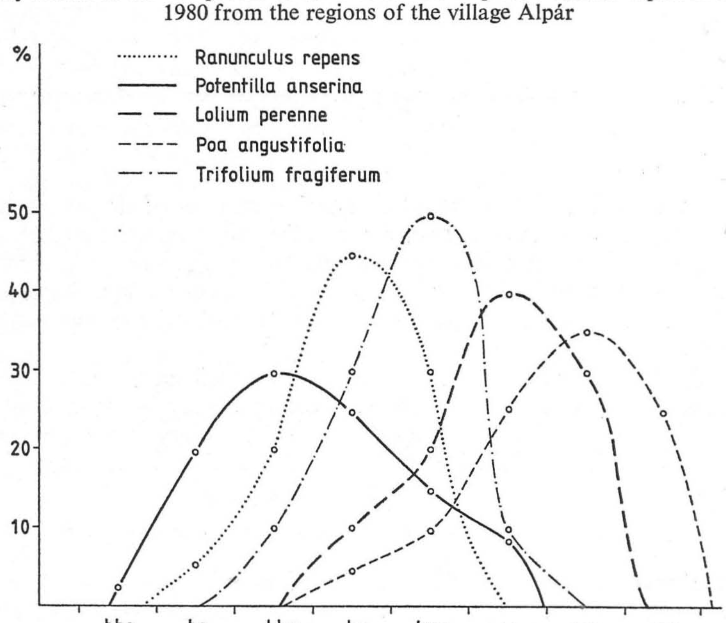

Fig. 14. Diagram reflecting the moisture demand of the five species components of the *Lolio-Potentilletum*

hern section, at the confines of the village Bokros. Its grass stands are of extremely varied species composition and the species components showed considerable differences in covering quota. This variedness is firstly caused by the varied mosaic state and heterogeneous hydrographic fundamentals of the floodplain ground, besides the consideration of the degree of pasturing and treading.

Regarding its expansion, apart from the Tisza-valley, it is mostly known from the Middle Danube-valley (KÁRPÁTI 1963) and the valley of the Danube's Yugoslavian tributary, the Sava (MARKOVIĆ 1978) (Fig. 15. A. B.).

4.1. *L.—P.a. potentilletosum anserinae*

Spreading

At the Tisza-valley it occupied the lowest, so-called transitional-like zone of the area ruled by the association. By this means it mostly joined to the grass stands of the *Trifolio fragiferi-Agrostetum stoloniferae*. Several transitions were demonstrable betweeen the two. Regarding its emergence it developed from the *Lolio-Alope-*

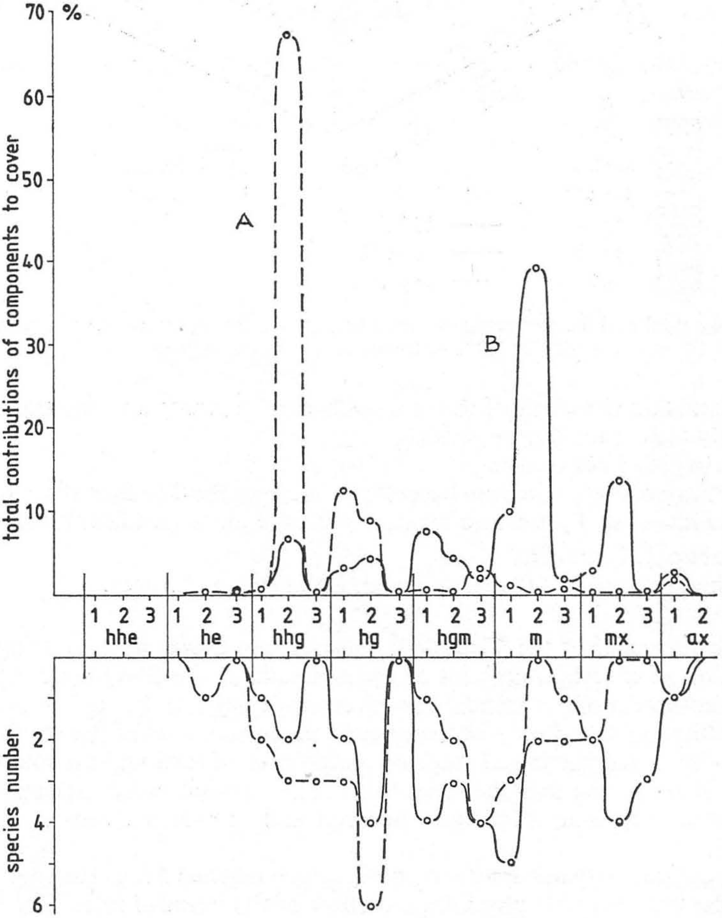

Fig. 15. The comparative hydroecological diagrams of the association drawn on the basis of the data by MARKOVIĆ from the Sava-valley (A) and KÁRPÁTI et *al.* from the Middle Danube-valley (B)

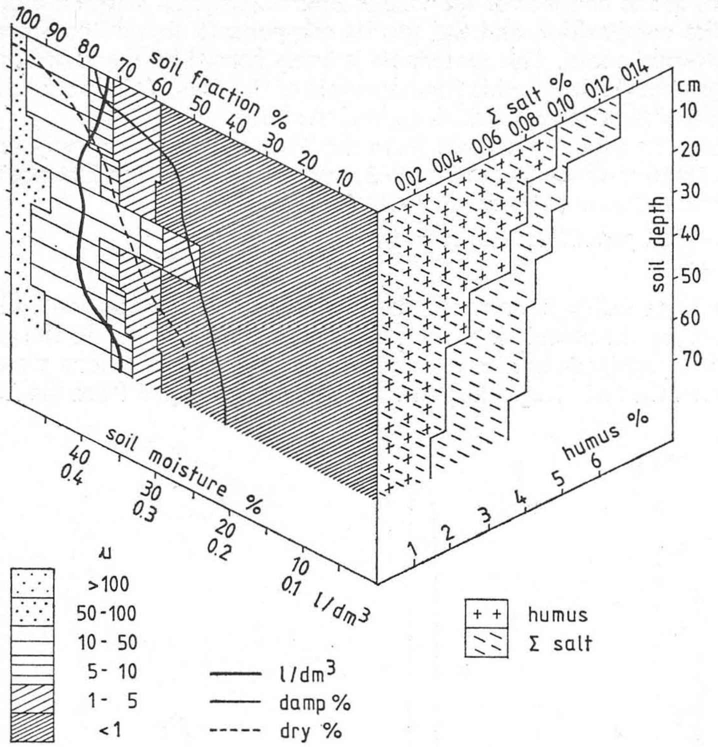

Fig. 16. Study results of the soil profile of the association's *Potentilla anserina* variant explored on May 28, 1980 at the limits of the village Alpár

curetum stands on the effect of the more enhanced treading and the stagnant waters occasionally lasting for longer periods.

Cenological relations

The Phragmitetea, Molinio-Juncetea as well as the Molinietalia elements, like the *Mentha aquatica, Lysimachia nummularia* have more significant covering quota.

Differential species

Eleocharis palustris, Mentha aquatica, Echinochloa crus-galli.

Soil

This is the relief of the Tiszaalpár Basin where it was able to bring about the accumulation of a certain amount of sodium salts at the flood-plain, by means of the water movement of the inundations (overrun-drying up). Its surface-near accumulation — although it had only just surpassed the lowest level of the alkalinity degree (0,13%) — indicated the initial stage of the process of turning into solonchak. This was referred to by the fact that the *Lotus tenuis,* which could be considered as a Puccinellietalia representative, had appeared and remained constant subsequently (Table 4.1).

The significant organic matter content, which reached 5% in the root zone, compensated the unfavourable physiological effect of the harmful salts. Despite the presence of the high colloid-containing fine matter fraction its water supply could be regarded as being favourableseen at the end of the Spring aspect (Fig. 16).

Hydroecology

In respect to the shaping of the total covering quota of its species components the culmination point of its drawn curve was detectable at *hhg2*, at the value of 20%, and referred to their wide adaptability. The decrease was steady from the *hhg2* towards the drier categories and their sub-groups, resp. (Fig. 18). The relationships in connection with the distribution of species number are also shown on this Figure. Regarding the distribution of the various species within the hydroecological categories, from the hygrophytons the components belonging to the hgl and 2 sub-groups are also significant, besides the dominating character of the *Potentilla anserina* and the *Agrostis stolonifera* of the *hhg2*, 3 sub-groups (Table 4).

4.2. *L.—P.a. trifolietosum fragiferi*

Spreading

This species preferred the farther section of the flood-plain rather than the littoral zone of the backwaters, where it occupied the flat lands which are eroded but get free of the stagnant waters sooner. Regarding its development this, too, can be interpreted as the degradation of the *Lolio-Alpecuretum* pastures. The species may also form a transition towards the *Trifolio fragiferi — Agrostetum.*

Cenological relations

The covering quota of the Agropyro-Rumicion and Plantaginetea representatives showed an increase, which fact in its major features is also characteristic to the association. The process of degradation of the *Lolio-Alopecuretum* can well be followed (Table 4.3).

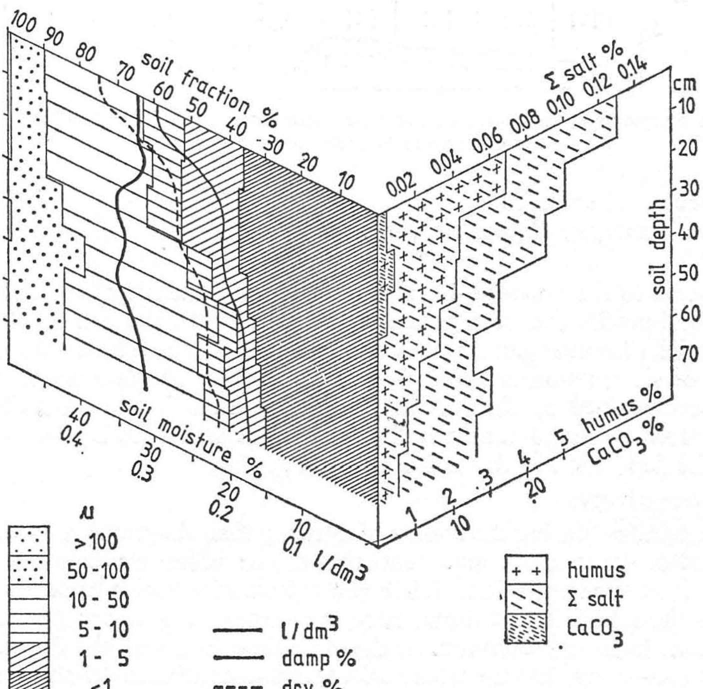

Fig. 17. Soil profile of the association's *Trifolium fragiferum* variant explored at the same time and place as in Fig. 16

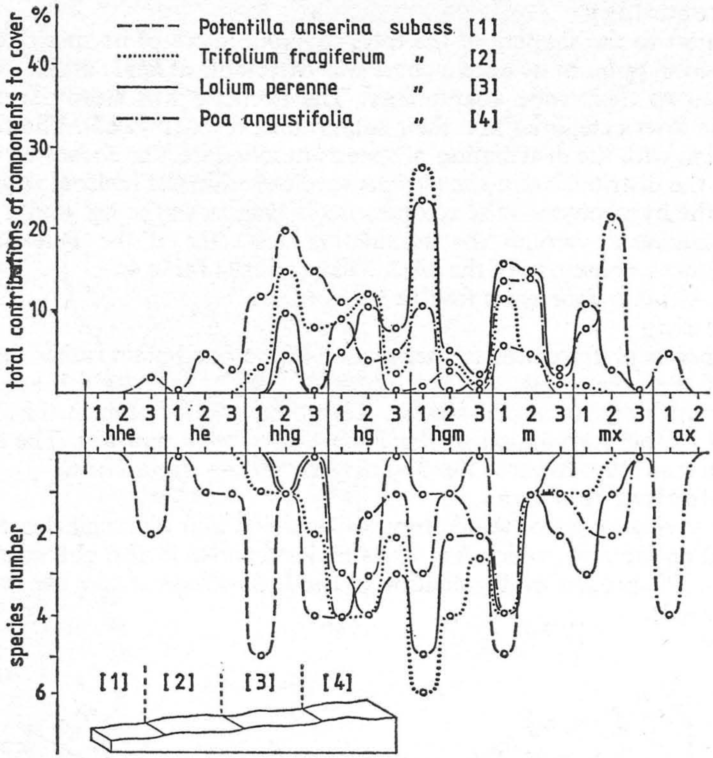

Fig. 18. The hydroecological curves of the four subassociations of the *Lo.-Pot.*, reflected in the changes in their species numbers

Differential species

Cerastium dubium, Alopecurus pratensis

Soil

Compared to the previous 4.1. the harmful salt-dynamic of its explored and investigated soil-profile can be regarded as being almost identical. At the same time it has essentially lower organic matter content. It is of loose structure from agrophysical point of view; its water supply is still favourable. The decrease in siltable fraction can be explained by the fact that the grass stand is situated at higher relief, for it is covered by inundations for shorter periods and there is shorter time at disposal for the deposition of the colloids (Fig. 17).

Hydroecology

It was manifest during the course of drawing their diagrams reflecting the moisture demand of the species components that the deviation was significant compared to the previous subassociation. While the culmination point appeared at *hhg2* in the case of the latter, it was found here overleaping a category *(hg)* at the *hgm1* sub-unit of the hygro-mesophyton. At the same time, however, the *Potentilla anserina* of the *hg2* sub-group, having wider adaptability, continued to show considerable covering quota. The quota of the representatives belonging to the mesophyton category significantly increased, first of all by means of the trifolium repens belonging to the *m1* sub-group (Fig. 18).

4.3. *L.—P.a. lolietosum (typicum)*

Spreading

Along the middle-Tisza this species was located at a one grade higher relief within the area possessed by the association, compared to the previous ones. Its degradation is also traceable through the *Lolio-Alopecuretum* pastures till the *Agrostio-Alopecuretum* marsh-wood grass-lands, depending on the intensity of treading and grazing.

Cenological relations

The greater the effect of the environmental conditions was on the *Lolium perenne* and the Plantaginetea and Agropyro-Rumicion elements, resp., the higher the ratio was of the total covering quota. Accordingly, the *Prunella vulgaris* and *Medicago lupulina* could be regarded as differential species. The cenological relations of the *Lolio-Potentilletum anserinae* could simultaneously also be characterized by this pasture type.

Character species

Potentilla anserina, Lotus tenuis, Ranunculus sardous, Plantago major ssp. *intermedia, Trifolium repens.*

Table 4. *Lolio-Potentilletum anserinae* 1. *potentilletosum anserinae* 2. *trifolietosum fragiferi* 3. *lolietosum* 4. *poëtosum angustifoliae*

F	W	Subassociation	1	2	3	4
		Hydato-helophyta: *hhe 3*				
4—5	10	*Iris pseudacorus* (Phragmitetea)	——			
5	11	*Alisma plantago-aquatica* (Phragmitetea)	------			
5	10	*Stachys palustris* (Phragmitetea)	------			
		Helophyta: *he 2,3*				
4—5	9	*Mentha aquatica* (Molinio-Arrhenatherea)	▬▬			
4—5	9	*Lycopus exaltatus* (Phragmitetea)	——			
		Helo-hygrophyta: *hhg 1*				
3—4	8	*Lysimachia nummularia* (Molinio-Juncetea)	▬▬	——		
4—5	10	*Eleocharis palustris* (Molinio-Juncetea)	▬▬			
4	9	*Lythrum salicaria* (Phragmitetea)	------			
4	8	*Juncus atratus* (Molinietalia)	------			
		hhg 2,3				
4—5	7	*Potentilla anserina* (Plantaginetea majoris)	███	▬▬	▬▬	——
3	8	*Agrostis stolonifera* (Agropyro-Rumicion)	▬▬	——		
4	9	*Juncus compressus* (Agrostion)	——			
3—4	9	*Bidens tripartita* (Bidentetea)	——			
3	8	*Myosoton aquaticum* (Calystegion)	——			
		Hygrophyta: *hg 1*				
2—3	·	*Lotus tenuis* (Puccinellietalia)	▬▬	▬▬	——	——
3—4		*Glycyrrhiza echinata* (Calystegion)	——	——	——	——
4	8	*Mentha pulegium* (Agropyro-Rumicion)	——	——	——	
3—4	7	*Carex hirta* (Molinio-Arrhenatherea)	——	——		
		hg 2				
4—5	8	*Ranunculus repens* (Agropyro-Rumicion)	▬▬	▬▬	——	
3—4	6	*Potentilla reptans* (Agropyro-Rumicion)	▬▬	——	▬▬	
3		*Rorippa sylvestris* (Agropyro-Rumicion)	——	▬▬	——	
4—5	8	*Ranunculus sardous* (Agropyro-rumicion)	——	——	——	——
3—4	5	*Sonchus arvensis* ssp. *uliginosus* (Calystegion)		------	------	------
3—4	9	*Echinochloa crus-galli* (Chenopodio-Scleranthea)	——			

F	W		1	2	3	4
		hg 3				
3—4	9	*Poa trivialis* (Molinio-Arrhenatherea)		▬	▬	—
2—4	4	*Vicia cracca* (Molinio-Arrhenatherea)			…..	—
3—7	7	*Festuca pratensis* (Molinio-Arrhenatherea)				—
		Hygro-mesophyta:				
		hgm 1				
2—3	7	*Plantago major ssp. intermedia* (Plantaginetea majoris)	—	▬	▬	▬
3—4	7	*Trifolium fragiferum* ssp. *bonnanini* (Agropyro-Rumicion)		▬	▬	—
3—5	8	*Polygonum amphibium* v. *terrestris* (Agropyro-Rumicion)	…..	—	—	
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)		—	—	
4	5	*Althaea officinalis* (Agrostion)		—	…..	…..
2—5	.	*Cerastium dubium* (Agropyro-Rumicion)		…..		
		hgm 2				
3	.	*Xanthium italicum* (Bidentetea)	—	—		
3—4	6	*Prunella vulgaris* (Plantaginetea)		—	—	
0	6	*Matricaria maritima* ssp. *inodora* (Chenopodietea)		…..	—	
		hgm 3				
2—3	5	*Rumex crispus* (Agropyro-Rumicion)	…..	…..	—	
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)	…..	…..	—	
		Mesophyta:				
		m 1				
0	5	*Trifolium repens* (Plantaginetea majoris)	—	—	—	—
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)	—	—	—	—
3—4	6	*Inula britannica* (Pantaginetea majoris)	…..	—	—	—
2—3	5	*Centaurium erythraea* (Nanocyperion)	…..			
2—3	6	*Centaurea pannonica* (Molinio-Arrhenatherea)				—
		m 2, 3				
2—3	.	*Lolium perenne* (Plantaginetea)	▬	▬	█	█
0	5	*Chenopodium album* (Chenopodio-Scleranthea)		—	—	
0	5	*Daucus carota* (Arrhenatherion)			…..	—
		Meso-xerophyta:				
		mx 1				
2—4	6	*Medicago lupulina* (Plantaginetea)		…..	—	—
0	5	*Cichorium intybus* (Polygonion avicularis)			…..	…..
2—3	4	*Polygonum aviculare* (Chenopodio-Scleranthea)			—	
		mx 2				
1—2	.	*Cuscuta epithymum* (Festuco-Brometea)			—	—
2	3	*Poa angustifolia* (Festuco-Brometea)				▬
2—3	4	*Plantago lanceolata* ssp. *sphaerostachya* (Festuco-Bromea)				—
2—3	.	*Ambrosia elatior* (Chenopodio-Scleranthea)				—
		Asteno-xerophyta:				
		ax 1				
2	3	*Cynodon dactylon* (Chenopodio-Scleranthea)				—
0	.	*Atriplex tatarica* (Chenopodio-Scleranthea)				…..
1	.	*Trifolium micranthum* (Festucion pseudovinae)				…..
		ax 3				
2	1	*Carex stenophylla* (Festuco-Puccinellietea)				—

Soil

Its explored and investigated profile did not show a considerable change as compared to the previous one.

Hydroecology

The shaping of its drawn curve differed in that the total covering quota of the mesophyton and mainly the meso-xerophyton species components rose to nearly similar degree as the total covering quota of the species belonging to the *hhg, hg* and *hgm* categories decreased. Thus, the multiplication of the *Lolium* of the *m2* sub-group, the *Medicago lupulina* of the *mx1* subgroup and the *Polygonum aviculare* at the sections exposed to extreme treading was observable (Table 4.3).

4.4. *L.—P.a. poëtosum angustifoliae*

Spreading

This forms the fourth zone of the inner flood-plain pastures occupied by the association, situated farther from the backwaters and the river-water, although it also frequently formed mosaic complexes. It developed at the sections which were covered by water during the course of the Tisza inundations for even shorter period than the previous ones. Nevertheless, it still had favourable site conditions for the development of this variant of humid-soiled pastures.

Cenological relations

The Molinio-Arrhenatherea is also dominant to a certain degree, besides the Agropyro-Rumicion and Plantaginetea species. However, some Festuco-Bromea and Chenopodio-Scleranthea representatives, resp., also obtained significant role. Nevertheless the Molinio-Juncetea's Agrostion., Bidentetea species were forced out from the cenosis. It was this sub-association which later expanded towards the drying out-soiled pasture type of the *Lolio -Festucetum pseudovinae.*

Differential species

Poa angustifolia, Plantago lanceolata ssp. *sphaerostachya, Cynodon dactylon.*

Hydroecology

During the analysis of such tendency of its cenoses it became evident that following the series of categories, its curve reflecting moisture demand ran a rather wide scope. Accordingly it was followable from the helophytons till the astenoxerophytons, although in varying quota (Fig. 18).

5. *Lolio — Alopecuretum pratensis* Bodrk. 62

This community was first described at the Tisza-valley, where at places it forms extensive flood-plain pastures equally at the Hungarian Upper-, Middle- and Lower--Tisza regions (Bodrogközy 1963). It is presumed to occur at other humid areas along rivers as well (Soó 1973). In respect to its zonation system it occupied a relief zone close to similar to the previous 4. association, where the stagnant water covering following the river's inundations is of average duration. This is also reflected in the development of its species composition. Considerable differences in grass associations were resulted even by the smaller relief variances at the extensive area possessed by its stands. It could be determined, however, that these units within association regularly recur even in the range of twenty years.

5.1. *L.—A.p. agrostetosum stoloniferae*

Spreading

There were currents developing as the consequence of inundations even at the area occupied by the association. Areas of periodical stagnant water also reminaed at places here at its eroded flat-lands. These were mostly frequent at the village Bokros.

Cenological relations

Although in general the Molinio-Arrhenatherea, Agropyro-Rumicion elements are charasterictic of the association, certain treading-tolerant Molinio-Juncetea representatives, like the *Eleocharis palustris, Juncus articulatus,* are also found. Its stands can be traced back to the cenoses of the *Agrostio-Alopecuretum* hayfield meadows of irrigation-meadow ground (Table 5.1).

Differential species

Agrostis stolonifera, Alopecurus geniculatus, Juncus compressus

Hydroecology

The helophytons are missing from its species components by now, nevertheless, from the helo-hygrophytons the *Eleocharis palustris, Juncus articulatus* which could be considered as members of the *hhg1* sub-group; the *Potentilla anserina* of the *hhg2* sub-group, as well as the *Agrostis stolonifera* of the *hhg3* sub-group showing significant covering quota, all reflect well the state of water-supply of these flat-lands (Fig. 19). From the hygro-mesophytons the *Alopecurus pratensis* of the *hgm1* sub-group is significant. The mesophytons were represented by the *Lolium perenne* of the *m2* sub-group, although with lower covering quota. The species claiming drier hydroecological demands were at best only represented in blades (Table 5).

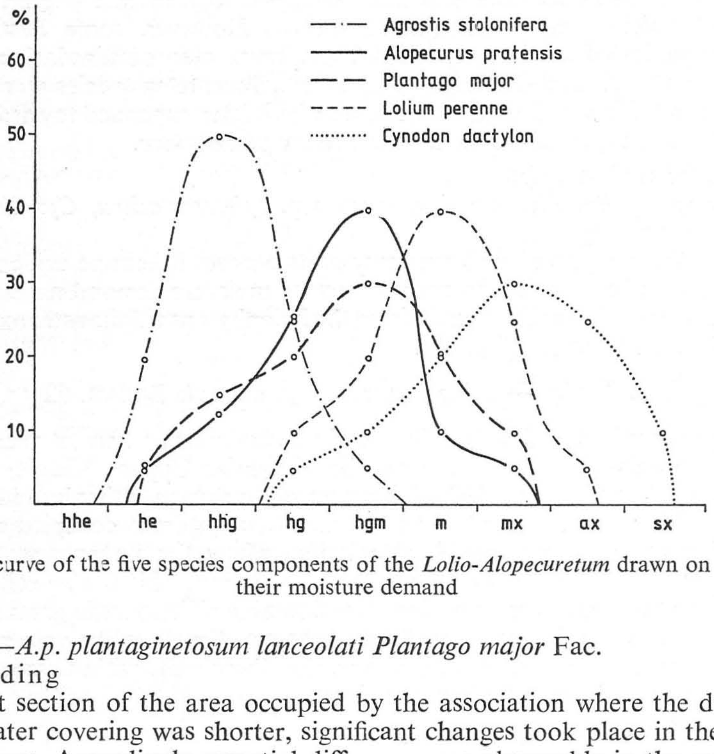

Fig. 19. The curve of the five species components of the *Lolio-Alopecuretum* drawn on the basis of their moisture demand

5.2. *L.—A.p. plantaginetosum lanceolati Plantago major* Fac.

Spreading

At that section of the area occupied by the association where the duration of stagnant water covering was shorter, significant changes took place in the pasture's site conditions. Accordingly essential difference was observable in the composition of the grass stand, too, in the same manner as those reported previously from the Hungarian Upper-Tisza valley.

Cenological relations

At our area it was not the characteristic *Plantago lanceolata* subassociation that was found, which is firstly characterized by the Festuco-Bromea species, but the *Plantago major* ssp., *intermedia*-produced facies of this. The Molinio-Juncetea, Calystegion and the Agrostion representatives were missing, however, the total covering quota of the Agropyro-Rumicion elements increased. Further comparative details are shown on Table 5.

Hydroecology

As the consequence of the change in the degree of water supply no helo-hygrophyton species were further found. Mainly the hygro-mesophytons dominated, first of all the *Alopecurus pratensis* of the *hgm1* sub-group and the *Plantago major* ssp. *intermedia.* From the mesophytons, there was an increase in the covering quota of the *Lolium perenne* of the *m2* sub-group, besides that of the *Trifolium repens* and *Taraxacum officinale* of the *m1* sub-group. The meso-xerophyton species components were also present, although their total covering quota was not considerable yet (Fig. 20). Further details are observable on Table 5.

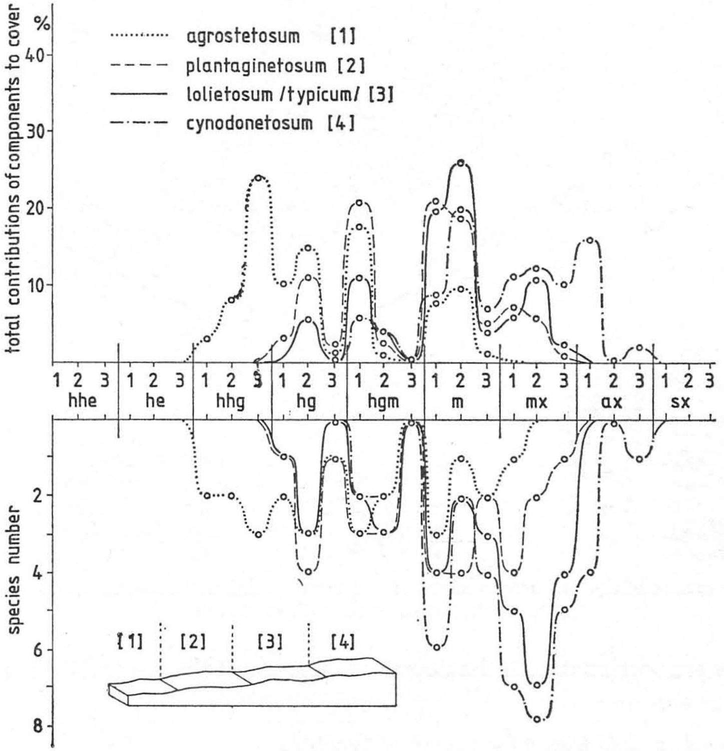

Fig. 20. Diagram illustrating the hydroecological state and changes in species number of the association's four smaller units

Owing to its location at higher relief the colloids of the stagnant waters were only able to depose at a slighter degree, as the consequence of the water covering of short duration. This explains the value around 60% its soil-profile's siltable fraction (the two substance- and the two silt-fractions).

Regarding water supply, the amount measured in the Summer aspect was half that of the Spring aspect. The accumulation of the sodium salts was not significant, their value in the explored soil profile did not reach the lowest level of the alkalinity degree (Figs. 21 and 22).

Hydroecology

It differs from the 5.2. in that the degree of decrease for the quota of the hygro-

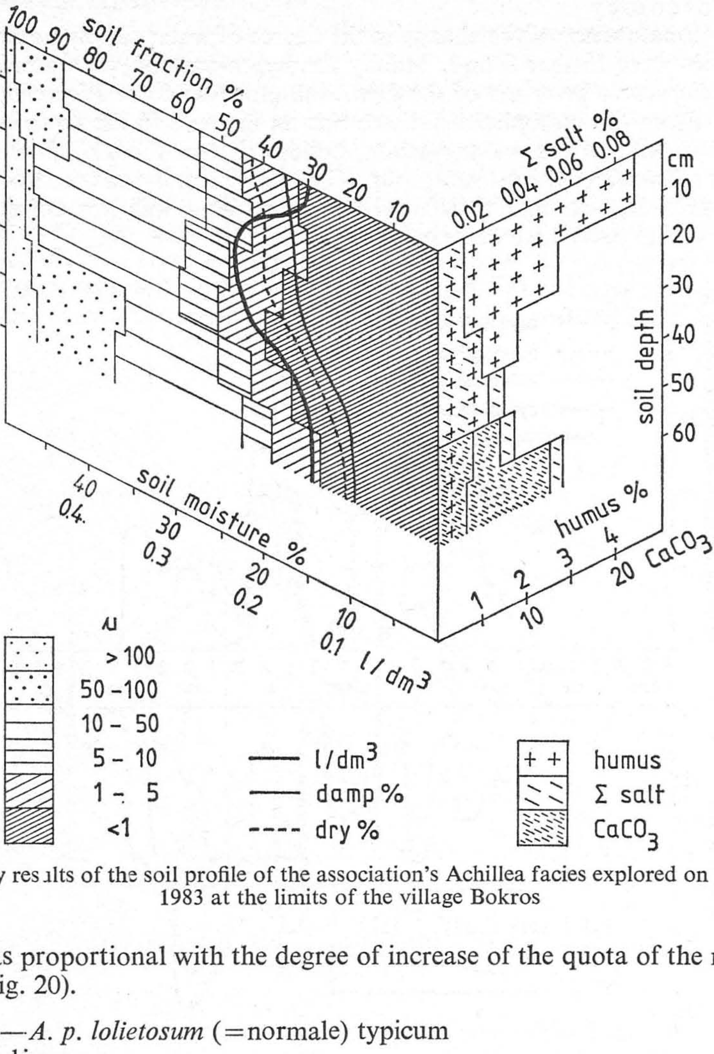

Fig. 21. Study results of the soil profile of the association's Achillea facies explored on November 8 1983 at the limits of the village Bokros

phytons was proportional with the degree of increase of the quota of the meso-xerophytons (Fig. 20).

5.3. *L.—A. p. lolietosum* (=normale) typicum

Spreading

Apart from the Tiszaalpár Basin, this species had been reported from the Tokaj region and the Environment Protection Area of the Tisza-valley at Mártély (BODROGKÖZY 1962, 1982). From the varieties of the association it was of largest expansion at our area. Its species composition became impoverished coming near the resting place of the animals.

Differential species

Ononis arvensis, Cerastium glomeratum

Soil

5.4. *L.—A.p. cynodonetosum*

Spreading

It appeared where the marsh-wood hayfields of the *Poo angustifoliae- Alopecuretum* were exposed to grazing and treading.

Table 5. *Lolio — Alopecuretum pratensis*
1. *agrostetosum* 2. *plantaginetosum lanceolati* 3. *typicum* 4. *cynodonetosum*

F	W	Subassociation:	1	2	3	4
		Helo-hygrophyta:				
		hhg 1				
4—5	10	*Eleocharis palustris* (Molinio-Juncea)				
4	10	*Juncus articulatus* (Molinio-Juncetea)				
		hhg 2				
4—5	7	*Potentilla anserina* (Plantaginetalia)				
4	9	*Alopecurus geniculatus* (Plantaginetea majoris)				
		hhg 3				
3	8	*Agrostis stolonifera* (Agropyro-Rumicion)				
3	8	*Myosoton aquaticum* (Calystegion)				
4	9	*Juncus compressus* (Agrostion)				
		Hygrophyta:				
		hg 1				
4	8	*Mentha pulegium* (Agropyro-Rumicion)				
3—4	7	*Carex hirta* (Molinio-Arrhenatherea)				
		hg 2				
4—5	8	*Ranunculus repens* (Agropyro-Rumicion)				
3	.	*Rorippa sylvestris* ssp. *kerneri* (Agropryo-Rumicion)				
3—4	6	Potentilla reptans (Agropyro-Rumicion)				
4—5	8	*Ranunculus sardous* (Agropyro-Rumicion)				
		hg 3				
3—4	9	*Poa trivialis* (Molinio-Arrhenatherea)				
3—4	7	*Festuca pratensis* (Molinio-Arrhenatherea)				
		Hygro-mesophyta:				
		hgm 1				
3	8	*Alopecurus pratensis* (Molinio-Arrhenatherea)				
2—3	7	*Plantago major* ssp. *intermedia* (Plantaginetea majoris)				
4	8	*Trifolium hybridum* (Molinio-Arrhenatherea)				
		hg 2, 3				
2—3	5	*Rumex crispus* (Molinio-Arrhenatherea)				
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)				
2—3	4	*Artemisia vulgaris* (Plantaginetea majoris)				
		Mesophyta:				
		m 1				
0	5	*Trifolium repens* (Molinio-Arrhenatherea)				
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)				
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)				
3—4	6	*Inula britannica* (Plantaginetea majoris)				
0	4	*Cirsium arvense* v. *horridum* (Chenopodietea)				
2—4	2	*Rumex acetosa* (Molinio-Arrhenatherea)				
		m 2				
2—3	.	*Lolium perenne* (Plantaginetalia)				
2—3	.	*Geranium pusillum* (Chenopodietea)				
0	6	*Trifolium pratense* (Molinio-Arrhenatherea)				
3	0	*Veronica arvensis* (Secalietea)				
		m 3				
0	5	*Daucus carota* (Arrhenatherion)				
2—3	3	*Agropyron repens* (Agropyro-Rumicion)				
0	5	*Capsella bnrsa-pastoris* (Chenopodio-Scleranthea)				
3	.	*Ononis arvensis* (Molinio-Arrhenatherea)				
2—3	3	*Euphorbia virgata* (Chenopodio-Scleranthea)				
		Meso-xerophyta:				
		mx 1				
2—4	6	*Medicago lupulina* (Plantaginetea majoris)				
40	4	*Trifolium campestre* (Festuco-Brometea)				

F	W	Subassociation:	1	2	3	4
2—3	4	*Polygonum aviculare* (Chenopodio-Scleranthea)			······	———
0	5	*Cichorium intybus* (Polygonion avicularis)				······
1—2	3	*Medicago falcata* (Festuco-Brometea)			······	······
2—3	3	*Bromus mollis* (Festuco-Brometea)		······		
2—3	3	*Silene vulgaris* (Molinio-Arrhenatherea)			———	
3	0	*Cerastium glomeratum* (Polygono-Chenopodion)				━━━
		mx 2			━━━	━━━
2	3	*Poa angustifolia* (Festuco-Brometea)		━━━	━━━	
2—3	4	*Plantago lanceolata* (Festuco-Bromea)				━━━
0	4	*Lotus corniculatus* ssp. *hirsutus*		━━━	━━━	———
		(Molinio-Arrhenatherea)		······	———	———
1	2	*Eryngium campestre* (Festuco-Brometea)			······	———
2—3	.	*Verbascum phlomoides* (Festuco-Bromea)		······	———	······
1—2	3	*Achillea collina* (Festuco-Bromea)			———	
1	7	*Cerastium arvense* (Festuco-Bromea)				
2—3	2	*Carduus nutans* ssp. *macrolepis* (Festuco-Brometea)			······	———
1—2	.	*Cynoglossum officinale* (Polygonion avicularis)			······	
2	3	*Echium vulgare* (Festuco-Brometea)				······
2—3	3	*Ononis spinosa* (Festuco-Brometea)				······
		mx 3				
1—2	3	*Erodium cicutarium* (Festuco-Bromea)		······	━━━	━━━
2—3	4	*Erigeron canadense* (Chenopodio-Scleranthea)			······	———
1—2	2	*Potentilla argentea* (Festuco-Brometea)			······	······
2—3	1	*Arenaria serpyllifolia* (Chenopodio-Scleranthea)			······	······
2—3	3	*Carex praecox* (Festuco-Bromea)				━━━
		Asteno-xerophyta:				
		ax 1				
2	3	*Cynodon dactylon* (Festuco-Bromea)				━━━
2	2	*Festuca pseudovina* (Festuco-Puccinellietea)				———
2	3	*Cerastium semidecandrum* (Festuco-Brometea)				———
1	.	*Trifolium striatum* (Festucion pseudovinae)				······
		ax 3				
1—2	.	*Limonium gmelinii* (Festucion pseudovinae)				———

Cenological relations

The composition of its cenoses follows from its development; besides the Molinio-Arrhenatherea and the Plantaginetea the Festuco-Bromea and Chenopodio-Scleranthea species multiplied, due to the water-covering of shorter duration (Table 5.4).

Differential species

Festuca pseudovina, Carex praecox.

Hydroecology

The repression of species having greater water demand is characteristic to this grass community filling out the area of highest relief within the *Lolio-Alopecuretum,* while the hygrophytons still found in the stands of the 5.3. were completely missing here. Therefore, the species with highest covering quota belonged to the mesophyton category. The leading role is played by the excellently treading-tolerant and well accommodating *Lolium perenne* of the *m2* sub-group. Compared to the previous subassociation a rising tendency was demonstrable within the meso-xerophyton category, from the viewpoint of both species- and covering quota. Furthermore, asteno xerophytons also stepped into certain cenoses. The species of outstandingly high value was the *Cynodon dactylon* of the *mx3* and *ax1* sub-groups, resp. (Fig. 20).

6. *Rorippo austriacae — Agropyretum* (TIM. 47) Tx 50

Spreading

This is also a pasture community first described from along the Tisza river

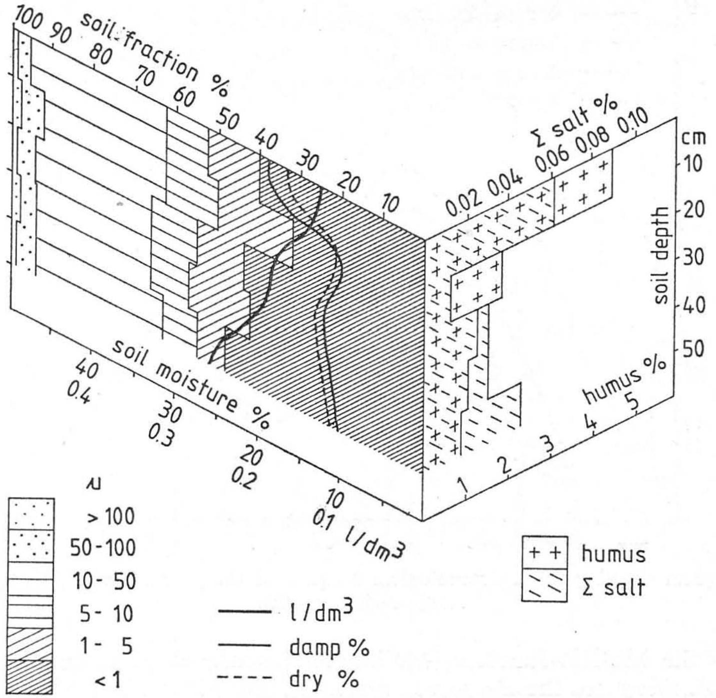

Fig. 22. Soil profile of the association's *Lolium* variant explored on August 15, 1980 at the same area as in Fig. 21

(TIMÁR 1947). In the Tiszaalpár Basin it proved to be of less frequent occurrence. Earlier some of its stands were known as facies (TIMÁR 1950): *Rorippa austriaca* fac. and *Agropyron repens* fac., resp. Although it appears at higher relief at the Tisza flood-plain, its double-level grass stands are of variegated appearance as the result of the varied nature of the area.

Cenological relations

They showed a wide range from cenosystematic viewpoint. The Polygono-Chenopodion, Chenopodio-Scleranthea species multiplied, besides the Molinio-Arrhenatherea, Agropyro-Rumicion representatives, and on occasions even the Festuco-Brometea species played role.

Character species

Rorippa austriaca, Rumex crispus, Tanacetum vulgare.

Units within association:

6.1. *R.a.—A.r. agrostetosum stoloniferae*

Spreading

Where the higher area sections of the flood-plain were situated directly in the neighbourhood of the backwaters a variant of transitional character developed. By this means they formed the lowest zone of the association.

Cenological relations

In consequence of its transitional character, Phragmitetea, Magnocaricion and Molinion species also occurred in blades. More significant quota, however, was

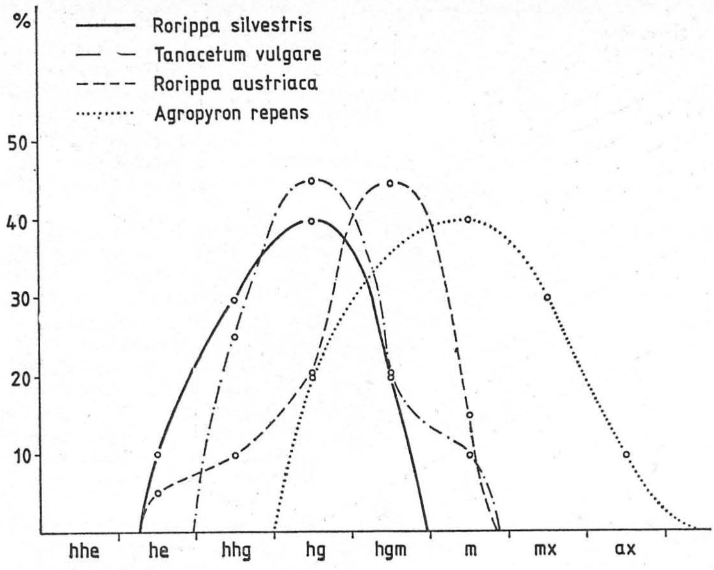

Fig. 23. Diagram showing the hydroecological demand of the four characteristic species of the *Rorippo-Agropyretum*

reached by the Molinio-Juncetea, Molinio-Arrhenatherea representatives, like the *Agrostis stolonifera* and the *Agropyron repens* having wider adaptability (Table 6.1).

Differential species

Lysimachia nummularia, Carex hirta, Chenopodium urbicum.

Hydroecology

Regarding the various categories reflecting moisture demand, its curve drawn on the basis of the subassociation's covering quota is protracted. Thus it is followable from the helohygrophytons till the meso-xerophytons. On the basis of their quota the value surpassing the line of 20% is touched at two places, in the case of the *hhg3* and the *m3* sub-groups. The leading role was played by the *Agrostis stolonifera* species components at the former and by the *Agropyron repens* at the latter.

6.2. *R.a.—A.r. heleochloëtosum*

Spreading

The stagnant waters gathered for shorter-longer periods in the smaller dips of the area occupied by the association changed the composition of the typical pasture stand to a certain degree. The deeper cattle prints in the watery soil disrupted the contiguous grass cover, thus making possible the entry of one year old mud vegetation. Its expansion, however, is not considerable at our area.

Cenological relations

Compared to the composition of its typical grass stands, the dominant species is the *Heleochloa alopecuroides* regarded as a Cyperio-Spergularion, besides the *Bidens tripartita, Lycopus europaeus, Xanthium italicum* belonging to the Bidentetea group. These species can simultaneously also be regarded as differential species (Table 6.2).

Hydroecology

The course of its drawn curve differs from the previous one in that its point reaching or surpassing the total covering quota of 20% appeared at three places:

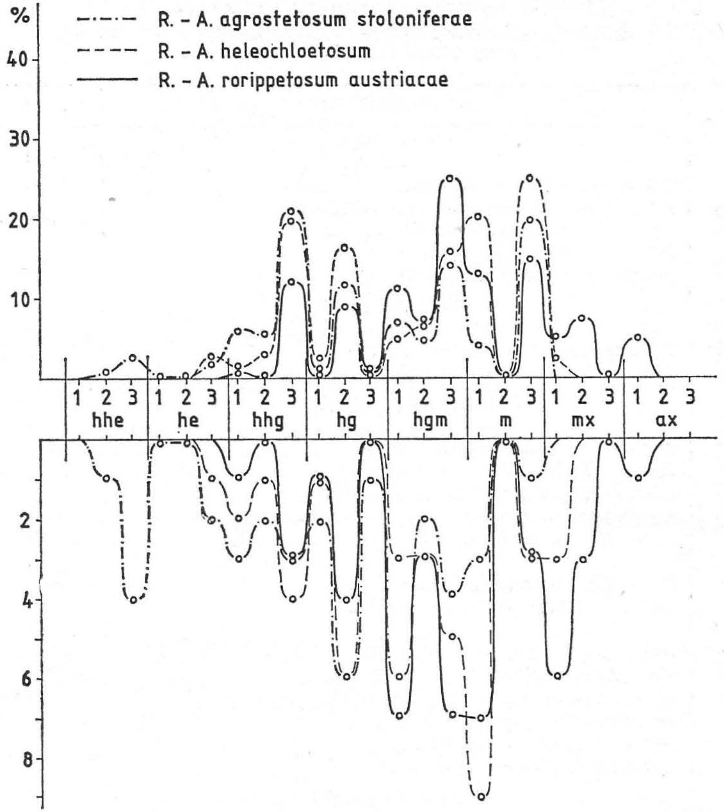

Fig. 24. Hydroecological relations of the association's smaller units

at *hhg3* the *Heleochloa alopecuroides,* at *m1* the *Trifolium repens* and at *m3* henceforward the *Agropyron repens* were the components with prominent quota (Fig. 24).

6.3. *R.a.—A.r. rorippetosum austriacae (typicum)*

Spreading

It is this subassociation which could be regarded as being typical at the Alpár section of the Tisza flood-plain, since it was probably of greater expansion at other reaches, too (TIMÁR 1950). As it formed the upper, extensive zone of the association it reached dry surface sooner following the inundations, therefore grazing was started earlier here and thus it was burdened in an increased degree.

Cenological relations

The number of the Festuco-Brometea and the Chenopodio-Scleranthea species increased on the effect of the environmental conditions which had become drier. The *Poa angustifolia* had a more considerable covering quota. From the Agropyro-Rumicion species the *Rorippa sylvestris* had a more significant quota here (Table 6.3).

Differential species

Matricaria maritima ssp. *inodora, Poa angustifolia, Medicago lupulina, Cynodon dactylon.*

Hydroecology

Owing to the species of wide hydroecological adaptability, the curve drawn on

Table 6. *Rorippo-Agropyretum repentis*
1. *agrostetosum stoloniferae* 2. *heleochloëtosum alopecuroidis*
3. *rorippetosum austriacae* (typicum)

F	W	Subassociation:	1	2	3
		Hydato-helophyta:			
		hhe 2, 3			
3	10	*Typhoides arundinacea* (Magnocaricion)	———		
4	10	*Bolboschoenus maritimus* (Phragmitetea)	------		
5	11	*Alisma plantago-aquatica* (Phragmitetea)	------		
4—5	10	*Iris pseudacorus* (Phragmitetea)	------		
5	10	*Stachys palustris* (Phragmitetea)	------		
		Helophyta:			
		he 3			
4—5	9	*Lycopus exaltatus* (Phragmitetea)	▬▬▬	▬▬▬	
4	9	*Euphorbia lucida* (Molinion)	------		
		Helo-hygrophyta:			
		hhg 1			
4—5	9	*Lycopus europaeus* (Bidentetea)		▬▬▬	
3	.	*Rumex stenophyllus* (Bidentetea)		------	------
4—5	10	*Eleocharis palustris* (Molinio-Juncetea)	———		
3—4	8	*Lysimachia nummularia* (Molinio-Juncetea)	———		
5	7	*Potentilla supina* (Nanocyperion)	———		
		hhg 2			
4—5	7	*Potentilla anserina* (Molinietalia)	▬▬▬	———	
4	8	Gratiola officinalis (Magnocaricion)	———		
		hhg 3			
3—4	.	*Rorippa sylvestris* (Agropyro-Rumicion)	▬▬▬	▬▬▬	▬▬▬
3	8	*Agrostis stolonifera* (Molinio-Juncetea)	████		▬▬▬
2—4	.	*Heleochloa alopecuroides* (Cyperio-Spergularion)		████	
4	9	*Juncus compressus* (Agrostion)	———		———
3—4	9	*Bidens tripartita* (Bidentetea)		———	
4	8	*Lythrum virgatum* (Agrostion)		------	
		Hygrophyton:			
		hg 1			
3—4	.	*Clycyrrhiza echinata* (Calystegion)		------	------
3—4	7	*Carex hirta* (Molinio-Arrhenatheretea)	———		
4—5	8	*Symphytum officinale* (Molinion)	------		
		hg 2			
2—3	7	*Tanacetum vulgare* (Calystegion)	▬▬▬	▬▬▬	▬▬▬
3—4	9	*Echinochloa crus-galli* (Chenopodietea)	▬▬▬	▬▬▬	▬▬▬
4—5	8	*Ranunculus repens* (Molinietalia)	———	------	———
3—4	6	*Potentilla reptans* (Agropyro-Rumicion)	▬▬▬	▬▬▬	———
3	.	*Rumex obtusifolius* (Calystegion)	▬▬▬	▬▬▬	
4	9	*Calystegia sepium* (Calystegion)	------	------	
		hg 3			
3—4	8	*Thalictrum lucidum* (Molinietalia)	------		
		Hygro-mesophyta:			
		hgm 1			
.	8	*Equisetum arvense* (Secalietea)	------	▬▬▬	▬▬▬
2—3	7	*Glechoma hederacea* (Molinio-Arrhenatherea)	------	▬▬▬	------
3—5	8	*Polygonum amphibium* f. *terrestris* (Agropyro-Rumicion)	———		———
2—3	7	*Plantago major* ssp. *intermedia* (Plantaginetea)		———	———
3	8	*Alopecurus pratensis* (Molinio-Arrhenatheretea)	------		———
4	5	*Althaea officinalis* (Molinio-Arrhenatheretea)	------		------
3—4	.	*Chenopodium urbicum* (Chenopodio-Scleranthea)	———		
3—4	5	*Mentha arvensis* (Molinietalia)			------
		hgm 2			
3	.	*Xanthium italicum* (Bidentetea)	▬▬▬	▬▬▬	▬▬▬
3—4	6	*Prunella vulgaris* (Bidentetea)	▬▬▬	▬▬▬	▬▬▬
0	6	*Matricaria maritima* ssp. *inodora* (Chenopodietea)		------	———

F	W	Subassociation	1	2	3
		hgm 3			
2—3	5	*Rumex crispus* (Agropyro-Rumicion)	——	——	——
4—5	8	*Rorippa austriaca* (Agropyro-Rumicion)	——	- - -	■■■
3	4	*Aristolochia clematitis* (Calystegion)	——	——	- - -
3—4	9	*Polygonum lapathifolium* (Bidentetea)	- - -	——	——
2—3	3	*Galium mollugo* (Festuco-Brometea)		——	- - -
3	6	*Eryngium planum* (Molinio-Arrhenatherea)			- - -
2—3	.	*Verbena officinalis* (Chenopodietea)			- - -
		Mesophyta			
		m 1			
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)	——	——	——
0	5	*Trifolium repens* (Molinio-Arrhenatherea)	- - -	——	——
2—3	.	*Sonchus asper* (Polygono-Chenopodion)	——	——	- - -
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)		——	——
0	6	*Xanthium strumarium* (Bidentetea)		——	- - -
0	4	*Cirsium arvense* (Chenopodio-Scleranthea)		- - -	——
3—4	6	*Inula britannica* (Agropyro-Rumicion)		——	
0	4	*Lotus corniculatus* (Plantaginetea)		——	
2—3	2	*Lactuca serriola* (Chenopodio-Scleranthea)		- - -	
		m 3			
2—3	3	*Agropyron repens* (Molinio-Arrhenatherea)	■■■	■■■	■■■
2—3	3	*Lythyrus tuberosus* (Secalietea)		- - -	- - -
0	5	*Daucus carota* (Arrhenatherion)		- - -	- - -
		Meso-xerophyta:			
		mx 1			
2—3	6	*Centaurea pannonica* (Molinio-Arrhenatherea)		- - -	——
0	3	*Vicia angustifolia* (Festuco-Brometea)			- - -
2—4	6	*Medicago lupulina* (Molinio-Arrhenatherea)		- - -	——
2—3	4	*Polygonum aviculare* (Chenopodio-Scleranthea)		- - -	- - -
0	4	*Trifolium campestre* (Festuco-Brometea)			- - -
0	5	*Cichorium intybus* (Molinio-Arrhenatherea)			- - -
		mx 2			
2	3	*Poa angustifolia* (Festuco-Brometea)		——	——
2—3	4	*Plantago lanceolata* (Festuco-Brometea)		——	- - -
1—2	3	*Achillea collina* (Chenopodio-Scleranthea)			- - -
		Asteno-xerophyton:			
		ax 1			
1—2	3	*Cynodon dactylon* (Chenopodio-Scleranthea)			■■■

the basis of the moisture demand of the subassociation's species components had an expanded course. This explains why the value of the total covering quota expressed in percentage only surpassed 20% on one occasion, namely in the case of the *hgm3* sub-group. Referring to the species of extreme appearance, partly the *Rorippa sylvestris* of the *hhg3* sub-group, partly the *Cynodon dactylon* of the *ax1* sub-group could be mentioned as examples. Figure 24 demonstrates the distribution according to subassociations of the species numbercovering quota within the various hydroecological categories.

7. *Lolio — Festucetum pseudovinae* (n. n.)

These are stands of highest relief at the flood-plain humid areas of the Tiszaalpár Basin, generally appearing in the form of islands. They frequently remained till our days in the neighbourhood of agriculturally cultivated hoed cultures, by evading tillage.

It is characteristic to its cenological relations that compared to the previous association, there was a further increase in the number and even the covering quota of the Festuco-Bromea, Festucion pseudovinae species — by now capable of enduring shorter periods of floods. In the consequence of the wavy character of the terrain, the association is not uniform here either, as even the site conditions varying to a slighter degree differentiated well separable units within association.

The character species of the *Lolio-Festucetum pseudovinae* were the *Daucus carota, Festuca pseudovina, Lolium perenne, Trifolium campestre.*

7.1. *L.—F.p. lolietosum*

Spreading

It developed at the Southern section of our area, in the region of the village Bokros at the sections being flater than typical, where its irrigation-like meadow not becoming salinous had fresh surface for longer periods, but the grass covering did not sustain discontinuities on the effect of the animal treadings.

Cenological relations

Apart from the species characteristic to the association, the Molinio-Arrhenatherea representatives also conceivable as differential species — like the *Potentilla reptans, Trifolium repens* and the *Stenactis annua belonging* to the Calystegion group — are the characteristic species components. These, however, did not influence the leading role played by the total covering quota of the *Lolium perenne* belonging to the predominant Plantaginetea class of the meadow, as well as the *Festuca pseudovina* classed among the Festucion pseudovinae group.

Hydroecology

From the association's three well separable sub-units, its drawn curve has the widest range. Although its differential species belong to the hygrophyta category, the culmination point of its curve — surpassing the value of 30% — appeared at the *m2* sub-group within the mesophytons (Fig. 26). By means of the *Festuca pseudovina,* however, the quota of the astenoxerophytons is also significant (Table 7.1).

7.2. *L.—F.p. plantaginetosum lanceolati*

Spreading

Such stands of this species developed which were similar to the type to a certain extent, but which were also well separable from that. The area occupied by its cenoses continuously decreases as the consequence of the flowing grass-tillage.

Cenological relations

The place of the previous Molinio-Arrhenatherea species is occupied by the Festuco-Bromea elements. Therefore, this subassociation formed a transition towards the type. The appearing *Podospermum canum* — although thought to be Festuco-Puccinellietea — could only be regarded as a pseudohalophyton species. The sodium salt content reaching the lowest level of the alkalinity degree could not be demonstrated in its explored and studied soil profile.

Differential species

Achillea setacea, Plantago lanceolata, Podospermum canum.

Hydroecology

The tracing of its drawn curve became narrowed down compared to the various hydroecological categories. Only the meso-, meso-xerophyton representatives took share in its cenoses. Two maximum-points appeared within the different categories and both reached the value of 30% (Fig. 36). In the case of the *m2* sub-group the *Lolium perenne,* and in that of the *mx2* the *Poa angustifolia* species components played the leading role.

7.3. *L.—F.p. festucetosum pseudovinae (typicum)*

Spreading

This is a pasture stand occupied by the association, at places ruling the highest relief of the Tisza flood-plain. Owing to the increasing expansion of the tillage area its cenoses incessantly decrease. Disregarding small patches, its elimination can be counted upon in the future.

Cenological relations

The Festuco-Bromea and the Festucion pseudovinae representatives became dominant. This is particularly valid for the Chenopodio-Scleranthea species having wider adaptability, like the *Cynodon dactylon, Eryngium campestre.* At the same time the more resistant Molinio-Arrhenatherea elements — although they played subordinate role — continued to be members of these grasses (Table 7.3).

Table 7. *Lolio-Festucetum pseudovinae*
1. *lolietosum perennis* 2. *plantaginetosum lanceolati* 3. *festucetosum pseudovinae*

F	W	Subassociation	1	2	3
		Hygrophyta:			
		hg 1, 2, 3			
3—4	6	*Potentilla reptans* (Molinio-Arrhenatheretea)	—		
2—3	.	*Lotus tenuis* (Festuco-Puecinellietea)	—		
2—4	8	*Stenactis annua* (Calystegion)	···		
		Mesophyta:			
		m 1			
2—3	5	*Taraxacum officinale* (Molinio-Arrhenatherea)	—	—	—
0	3	*Convolvulus arvensis* (Chenopodio-Scleranthea)	—	—	···
0	5	*Trifolium repens* (Molinio-Arrhenatheretea)	—		
		m 2			
2—3	5	*Lolium perenne* (Plantaginetea majoris)	■	■	■
2—3	6	*Trifolium pratense* (Molinio-Arrhenatheretea)	—		—
3	.	*Veronica arvensis* (Secalietea)	···	···	
		m 3			
0	5	*Daucus carota* (Molinio-Arrhenatheretea)	—	—	—
0	6	*Leontodon hispidus* ssp. *hastilis* (Molinio-Arrhenatherea)	—	—	···
		Meso-xerophyta:			
		mx 1			
0	4	*Trifolium campestre* (Festuco-Brometea)	—	—	—
0	3	*Galium verum* (Festuco-Bromea)	—	—	—
2—3	6	*Medicago lupulina* (Molinio-Arrhenatherea)	—	—	—
		mx 2			
2	3	*Poa angustifolia* (Festuco-Bromea)	—	■	■
0	4	*Lotus corniculatus* v. *hirsutus* (Molinio-Arrhenatherea)	—	—	—
2—3	3	*Ononis spinosa* ssp. *austriaca* (Festuco-Bromea)	—	···	···
1	2	*Eryngium campestre* (Chenopodio-Scleranthea)		···	—
2—3	2	*Carduus nutans* ssp. *macrolepis* (Festuco-Bromea)		···	—
0	4	*Plantago lanceolata* (Festuco-Bromea)		—	
2	2	*Achillea setacea* (Festucion pseudovinae)		—	
2	3	*Echium vulgare* (Festuco-Bromea)			···
		mx 3			
1—2	3	*Erodium cicutarium* (Festuco-Bromea)	···	—	—
2—3	1	*Hieracium pilosella* (Festuco-Bromea)	···	—	—
1—2	2	*Trifolium arvense* (Festuco-Bromea)	···	—	···
1—2	3	*Euphorbia cyparissias* (Festuco-Bromea)		—	—
2—4	5	*Podospermum canum* (Festuco-Puccinellietea)		—	—
2	3	*Fragaria viridis* (Festucetalia valesiacae)	—	—	
1—2	2	*Potentilla argentea* (Festuco-Bromea)			—
		Asteno-xerophyta:			
		ax 1			
2	2	*Festuca pseudovina* (Festucion pseudovinae)	■	■	■
2	3	*Cynodon dactylon* (Chenopodio-Scleranthea)	···		—
2	3	*Cerastium semidecandrum* (Festuco-Bromea)			—
1	2	*Trifolium striatum* (Festucion pseudovinae)			···
2	2	*Gypsophila muralis* (Bidentetea)			···

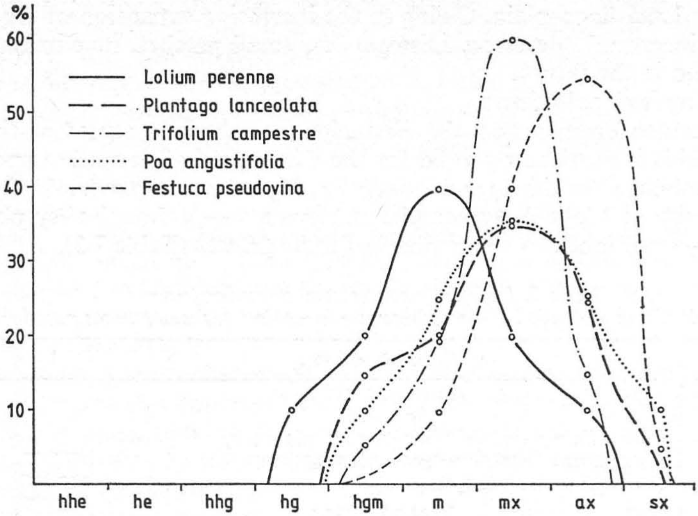

Fig. 25. Moisture demand of the five species components of the *Lolio-Festucetum pseudovinae*

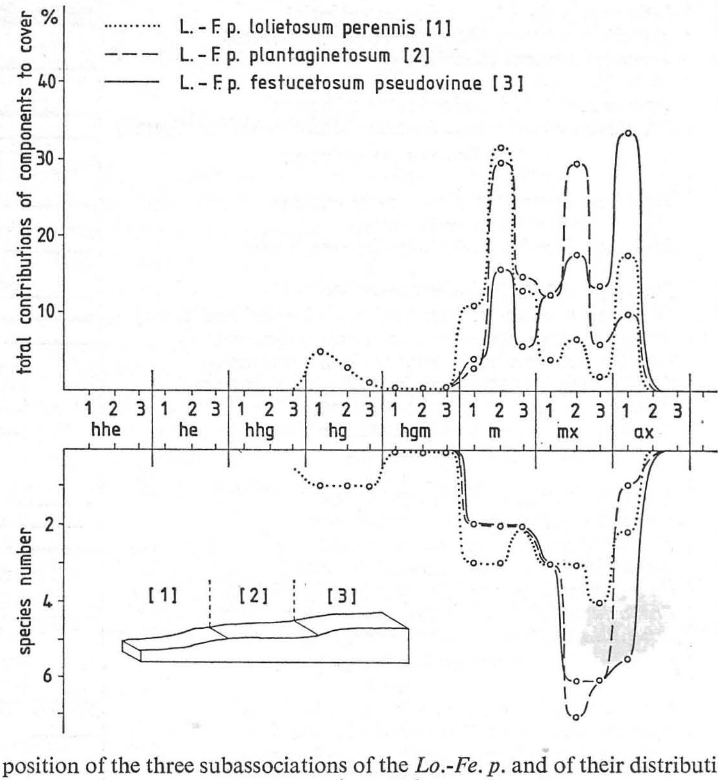

Fig. 26. The position of the three subassociations of the *Lo.-Fe. p.* and of their distribution according to species number

Differential species

Potentilla argentea, Carduus nutans ssp. *macrolepis, Cynodon dactylon.*

Hydroecology

Similarly to the previous, the species components of this subassociation were distributed among the mesophyton mesoxerophyton and asteno-xerophyton categories. Its drawn curve showed steady rise towards the latter (Fig. 36). From the mesophytons the species playing leading role were the *Lolium* of the *m2* sub-group, the *Poa angustifolia* of the *mx2,* and the *Festuca pseudovina* as well as the *Cynodon dactylon* of the *ax1*-s. The relationship between their species number- and total covering quota is detectable on Fig 26. Further details are shown on Table.

In conclusion it could be determined that the Lolio-Festucetum pseudovinae, the Poo angustifoliae-Alopecuretum and the Cynodonto-Poetum angustifoliae grass resp., can be regarded as pasture grasses which have become degraded on the effect of treading and grazing.

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A Közép-Tiszavölgy Növénytársulásainak hidroökológiája I. Agropyro-Rumicion

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Kivonat

A magyarországi Tiszavölgy középső tájegységének a leendő 4000 ha kiterjedésű Alpári tározó területén és környékén a taposást és legeltetést tűrő félruderális Plantaginetea gyeptársulások közül az időnkénti vízelárasztásnak kitett Agropyro-Rumicion legelő-társulások összetételének és hidroökológiai viszonyainak tisztázása volt elsősorban a feladat. Ennek során 7 asszociáció: *Rumici-Alopecuretum geniculati, Rorippo sylvestris — Agrostetum. Trifolio fragiferi- Agrostetum stoloniferae, Lolio-Potentilletum anserinae, Lolio-Alopecuretum pratensis, Rorippo austriacae-Agropyretum* és a *Lolio-Festucetum pseudovinae,* valamint asszociáció alatti egységeik fajkomponenseinek 8 hidroökológiai kategórián belől 24 alcsoportba történt besorolására került sor, talajökológiai viszonyaik figyelembe vételével. Össz. borítási részesedésük alapján megszerkesztett grafikonjaik alkalmasak az összefüggések feltárására. Lehetőség kínálkozott máshonnan közlésre került vizsgálati eredményekkel való összevetésre is.

Гидроэкология растительных сообществ алпарской котловины долины реки тисы I. Agropyro—Rumicion

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Резюме

Основной задачей работы является ознакомление с гидроэкологическими отношениями луговых сообществ Agropyro—Rumicion образовавшихся под влиянием заливания, затаптывания и выпаса полурудеральных (Plantaginetea) дернистых растительных сообществ в области средней части долины венгерской Тисы, а также на 4 тысяч га территории в окрестности водохпанилища Алпар.

На основании 7 ассоциаций *Rumici—Aloperetum geniculati*, *Rorippo silvestri—Agrostetum*, *Trifoliofragiferi—Agrostetum stoloniferae, Lolio—Potentilletum anserinae, Lolio—Alopecuretum pratensis, Rorippo austriaae Agrophretum* u *Lolio Festucetum pseudovinae* учетом экологических условий почвы, а также в рамках 8 гидроецоплогических компонентов, образовалось 24 подгруппы. Для общего изображения всех приведенных данных исследования сосравлены графики. Полученные данные послужат материалом для сравнения с другими результатами.

Hidroekologija biljnih zajednica basena Alpár u dolini reke Tise. I. Agropyro-Rumicion

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Abstrakt

Istraživanjima su obuhvaćeni sastav i hidroekološki uslovi Agropyro-Rumicion zajednice pod ispašom, koje su povremeno plavljene. Te livade se nalaze na području srednjeg toka reke Tise u Madjarskoj, na budućem području akumulacije Alpár, veličine 4000 ha. Ove livade pripadaju poluruderalnom tipu Plantaginetea sastojina i podnose gaženje is ispašu. Polazeći od ekoloških osobenosti tla, unutar sledećih 7 asocijacija: *Rumici-Alopecuretum geniculati, Rorippo sylvestri-Agrostetum, Trifolio fragiferi-Agrostetum stoloniferae, Lolio-Potentilletum anserinae, Lolio-Alopecuretum pratensis, Rorippo austriacae-Agropyretum* i *Lolio-Festucetum pseudovinae* i sastava vrsta njihovih subasocijacija, u okviru 8 hidroekoloških kategorija, izvršeno je njihovo uvrštanje u 24 subkategorije. Grafički prikazi učešća u ukupnojpo krovnosti, omogućujus agledavanje njihove uslovljenosti, kao i poredjenje dobijenih rezultata sa rezultatima istraživanja sa drugih lokaliteta.

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ЭКОЛОГО-БИОЛОГИЧЕСКИЕ ОСОБЕННОСТИ, ПУТИ ОХРАНЫ И ВОССТАНОВЛЕНИЯ ЕСТЕСТВЕННОГО АРЕАЛА NARCISSUS ANGUSTIFOLIUS CURT. В БАССЕЙНЕ РЕКИ ТИСЫ

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Аннотация

Изложены результаты комплексного биосистематического исследования *Narcissus angustifolius* Curt. в Закарпатье. Приведены сведения об экологической и фитоценотической приуроченности вида, возрастной структуре его ценопопуляций, большом и малом жизненных циклах, внутри- и межпопуляционной изменчивости вегетативных и репродуктивных признаков. Освещены наиболее важные аспекты репродуктивной биологии вида, его таксономическая и популяционная структура, экологическая и кариотипическая дифференциация. Рассмотрены некоторые вопросы происхождения и дальнейшей эволюции *N. angustifolius*.. На основании результатов исследований предложены пути охраны и восстановления естественного ареала вида в данном регионе.

Введение

Изучение эколого-биологических особенностей растений в природных условиях обитания, познание таксономической и популяционной структуры видов, их морфолого-географической, экологической и генетической дифференциации, а также фитоценотической роли имеют большое значение для решения многих вопросов систематики и микроэволюции. До настоящего времени примеров комплексного исследования отдельных таксонов очень мало. Совершенно очевидно, что в первую очередь всестороннему изучению должны подвергаться редкие и исчезающие виды растений. Это является главным условием разработки и успешного осуществления мероприятий, направленных на их охрану и воссоздание.

Исходя из этих предпосылок, нами предпринят комплексный биосистематический подход к изучению нарцисса узколистного (*Narcissus angustifolius* Curt) — одного из наиболее редких видов растений природной флоры, представляющего большой научный и практический интерес. На территории СССР вид встречается только в Закарпатье, где имеет крайнюю северо-восточную границу ареала. В настоящее время под мощным давлением антропогенного фактора происходит его интенсивное сокращение. *N. angustifolius* находится на грани исчезновения не только в пределах Украинских Карпат, но и в других регионах. В связи с этим вид включен в Красные книги СССР и Украины (Красная книга. Дикорастушие.., 1975; Красная книга СССР.., 1978; Червона книга Української РСР, 1980; Редкие и исчезающие.., 1982), взят под охрану в Венгрии (Csapody 1982) и других европейских странах.

Материал и методика

Наблюдения и сбор материала проводились в период с 1982 по 1984 гг. в шести модельных популяциях *N. angustifolius*,, расположенных в равнинно-предгорной (120—250 м над ур. м.) и высокогорной (1350—1500 м над ур. м.) зонах Украинских Карпат. В процессе выполнения работы применялись стационарные, полустационарные, маршрутные и лабораторные методы исследования.

Физико-химический состав почв из наиболее типичных местопроизрастаний вида исследовался по общепринятой методике (Практикум по почвоведению, 1980). Геоботанические обследования проводились в соответствии с принципами советской геоботанической школы (Сукачев 1957, Шенников 1961 и др.).

Для изучения биоморфологических особенностей, а также внутри- и межпопуляционной изменчивости вида из каждой популяции по принципу рендомизации отбиралось 50 генеративных особей, которые исследовались по 12 морфологическим признакам.

Для определения числа хромосом и изучения их морфологии применялся метод давленых препаратов (Battaglia 1957). Эмбриологические исследования были проведены по общей цитологической методике (Паушева 1980 и др.). Рисунки выполнялись рисовальным аппаратом РА—4, микросъемка — с помощью микроскопа *Ergaval-Zeiss* с микрофотографическим устройством *mf-matic*, а также стереоскопического микроскопа МБС—9.

В основу исследования семенной продуктивности положены методики Т. А. Работнова (1950 б) и И. В. Вайнагия (1974). Изучение большого жизненного цикла, определение возрастной структуры и численности ценопопуляций проводились на трансектах, которые закладывались рендомным методом (Ценопопуляции растений.., 1976). Выделение возрастных состояний особей, а также классификация ценопопуляций проведены по Работнову (1950 а).

Полученные цифровые данные обрабатывались вариационно-статистическими методами (Weber 1961, Плохинский 1970, Зайцев, 1973 и др.). Определялись основные статистические показатели, проводились корреляционный, регрессионный, однофакторный и двухфакторный дисперсионный анализы. Расчеты проведены на ЭВМ ЕС—1020, программа составлена на алгоритмическом языке FORTRAN — IV.

Результаты и обсуждение

До настоящего времени *N. angustifolius* изучен недостаточно. Известно лишь несколько работ, в которых рассматриваются некоторые эколого-фитоценотические особенности, распространение и отдельные черты биологии вида (Артюшенко, Харкевич 1956, Харкевич 1960, Комендар 1964, Артюшенко 1970, Комендар, Пердук, Машанова 1977 и др.).

Относительно систематического положения *N. angustifolius* в литературе нет единого мнения. Ранее нами уже отмечалось (Комендар, Крічфалушій 1984), что большинство исследователей считает его вполне самостоятельным видом, хотя некоторая часть из них рассматривает *N. angustifolius* в качестве подвида *N. poeticus L.* Имеются также определенные неясности в синонимике и внутривидовой номенклатуре, обусловленные, главным образом, большой полиморфностью вида и возникшей в связи с этим таксономической путаницей.

Общий ареал *N. angustifolius* охватывает горные системы Южной и Средней Европы от Французских Альп до Восточных Карпат включительно (Hegi

1939, Фомін, Бордзіловський 1954, ZAHARIADI 1966, WEBB 1980 и др.). Отдельные местопроизрастания вида указываются и для Венгрии (BOROS 1924, JÁVORKA 1925, GÁYER 1927, HORVÁTH SZINETÁR 1965, ISÉPY PRISZTER 1972, SOÓ 1973).

На Закарпатье *N. angustifolius* встречается в бассейне верхнего и среднего течения р. Тисы. Первые упоминания о нем находим в работах St. FEDOROWICZ (1910), W. SZAFER (1919), А. Маргитая (1923), K. DOMIN, PODPERA (1928), MARGITTA I(1938), M. DEYL (1940) и B. PAWLOWSKY (1947). В дальнейшем распространение вида в этом регионе изучалось С. С. Фодором (1956) и В.И. Комендаром (1964). Согласно нашим исследованиям, основная часть ареала (26 местопроизрастаний) находится в субальпийском поясе горных хребтов Свидовец, Мармарошские Альпы и отчасти Горганы, на высотах 1400—1600 м над ур. м. На низменности и в предгорье (120—250 м над ур. м.) вид имеет островное распространение и на сегодня сохранился лишь в 4 местообитаниях из 13, отмеченных несколько десятков лет назад. Эти местопроизрастания следует считать наиболее низкорасположенными и удаленными от основного ареала горного по своему происхождению *N. angustifolius*. В связи с этим некоторые исследователи (Чопик 1976, 1978) полагают, что они имеют вторичное происхождение.

В субальпийском поясе Украинских Карпат *N. angustifolius* встречается на высокогорных лугах, а также среди криволесья из *Duschekia viridis* (CHAIX) OPIZ и *Juniperus sibirica* BURGSD. (рис. 1). Нарциссовые луга в горах приурочены к горно-луговым буроземным и горно-луговым торфянистым почвам с разной степенью гумусированности и щебнистости. В сложении растительных сообществ *N. angustifolius* является временным содоминантом с обилием 15—25% (балл 2 по шкале Браун—Бланке). Описано 8 ассоциаций с флористическим ядром из 10 видов сосудистых растений. Всего здесь встречается 37 видов, из

Рис. I. Природные заросли *Narcissus angustifolius* на г. Подпула (Свидовецкий хребет)

Рис. 2. Луговые сообщества *Narcissus angustifolius* в заповеднике Долина нарциссов» (в окрестностях г. Хуста)

которых к злакам относятся 7, к разнотравью — 22, к осокам и ситникам — 2; группа зеленых мхов насчитывает 6 видов (Комендар, Кричфалуший 1985).

В равнинно-предгорной зоне *N. angustifolius* встречается в луговых и лесных сообществах в основном на дерново-буроземных глеевых и бурых лесных оподзоленных глееватых почвах (рис. 2). Здесь играет более заметную роль, являясь доминантом или содоминантом с обилием 15—35% (балл 2—3). Выделено 7 ассоциаций, флористическое ядро которых составляют 12 видов сосудистых растений. Всего отмечено 118 видов, из них к злакам относятся 16, к разноотравью — 76, а к осокам и ситникам — 22 (Комендар, Кричфалуший 1985). Как видно, *N. angustifolius* — вид с широкой экологической амплитудой. Он встречается в разных высотных поясах, в нескольких типах фитоценозов, на почвах, отличающихся как по физико-химическим свойствам, так и по режиму увлажнения. Основными экологическими факторами, лимитирующими распространение вида, являются чрезмерное затенение под пологом лесов, почвы с нейтральной и щелочной реакцией (оптимум: pH=3, 4—4, 9), сильно каменистые и скалистые субстраты.

В результате проведенных исследований установлено, что подобное различие условий произрастания *N. angustifolius* приводит к биоморфологическим отличиям между группами равнинно-предгорных и высокогорных популяций. Степень различий между популяциями из одного пояса варьирует от полного отсутствия до уровня, который значительно ниже межгрупповых различий.

Так, сравнительно-кариологическое исследование показало (Кричфалуший, Свешникова 1985), что все полуляции имеют сходный стандартный кариотип ($K=2n=14=2\cdot)4SA+2SM+SM^{st}$ (рис. 3), т. е. относятся кодному виду. На базе основного числа хромосом обнаружено три вариации кариотипа, отличающиеся между собой по колочеству дополнительных хромосом ($2n=14+0-4B$). Генетическая дифференциация предгорных и высокогорных популяций проявляется в различии между ними по количеству спутничных хромосом, а также по характеру распределения дополнительных хромосом. В предгорных популяциях спутничной является УП пара субметацентрических хромосом, а число растений с В-хромосомами варьирует от 36 до 52%. В высокогорных местообитаниях вида обнаружено две спутничные хромосомы — УI и УII, а количество особей с допольнительными хромосомами составляет 4—12% от общего числа исследованных экземпляров.

Наблюдения за сезонным ритмом роста и развития *N. angustifolius* показали, что неблагоприятные условия высокогорья влияют на смещение фенофаз и ускоряют прохождение растениями отдельных этапов малого жизненного цикла. На низменности и в предгорье надземный годичный цикл развития продолжается в течение 4 месяцев (апрель-июль), а в высокогорном поясе — 2,5—3 месяцев (вторая половина мая — начало августа) и в более поздние календарные сроки.

В ходе большого жизненного цикла особи *N. angustifolius* проходят через ряд последовательных возрастных состояний. На основании комплекса качественных и количественных признаков, исследованных у 25—30 экземпляров каждого возрастного состояния, выделены 5 возрастных групп и 8 подгрупп особей. Основные этапы большого жизненного цикла растений в разных высотных поясах совпадают, однако в высокогорье наблюдается его биологическое сокращение в связи с выпаданием средневозрастного состояния генеративного периода.

Исследование возрастной структуры и численности ценопопуляций *N. angustifolius* в 13 наиболее типичных сообществах позволило определить экологический и фитоценотический оптимумы вида. На низменности и в предгорье экологический оптимум, т. е. условия наиболее благоприятные для роста и развития растений (Работнов 1950 б), реализуется в широколиственных лесах. Здесь структура возрастных спектров очень благоприятна для вида и характеризуется преобладанием средне- и мощноразвитых особей генеративного периода (46,9%), быстрыми темпами их развития, максимальной семенной продуктивностью и оптимальной плотностью ценопопуляций (75—85 особей на 1 м^2). Фитоценотический оптимум, т. е. условия, при которых ценопопуляция достигает максимальной интенсивности воздействия на среду (Работнов, 1950 б), наблюдается на высокотравных лугах. В этих ценопопуляциях численность особей наибольшая (308,2—319,3 экземпляра на 1 м^2), однако структура возрастных спектров неблагоприятна для вида, преобладают слабо- и средне-развитые особи генеративного периода (21,5—35%), возрастает участие фракции прегенеративных растений вследствие ухудшения условий существования. Как видно, экологический и фитоценотический оптимумы *N. angustifolius* в этой зоне не совпадают. В целом эколого-фитоценотические условия наиболее близки к оптимальным на разнотравно-элаковых лугах.

В высокогорном поясе экологический и фитоценотический оптимумы совпадают на субальпийских высокотравных лугах. Здесь численность особей наивысшая из всех высокогорных ценопопуляций (76 экземпляров на 1 м^2), группа генеративных растений наиболее многочисленна (57,9%), однако доля мощноразвитых экземпляров несколько ниже, чем в лесах. Анализ возрастной структуры ценопопуляций *N. angustifolius* позволяет выделить базовые спектры, характерные для сообществ, находящихся в дефинитивном состоянии (рис. 4). Структура базовых спектров коррелирует в общих чертах со способами размножения и поддержания численности ценопопуляций. В зависимости от степени антропогенного влияния и эколого-ценотических условий выявлены несколько сильноотличающихся вариаций возрастных спектров, а также регрессивный тип ценопопуляции, соответствующий одной из последних степеней пастбищной дегрессии.

В природных местообитаниях у *N. angustifolius* наблюдаются три формы вегетативного размножения. Энергия вегетативного размножения зависит от условий местообитания и коррелирует с интенсивностью семенного размножения. В широколиственных лесах низменности и предгорья полностью преобладает семенное возобновление ценопопуляций, в высокогорном поясе — вегетативное. В луговых сообществах предгорья самоподдержание ценопопуляций осуществляется как семенным, так и вегетативным способом, при доминировании семенного разножения.

Исследовались все основные эмбриональные процессы у *N. angustifolius*: микроспорогенез и развитие мужского гаметофита, мегаспорогенез и развитие женского гаметофита, оплодотворение, развитие эндосперма и зародыша (Кричфалуший 1984). Установлено, что высокогорные популяции вида характеризуются наличием некоторых эмбриологических особенностей (отклюнения в процессе мейоза и формирования микроспор, более низкая фертильность пыльцы, в среднем на 33,9% по сравнению с предгорными популяциями, гибель семяпочек на ранних стадиях развития, смещение сроков и ускоренные темпы прохождения отдельных этапов эмбриогенеза), обусловленных воздействием суровых климатических условий на микроспорогенез, опыление и оплодотворение.

Интенсивность семенного размножения *N. angustifolius* зависит от условий местообитания и коррелирует, как уже отмечалось, с энергией вегетативного размножения. Средние значения элементов семенной продуктивности популяций из разных поясов достоверно различаются между собой по всем уровням значимости. Процент обсеменения предгорных популяций в течение трех лет исследований варьировал от 16,9 до 29,2%, высокогорных — от 3,6 до 16,8%. Двухфакторным дисперсионным анализом установлено, что неблагоприятные климатические условия высокогорья существенно снижают как потенциальную, так и фактическую семенную продуктивность. Количество развитых семяпочек на побег в высокогорных популяциях в среднем на 20,62% ниже, чем в предгорных, а семян — на 66,98%. Корреляция между количеством семяпочек и семян во всех исследованных популяциях отсуствует. В целом способность вида к семенному размножению довольно низкая, в особенности высокогорных популяций.

По способу диссеминации *N. angustifolius* относится к барохорам, отчасти баллистам (по классификации Р. Е. Левиной 1957). Прорастание семян в природе подземное осеннее. Полевая всхожесть семян зависит от эколого-фитоценотических условий местообитания и в среднем равна 62%. Лабораторная всхожесть семян из предгорных популяций варьирует от 71 до 97% и в среднем составляет 84,8%, из высокогорных — от 36 до 87%, средняя — 54,35%. Всхожесть семян сохраняется в течение 3—4 лет, но процент всхожести уменьшается от года к году.

Для исследования морфолого-географической дифференциации популяций *N. angustifolius* применен анализ внутри- и межпопуляционной изменчивости вегетативных и репродуктивных признаков (Майр 1974). Установлено, что большинство признаков подвержены географической изменчивости и проявляют среднюю степень варьирования (V=11—20%). Высокая степень поли-

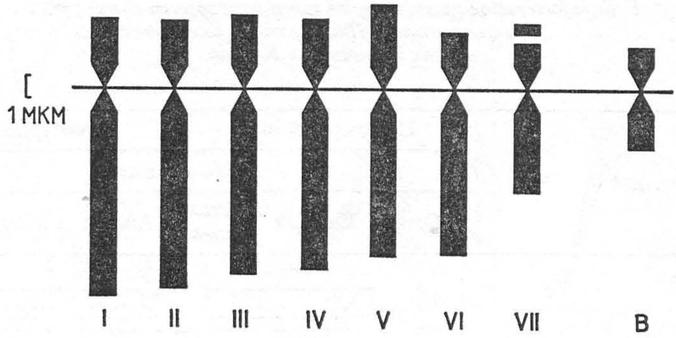

Рис. 3. Идиограмма *Narcissus angustifolius*

морфизма подземных органов (V=25—40%) определяется, главным образом, экологическими условиями местообитания. Признаки с низкой и средней степенью изменчивости использовались в качестве критерия морфолого-географической дифференциации популяций, так как они довольно стабильны и менее зависимы от влияния экологических факторов. Характер варьирования признаков в пределах одного пояса в общих чертах совпадает. Кривые величин коэффициентов вариации из разных поясов имеют свои особенности, вследствие чего они менее сопоставимы. Географическая изменчивость *N. angustifolius* проявляется в значительном преобладании признаков предгорных популяций над соответствующими параметрами высокогорных. Изученные популяции достоверно различаются между собой по 9 признакам из 12 исследованных нами (таблица). Поскольку в характере географической изменчивости наблюдается отсутствие трансгрессии вариационных интервалов вид следует считать политическим.

В предгорных и высокогорных популяциях существует взаимосвязь между 18 признаками, из них 9 являются общими для обоих поясов. Установленные зависимости выражаются аналитически в виде линейных функций и соответствующих уравнений регрессии. Сравнением средних значений признаков при помощи критерия Стьюдента, а также корреляционным анализом доказано, что по характеру большинства взаимосвязей все популяции относятся к некогда единой первичной популяции вида, которая затем распалась, в силу ряда причин, территориально на локальные. Степень расхождения между популяциями из одного пояса существенно ниже, чем между популяциями из разных поясов.

На основании морфологических отличий по числу листьев между популяциями из предгорного и высокогорного поясов В. И. Комендар (1969) описал трехлистную и четырехлистную формы данного вида. В результате проведенных нами биокомплексных исследований *N. angustifolius* установлено, что между этими группами популяций имеются существенные морфофизиологические, биологические, эколого-фитоценотические и кариотипические различия. Таким образом, есть все основания считать, что в Закарпатье *N. angustifolius* представлен двумя климатическими (географическими) экотипами. На низменности и в предгорье произрастает *N. angustifolius* oec. *praemontanus* KOMENDAR et KRICSFALUSHIJ. В высокогорном поясе встречается *N. angustifolius* oec. *altimontanus* KOMENDAR et KRICSFALUSHIJ (Комендар, Крічфалушій 1984). Вы-

Географическаяа изменчивость признаков шести популяций Narcissus augustioflius в разных высотных поясах Украинских Карпат

Таблица.

Признак	Предгорный пояс			Высокогорный пояс		
	Популяция					
	Дубровы	Киреши	Била Млака	Апецка	Подпула	Стог
Луковица						
Длина, см	4,09	3,75	3,77	2,78	2,80	3,36
Ширина, см	2,29	1,94	1,80	1,68	1,59	2,03
Вес, г	6,76	5,92	5,17	3,89	3,49	6,02
Листья						
Число, шт	3,59	3,56	3,56	2,68	2,78	2,86
Длина, см	25,65	39,29	38,12	26,59	25,59	26,26
Ширина, см	0,76	0,76	0,73	0,68	0,63	0,69
Цветонос						
Высота, см	55,49	49,88	48,60	35,11	35,19	41,55
Цветок						
Диаметр, см	7,11	6,44	6,38	6,12	6,29	6,70
Длина трубки, см	2,78	2,76	2,69	2,98	2,91	2,96
Длина пыльников, см	0,53	0,52	0,51	0,51	0,53	0,50
Плод						
Длина, см	1,82	1,70	1,71	1,41	1,48	1,52
Ширина, см	1,15	1,16	1,15	1,18	1,14	1,19

ПРИМЕЧАНИЕ: обведены и соединены средние значения признаков, между которми отсутствует достоверная разница.

деленные экотипы являются, по существу, аллопатрическими рассами данного вида, между которыми возникли наблюдаемые различия вследствие их приспособления к сильно отличающимся условиям среды и длительной географической изоляции. В систематическом отношении разница между выделенными экотипами соответствует таксономическому рангу подвидов. Следовательно, предгорный экотип является новым для науки таксоном — *N. angustifolius* subsp. *transcarpathicus* Kricsfalushij, comb. nov. (Крічфалуший 1984).

Анализ популяционной структуры *N. angustifolius* позволил выделить

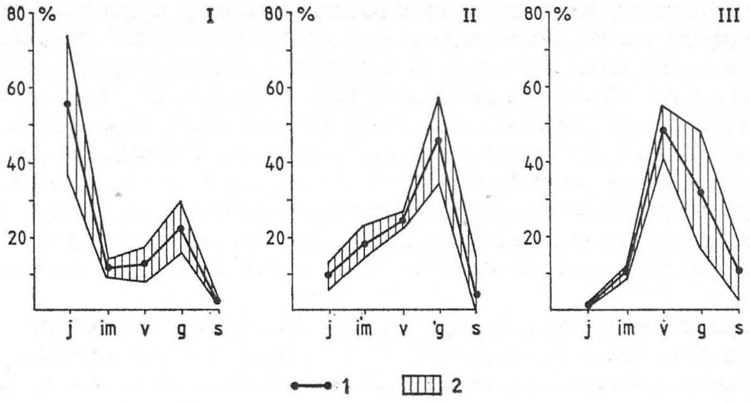

Рис. 4. Базовые спектры ценопопуляций *Narcissus angustifolius*
I — широколиственные леса (низменность и предгорный пояс);
II — луговые сообщества (предгорный пояс);
III — кустарниковое криволесье и высокогорные луга (субальпийский пояс);
I — базовый спектр; 2 — зона базового спектра ($\bar{x} = \pm 3 \sim$)
(Рис. *4* оставиь из первого варианта стари!)

внутри предгорного климатоэкотипа два ценоэкотипа: луговой и лесной. Первый экотип объединяет популяции, приуроченные к луговым ценозам на бедных дерного-буроземных глеевых почвах. Второй включает популяции, местообитания которых связаны с широколиственными лесами и богатыми гумусом бурыми лесными оподзоленными глееватыми почвами. Морфологические параметры этих популяций существенно превышают соответствующие характеристики луговых популяций по 6 признакам, а длина листьев у растений лесных сообществ заметно короче, чем у луговых (таблица). Были обнаружены и другие особенности лесных популяций, проявляющиеся в запаздывании фенофаз развития, пространственной и возрастной структуре, способах возобновления и повышенной концентрации дополнительных хромосом. По-видимому, в систематическом отношении описанные выше ценоэкотипы можно рассматривать как луговую (*N. angustifolius* f. *pratensis* KRICSFALUSHIJ) и лесную (*N. angustifolius* f. *sylvatica* KRICSFALUSHIJ) формы данного вида.

Высокогорные популяции также распределяются на две группы. К первой группе относятся сообщества, местообитания которых связаны с кустарниковым криволесьем и высокогорными низкотравными лугами на горно-луговых щебнистых почвах. Ко второй — популяции, приуроченные к субальпийским высокотравным лугам на горно-луговых буроземных почвах с мощным гумусным горизонтом. Они превышают популяции первой группы по 5 морфологическим признакам (таблица), а также отличаются по характеру возрастной структуры. Однако здесь ведущими факторами, воздействующими на дифференциацию популяций, являются, главным образом, эдафические условия, поэтому форма растений наследственно не закреплена, что установлено экспериментальным путем. Таким образом, фенотип этих популяций является следствием модификационной изменчивости и они могут быть выделены лишь в качестве экад.

Установленная нами внутривидовая дифференциация *N. angustifolius*, его широкая экологическая пластичность и современный дизъюнктивный ареал являются следствием влияния на процесс возникновения и дальнейшую эволюцию вида резкоизменявшихся условий физико-географической среды (орогенез, оледенения и др.). Существование на Закарпатье равнинно-предгорной группы популяций можно объяснить миграцией вида в плейстоцене из высокогорных районов Украинских Карпат на Средне-Дунайскую низменность, где он сохранился на сегодня в рефугиумах ледникового периода. Свидетельством в пользу этой гипотезы являются многие палеоботанические и палеонтологические находки, а также результаты проведенных нами исследований. Исходя из вышесказанного, наши взгляды на вопрос происхождения равнинного участка ареала *N. angustifolius* расходятся с мнением Чопика (1976, 1978) о его вторичном характере.

Детальная биологическая информация о *N. angustifolius*, которой мы располагаем в результате проведенных исследований, а также изучение влияния антропогенных факторов на ареал и биоморфологические особенности вида позволяют разработать научные основы его охраны. Основной путь заключается в сохранении всего генофонда вида и воссоздании его локальных популяций в природных условиях обитания. Наиболее действенными являются охрана популяций в естественных местопроизрастаниях на существующих заповедных территориях («Долина нарциссов»), а также организация новых памятников природы. Предполагается воссоздание на ценогенетической основе моделированных экосистем в первичных местообитаниях вида. Определенная роль отводится и такой охранной мере, как культивирование *N. angustifolius* в ботсадах.

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A Narcissus angustifolius Curt. ökologia-biologiai sajátosságai, a faj útjainak védelme és természeti kiterjedésének visszaállítása a Tisza folyó medencéjében

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Uzsgorodi Állami Egyetem, Botanikai Tanszéke, Szovjetunió

Kivonat

A *Narcissus angustifolius* CURT. bioszisztematikai kísérleteknek eredményeit közlik a Kárpátaljáról. Adatokat közölnek a fajok ökológiai és fitocönológiai alkalmazkodásairól, a nagy és kis életciklusról, a belső- és populációközti vegetatív és reproductív jellemvonásainak változásairól. Adatokat közölnek a reproductív biológia fő aszpectusairól, a faj taxonómiájáról, ökológiai, fenotipikus és káriotipikus differenciációjáról. Nyomon követték a *N. angustifolius* származását és további evolúcióját. A kísérletek eredményei alapján ajánlják a faj megvédésének útjait védelmét és visszatelepítését a természetvédelmi régióba.

Ecological and biological features, ways of protection and regeneration of the natural area of Narcissus angustifolius Curt. In the basin of the Tissa river

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Results of complex biosystematic study of *Narcissus angustifolius* Curt. in Transcarpathia are reported. Information on ecological and phytocenotypic environment of the species, age structure of its cenopopulations, great and small life cycles, variability of vegetative and reproductive features within the population is given. The most important aspects of the reproductive biology of the species, its taxonomic and population structure, ecological and karyotypic differentiation are elucidated. (In the paper). Some problems of the origin and further evolution of *N. angustifolius* are considered. Some ways and methods of protection and regeneration of the natural area of the species in this region are suggested.

Ekološko-biološko osobenosti Narcissus angustifolius CURT.j mogu nosti za tite vrste i uspostavljanja njenog prirodnog areala u dolini reke Bise

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Abstrakt

U radu se prikazuju rezultati biosistematskih ispitivanja *Narcissus angustifolius* CURT. sa podnožja Karpata. Iznose se podaci o ekološko-fitocenološkoj adaptaciji vrste, o dijapazonu životnih ciklusa, o unutrašnjim i medjupopulacijskim vegetativnim i reproduktivnim karakteristikama. Daju se podaci o osnovnim aspektima reproduktivne biologije, o taksonomskom statusu vrste, o ekološkoj, fenotipskoj i kariotipskoj diferencijaciji. Prikazano je poreklo i evolucija vrste. Na osnovu rezultata istraživanja daje se predlog za zaštitu i uspostavljanje vrste u regionu njenog prirodnog areala rasprostranjenja.

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INVESTIGATION OF MOSQUITO FAUNA (DIPTERA, CULICIDAE) IN POTISJE

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Abstract

During a four year investigation (1979—1982) of fauna of mosquitoes in the region of Potisje 18 species were recorded. The material was collected on seven localities along the river Tisa and eleven localities which represent river lakes, pools and swamps, all of them being the remnants of the former course of the river. Nine species, of total 18, were found in breeding places along river, and the rest in breeding places of former river course. Six species are mutual for both types of breeding places. With five species that have been recorded during previous researches, it is the total of 23 registered species in the region of Potisje.

Introduction

Flooded areas along the Tisa as well as the remaining parts of the former course of this river are typical breeding places of mosquitoes. Faunistical researches of the family Culicidae (Diptera) in this area were conducted during a four year period from 1979 to 1982.

The material was collected on seven localities along the Tisa and eleven localities being often in the form of crescent depressions, lakes, pools and swamps and are the remaining parts of the previous river cours. Some of these lakes are characterized with a certain percent of salt in water. Fauna of mosquitoes in this area, specially along the river banks, has already been the subject of research. ADAMOVIĆ (1975) examined in detail the subfamily *Anopheline* and recorded four species of genus *Anopheles*. Matilda MOROVIĆ (1980) registered the presence of species *Aedes cataphylla* DYAR in the vicinty of Novi Kneževac, the one which was not recorded in our researches (Fig. 1).

Area examined

The river Tisa rises in the Carpathians. When it descends to Pannonia plain it becomes a typical lowland river. On the territory of Yugoslavia, i.e. Vojvodina, it receives small quantity of water, only 9,4% of total quantity that enters in our country. Of 9,4% 6,4% enters from the river Begej and the rest of 3% from all other tributaries.

The bed of the river Tisa is an uniform one without the islets and river branches. Flowing through the plains it has a very small fall of only 28 mm/km. A small fall of the river causes its meandres and their downstream movments. Slow flowing of the Tisa through these meandres causes high water level and freguent floods. These were the reasons why the course of the Tisa was regulated during the middle of 19th century. The length of the river was reduced from 1429 km to 977 km. The parts of the river course that had been cut off retained their crescent forms and turned to pools, lakes and swamps. There are a lot of crescant depressions all over the fields in Vojvodina, specially in Banat and Bačka. During drought years, those that are on saline soil are without water and vegetation and are covered with crystallized soda and various salts which make the water brackish.

The Tisa has two maximums and two minimums. For the appearance of the mosquitoes the first maximum is more interesting. It occurs in April as a result of snow melting in the Carpathians where it starts earlier than in the Alps because of smaller altitudes. The second maximum occurs around November 20th and is of minor interest. These two maximum are separated by period of low waters.

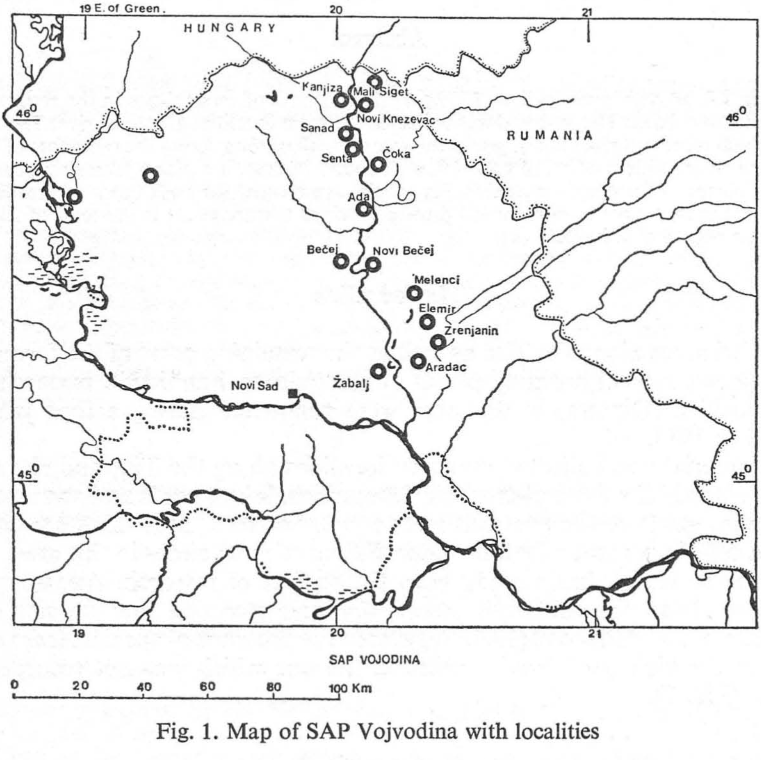

Fig. 1. Map of SAP Vojvodina with localities

Water level of the Tisa changes as it approaches the Danube. The first maximum in this area lasts almost three months — from April till June, and is caused by high water level of the Danube (Bukurob 1977).

Sampling method

When choosing localities a care was taken that breeding places in flooded areas along the Tisa and those in pools, lakes and swamps, that is the parts of the former course, should be included equally. The crescent depressions are more or less in the vicinity of the river course, usually having freshwater and only a few having brackish water (Slano kopovo near Novi Bečej, Rusanda near Melenci and Okanj near Elemir).

Along the Tisa material was collected in the vicinity of Žabalj, Bečej, Ada, Senta, Sanad, Novi Kneževac and Kanjiža, while pools, lakes and swamps are near following places Mali Siget, Čoka, Novi Bečej, Elemir, Melenci, Zrenjanin, Aradac, Orlovat, Okanj, Bački Monoštor and Svetozar Miletić (Fig. 2).

The number of larvae and adults during the field work was established with method approved by WHO. Larvae were collected by means of net dia 25 cm, and adults by means of aspirator and hand net.

By use of standard methods the material was prepared, determined and is kept within the collections of the Institute of Biology in Novi Sad.

Results and Discussion

Researches conducted during a four year period enabled us to collect numerous and various material (over 2000 samples of adults and about 1500 samples of larvae) and to investigate this area thoroughly.

In regard to the production of mosquito breeding places flooded areas along the Tisa are more important. Flooded areas along the embankment in the vicinity of Novi Kneževac, Ada, Senta and Sanad cause the appearance and development of numerous samples of species *Aedes vexans* MEIGEN, *Aedes cinereus* MEIGEN, *Aedes sticticus* MEIGEN and *Aedes rossicus* DOL., GORIC., MITROF. Depending on year, *Aedes vexans* is predominant with its 50—60% of the total number of collected samples, all over researched areas along the Tisa. The number of generations of this and other species developing on this type of locality directly depends on the number of floods of riverside zone where the eggs have been laid, water temperature and the proportion between the lenght of day and night. Usually there are two generations of these species per year that are most numerous at the end of May — beginning of June and in the middle of July. If there are more rainfalls during a year and more oscillations of water level polivoltine species give three or rarely four generations within the period April—September. Beside mentioned species found on the localities along the Tisa the following were recorded: *Aedes cantans* MEIGEN, *Culex pipiens comp.* LINNAEUS, *Culex modestus* FICALBI, *Culex territans* WALKER and *Anopheles maculipennis comp.* MEIGEN.

Species of genus *Culex* are also abundant in this area, specially in inhabited places and are represented with about 15% (14,75%) of total number of collected mosquitoes. They have two or three generations per year depending on the quantity of rainfalls and their breeding places can be found in the most various places with water. Adults of these species fly much longer than the representatives of genus *Aedes*. If days are warm during middle of October females, probably searching for winter shelters, can be found easily. Species *Aedes cantans* is rather small in number and was registered on only two localities along Tisa (Žabalj, Novi Kneževac). This is a an early spring univoltine species.

Species of *Anopheles maculipennis* comp. can be found during the whole season. During our researches larvae were collected in most cases. Adults usually stayed in stables basements and apartments, the places we did not controll. ADAMOVIĆ (1975) in his detailed researches of the region of Potisje recorded the presence of species *Anopheles atroparvus* VAN THIEL (Melenci, Čoka, Martonoš, Sakule and Čenta), *Anopheles maculipennis* MEIGEN (Bečej, Melenci, Sakule and Opovo), *Anopheles messeae* FALLERONI (Bečej, Biserno Ostrvo, Žabalj and Perlez) and *Anopheles clavider* MEIGEN (Melenci). The most numerous species in all controlled places was

Anopheles messeae. The material was collected in stables of 12 inhabited places in Potisje from June to October 1974 and 1975.

The second group of mosquito breeding places are pools, lakes and swamps, the remnants of the former river course. Some of these breeding places have the production which can be compared with the production of flooded areas along Tisa. These are lakes Slano kopovo, Rusanda, Okanj and Carska bara.

As far as fauna is concerned these localities are more interesting as there are conditions for developing of a number of different species which, at the same time, belong to rather rare species in this region. Species *Aedes caspius* PALLAS, *Aedes dorsalis* MEIGEN and *Aedes flavescens* MÜLLER are predominant on salines and they are very numerous in June and at the beginning of July.

Early in spring univoltine species such as *Aedes rusticus* ROSSI, *Aedes cantans, Aedes excrucians* WALKER and *Aedes annulipes* were found in forest covered areas (Carska bara, Bački Monoštor and Svetozar Miletić). Larvae of these species were registered at the end of March — beginning of April when the water temperature is relatively low (+4 to +7 °C). The adults of these species are reperesented in the largest number in June, while single samples can be found even in August.

Species *Culiseta annulata* SCHRANK was recorded, during our investigation, only in surroundings of Apatin, ADAMOVIĆ, (1975) designates this species as one of the most frequent in Potisje. According to this data samples of this species were found in all controlled stables.

Species *Uranotaenia ungiculata* EDWARDS has been recorded in Vojvodina till now only in surroundings of Melenci and Elemir. In July 1982 two females and one male were caught with hand net near Melenci. The next discovery was at the end of September 1982 when larvae were collected near Okanj lake (BOŽIČIĆ, 1982).

Species *Mansonia richiardii* FICALBI was registered near Čoka, Melenci, Bački Monoštor, Novi Bečej, Senta and Svetozar Miletić. Single samples were caught on all localities except for surroundings of Novi Bečej and Svetozar Miletić where more

Aëdes (Aädes) rossicus DOLB. GORIC. MITROF. 1930
∗+ *Aëdes (Aädes) cinereus* MEIGEN. 1830
▲∗+ *Aëdes (Aëdimorphus) vexans* MEIGEN. 1830
\+ *Aëdes (Ochlerotatus) stictitus* MEIGEN. 1838
\+ *Aëdes (Ochlerotatus) cantas* MEIGEN. 1818
Aëdes (Ochlerotatus) rusticus ROSSI. 1790
∗ *Aëdes (Ochlerotatus) flavescens* MÜLLER. 1764
▲∗ *Aëdes (Ochlerotatus) caspius* PALLAS. 1771
◆ *Aëdes (Ochlerotatus) dorsalis* MEIGEN. 1830
∗ *Aëdes (Ochlerotatus) excrucians* WALKER. 1856
Aëdes (Ochlerotatus) annulipes MEIGEN. 1830
Culex (Barraudius) modestus FICALBI. 1889
\+ *Culex (Culex) pipiens comp.* LINNAEUS. 1758
∗ *Culex (Neoculex) territans* WALKER. 1856
Culiseta (Culiseta) annulata SCHRANK. 1776
\+ *Mansonia (Coquillettidia) richiardii* FICALBI. 1889
Uranotaenia (Pseudoficalbia) unguiculata EDWARDS. 1913
Aëdes (Ochlerotatus) catphylla DYAR. 1916
Anopheles (Anopheles) atroparvus VAN THIEL. 1927
Anopheles (Anopheles) maculipennis MEIGEN. 1818
Anopheles (Anopheles) messae FALLERONI. 1926
Anopheles (Anopheles) claviger MEIGEN. 1804

◆MALARIA∗TULAREMIA+LYMPHOCYTIC CHORIOMENINGITIS ▲TAHYNA VIRUS ENCEPHALITIS

Fig. 2. List of mosquitoes species in Potisje

samples were found but hardly could be characterized as numerous. First adult samples appear at the end of June and are most numerous at the end of July.

On the whole territory of Vojvodina 31 species of mosquitoes have been registered till now. Genus *Anopheles* is represented with 6 species, genus *Aedes* with 15 and genus *Culex* with 4. Genus *Culiseta* is represented with 3 species and genera *Uranotaenia, Orthopodomyia* and *Mansonia* with one species each.

We are not of the opinion that this is the final number of present species, specially if we compare the results of these faunistical researches with the results obtained in Hungary (Mihalyi, 1941, 1945, 1961; Mihalyi et al 1963) a country with similar conditions for mosquitoes development.

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Szúnyogfauna vizsgálatok (Culicidae, Diptera) a Tiszamentén

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Kivonat

A Tisza árterülete, valamint a visszamaradt holtágai a szúnyogfejlődés tipikus biotópusai. A Culicidae család *(Diptera)* faunisztikai vizsglatára az 1979—1982 időszakban került sor a nevezett térségben.

Az anyaggyűjtés 7 gyűjtőterületet ölelt föl a Tiszamentén (Zsablya, Becse, Ada, Zenta, Szanád, Törökkanizsa és Kanizsa). A további 11 gyűjtőtérséget a Mali Siget, Csóka, Törökbecse, Elemér, Melence, Zrenjanin, Aradac, Orlovát, Okanj, Bácsmonostor és Svetozar Miletić környékén elterülő félholdalakú depressziók, mocsarak, tószerű Tisza-maradványok képezték. Egyesek, mint a Törökbecsei Sóskopó, valamint a Melencei- és Orlováti tavak, jelentősebb sómennyiséget tartalmaznak.

A föltüntetett kutatási térségből 18 szúnyogfaj jelenléte volt kimutatható: *Ae. vexans, Ae. sticticus, Ae. cinereus, Ae. rossicus, Ae. cantans, Ae. flavescens, Ae. caspius, Ae. dorsalis, Ae. excrucians. Ae. rusticus, Culiseta annulata, C. pipiens comp., C. modes us, C. territans, An. maculipennis comp., M. richiardii, U. unquiculata,* és *Ae. annulipes.*

Исследование фауны комаров в окрестности потишйе

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Резюме

На протяжении 4-х летних исследований (1979—1982) на территории Потишйе нам удалось познакомиться с 18 видами комаров. Из модельных образцов 6 были пойманы по реке Тиса, II- в зоне берегов Тисы (старицах, берегах). Из приведенных 18 видов комаров по территориальному распределению 9 явилось характерными для самой реки Тисы, а 9 — для её заливной территории. С раннее описанными 5 видами в настоящее время на территории Потишйе втречается 23 вида комаров.

Istraživanja faune komaraca (Diptera, Culicidae) u Potisju

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Rezime

Plavne površine uz Tisu kao i ostaci nekadašnjeg toka ove ravničarske reke (mrtva Tisa) predstavljaju tipična legla komaraca. Faunistička istraživanja familije *Culicidae (Diptera)* ovog područja obavljena su u sezoni 1979—1982. godine.

Materijal je prikupljan na sedam lokaliteta uz Tisu (Žabalj, Bečej, Ada, Senta, Sanad, Novi Kneževac i Kanjiža) i jedanest lokaliteta koja predstavljaju ostatke nekadašnje Tise a danas su najčešće polumesečaste depresije, jezera, ili močvare. Ovi lokaliteti nalaze se u neposrednoj blizini sledećih mesta: Mali Siget, Čoka, novi Bečej, Elemir, Melenci, Zrenjanin, Aradac, Orlovat, Okanj, Bački Monoštor i Svetozar Miletić. Pojedine od navedenih polumesečastih depresija karakterišu se izvesnim procentom soli u vodi. Prvenstveno to su jezera kod Novog Bečeja, Melenaca i Orlovata.

Na svim navedenim lokalitetima zabeleženo je 18 vrsta, štosa predhodnih 5 koje nismo zabeležili u toku našeg rada čini ukupno 23 vrste komaraca na području Potisja. To su sledeće vrste: *Aedes rossicus, Aedes cinereus, Aedes vexans, Aedes sticticus, Aedes cantans, Aedes rusticus, Aedes flavescens, Aedes caspius, Aedes dorsalis, Aedes excrucians, Aedes annulipes, Culex modestus, Culex pipiens comp., Culex territans, Culiseta annulata, Mansonia richiardii, Uranotaenia unguiculata, Aedes cataphylla, Anopheles atroparvus, Anopheles maculipennis, Anopheles messeae, Anopheles claviger*.

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ICHTHYOLOGICAL AND PISCATORIAL PROBLEMS AT THE KISKÖRE WATER BASIN

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Abstract

During the course of the past 15 years the occurrence of 49 fish species had been demonstrated at the reaches of the Tisza river above Kisköre (Eastern-Hungary) and at the more than 100 km² large flood-plain water basin, resp., established lately at this section.

On the effect of the damming up started in 1973 the ratio of the rheophyll and limnophyll species strongly shifted to the advantage of the latter. Earlier this reach could be included in the upper section of the carp-zone, today it belongs to the lower section. In the shallow basin area the stand of the stagnophyll species also began to increase. Among our more important useful fish, the present circumstances are favourable for mainly the carp and pikeperch.

Firstly the increasing of the carp-stock is desirable at the basin, however, for this — contrary to the earlier practice — not the introductions, but the improvement of the conditions for natural increase is recommended.

Introduction

Till our days three river barrages had been established at the Tisza river: two in Hungary (at the settlements Tiszalök and Kisköre), and one in Yugoslavia (beside Novi-Bečej). The greatest change in the ecological relations of the river was caused by the operation of the barrage started at Kisköre, since here, above the river barrage, a water basin larger than 100 km² was also developed at the wide flood area. Water is stored at the averagely 4—5 km wide flood plain from March till October, and although today the water level is still about 1 metre lower than finally planned, a water-covering over 50 cm can be found at close to ten thousand hectares.

The water basin, however, has not become a uniform water area (Fig. 1). Protruding in the form of islands, the higher riverside sectors following the river more or less terminate the bed from the inner areas of shallow water even today. The ecological differences of the river-bed and storage area are also manifested in the species composition of their fish fauna, however, the situation is complicated by the fact that the storage area is only a periodical living place, from where the fish withdraw to the old backwaters and river-water beds (Tisza river, Small-Tisza, Eger-brook) at the time of Autumn draining.

From the viewpoint of fish economy the water area belongs to the Hungarian National Association for Fishing. However, in their present number, the anglers are unable as yet to utilize the basin duly, therefore small gear fishing is also allowed for the time being.

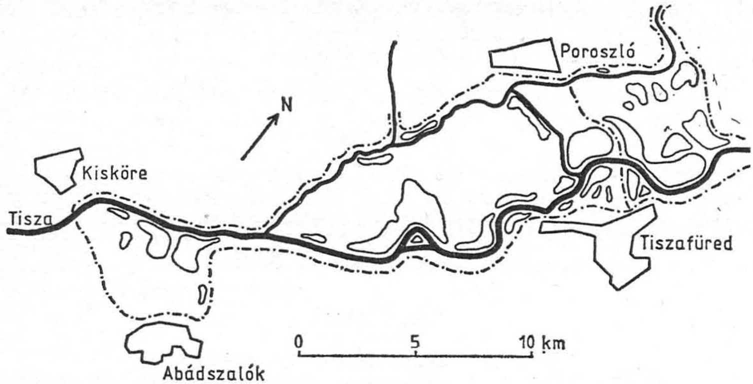

Fig. 1. Map sketch of the Kisköre water basin, indicating the bordering dams, river-waters and islands

The fish fauna of the water basin

During the course of our observations since 1970, the presence of 49 fish species had been demonstrated at the reach falling to the area of the water basin at the subsequently banked up (filled) storage area. The collections were mainly performed with fish-traps, small meshed drag- and square fishing-nets as well as with angling methods. For the determination of the samples the books of BERG (1949), BĂNĂRESCU (1964), BERINKEY (1966), LADIGES and VOGT (1965) and BALON (1967) were used, and in the case of the *Gymnocephalus baloni* the original description of the species was used (HOLČIK and HENSEL 1974). Firstly the work of MÜLLER (1983) served at the base for the style of writing the species names.

The place and incidence of occurrence are also referred to in a few words when listing the species.

Acipenseridae

Acipenser ruthenus L. — this was common earlier, today only few numbers occur in the river-bed.
Acipenser gueldenstaedti Brandt — an individual weighing 5 kg was caught on April 18, 1980 from the Tisza river at Tizsafüred.

Salmonidae

Salmo trutta fario L. — a few individuals are carried off year by year with the Spring rise of the Eger-brook.
Salmo gairdneri RICH. — its occurrence is similar to that of the formes species.

Esocidae

Esox lucius L. — this is mostly frequent in the storage area, but the size of the stock strongly fluctuates.

Cyprinidae

Leuciscus leuciscus L. — one single individual was caught in the Tisza bed at Tiszafüred on November 16, 1978.

Leuciscus cephalus L. — this was common earlier, nowadays only a small stock lives in the river.
Leuciscus idus L. — this is similar to the former, but is more frequent.
Rutilus rutilus L. — it occurs in large numbers at the storage area.
Ctenopharyngodon idella VAL. — this is not rare neither in the river, nor in the storage area.
Scardinius erythrophthalmus L. — it is frequent in the storage area.
Aspius aspius L. — the species is quite frequent both in the river and at the storage area.
Leucaspius delineatus HECK. — it is no rare in the shallow pits found along the dams.
Alburnus alburnus L. — this species can be found in teams everywhere.
Abramis brama L. — it occurs in masses, being the most frequent hauls of the fishers and anglers both at the river and at the storage tank.
Abramis ballerus L. — this is frequent at the storage tank as well as in the river.
Abramis sapa PALL. — the species only lives in the river, its stock has strongly decreased.
Blicca bjoerkna L. — this was the most frequent fish in the river, compared to this its stock has fallen, but is still frequent.
Vimba vimba L. — this species was rare earlier, too, but not one sample was caught during the past years.
Pelecus cultratus L. — it lives in small numbers, mainly in the river-bed.
Tinca tinca L. — the species is increasing at the marish areas.
Chondrostoma nasus L. — this was common, but nowadays it only lives in small numbers in the river-bed.
Barbus barbus L. the species has greatly decreased in number since the banking up.
Gobio gobio L. — it occurred in large numbers earlier, now it is becoming rarer.
Gobio albipinnatus LUK. — this is frequent in the river and its stock is increasing.
Pseudorasbora parva SCHLEG. — this probably came to the storage tank from fish ponds, its increase is expected, but is rare at present.
Rhodeus sericeus amarus BLOCH — it is quite frequent in the shallow waters along the dams.
Carassius carassius L. — this began to increase in the storage area, but its stock is still small.
Carassius auratus gibelio BLOCH — the species greatly increased following banking up, later it slightly fell back, but is still frequent in the river and storage area.
Cyprinus carpio L. — its stock is made larger by introductions, it is frequent.
Hypophthalmichthys molitrix VAL. — its stock is of medium size, it is found both in the river and at the storage area.
Aristichthys nobilis RICH. — this species is similar to the previous one, but is rarer.

Siluridae

Silurus glanis L. — its stock is of medium size, mainly living in the river.

Ictaluridae

Ictalurus nebulosus LE SUEUR — it is rather frequent at the storage area.

Cobitidae

Misgurnus fossilis L. — the species is increasing at the storage area.
Cobitis taenia L. — it is more frequent than the former at muddy areas.
Cobitis aurata FIL. — this is frequent at the more current bed sections.

Anguillidae

Anguilla anguilla L. — the species regularly occurs in the river, but is rare.

Gadidae

Lota lota L. — its stock has greatly decreased in the river, nowadays it is rather a rarity.

Percidae

Perca fluviatilis L. — this is common everywhere, but not frequent.
Stizostedion lucioperca L. — it is frequent both in the river and at the storage area, its stock is increasing.
Stizostedion volgensis GMEL. — earlier it was rare, but it is increasing nowadays.
Gymnocephalus cernua L. — this is common everywhere.
Gymnocephalus baloni HOK. et HENS. — the species is not rare at the more current reaches.
Gymnocephalus schraetzer L. — this is quite frequent in the river.
Zingel zingel L. — it was common in the river, but has greatly decreased.
Zingel streber SIEB. — a smaller stock lived in the river, but its occurrence was not observed during the past years.

Centrarchidae

Micropterus salmoides LACEP. — 30 individuals were introduced in 1984 at a more confined (enclosed) bay (inlet?) of the storage tank.
Lepomis gibbosus L. — this occurs in smaller number, mostly at the storage area.

It should be mentioned in connection with the *Cobitus aurata* that it was described from the Tisza river by JÁSZFALUSI (1948) under the naming *C. a. bulgarica* DRENSKY, but this subspecies is not included by BERINKEY (1966) in his work on the Hungarian fish fauna, only the *C. a. balcanica* KARAMAN subspecies. The ecological demands of the population living here are rather indicative of the former, but morphologically they show a transition between the two subspecies.

The fish stand before (prior to) the damming up of the water.

Before damming up, the Tisza reaches dealt with — in accordance with its middle-section character — ensured varied environmental conditions for the fish. Sections of both shallow and deep water, as well as slow and rapid current occurred.

The substance of the bed was generally formed by rough sand in the current line and by fine sand at the shores, but pebbly sections also occurred where the average granule size surpassed 8 mm (LÁSZLÓFFY 1982). The banks were also manifold. Many variations occurred, from gently sloping sand-beds to underwashed, dividing riverside sectors; from barren banks to such lined by forests and slanting trees.

In this manifold environment numerous species found their living conditions, thus the fish fauna was also characterized by great variety and relatively high species number. On the basis of the dominancy relations regarding the occurring species, before the banking up the reach could be ranked among the upper section of the carp-zone (bream-region), adjacent to the barbel-region.

Mainly the predominance of the limnophyll species increasing in the stagnant waters of inundations gave ground for the ranking amongst the carp-region; the most significant being: *Blicca bjoerkna, Abramis ballerus,* abramis brama, *Cyprinus carpio, Stizostedion lucioperca* (HARKA 1974), but the same was strengthened by the reophyll species characteristic to the carp-region, too: *Abramis sapa, Gobio albipinnatus, Cobitis aurata, Acerina schraetzer, Leuciscus idus,* etc.

The nearness (vicinity) of the barbel-region was indicated by the high ratio of the reophyll elements demanding more intensive current: *Acipenser ruthenus, Barbus barbus, Chondrostoma nasus, Leuciscus cephalus, Lota lota,* furthermore, the *Zingel zingel* and the *Zingel streber.*

The effect of the banking up

The banking up of the water started in 1973 displayed its effect even in the first years. Despite the fact that till 1977 the water had only filled up the bed, the speed of the river considerably decreased, leading to enhanced sediment formation. The pebbly bed sections dissappeared and the rough sand dominating earlier at the current line was replaced by fine sand at the upper part of the storage tank and first by clayey-sandy mud going downwards, then by deep mud layer at Kisköre (BANCSI et *al.* 1981).

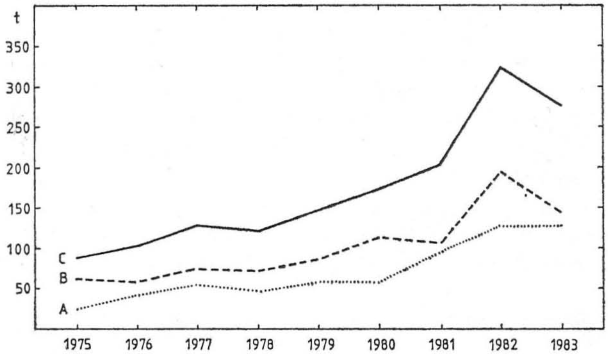

Fig. 2. Development of the total hauls at the water basin (in tons). A: anglers, B: fishers, C: the two together

The experiences gained at Tiszalök demonstrated that following the beginning intensive alluviu-deposition the situation became stable (MÁTRAI 1973), nevertheless, the species roeing on firm bottom — e.g. *Acipenser ruthenus, Barbus barbus* — were less and less able to find spawning-ground, therefore their migration had begun,

The canged ecological relations were unfavourable for every reophyll species, and this was well reflected in the number of individuals caught during the course of the probe fishings (Table 1). The great decrease exhibited for the certain species indicated the tendency of the river-water's fauna becoming poorer.

The same changes displayed positive effect in respect to the limnophyll species as well as the whole fish-produce. The water's transparency increased with the decrease of the floated (suspended?) alluvium, thus providing more favourable light conditions for the photosynthesis of algáe. Even earlier, only the lack of light hindered the more enhanced organic matter production in the water rich in nutriment (HAMAR 1977), therefore the greater primary production as the consequence of the banking up also resulted the considerable increase of the water's fish-aliment stock (supply).

Since 1978 the barrage has held back the Spring inundations, thus the long-lasting water covering has become regular in the storage area, creating rather favourable conditions for the limnophyll species of the carp-region. The spread water warms up more quickly, which speeds up *the maturity of the...!?* and shortens the period of roeing, furthermore, promotes the increase of aliment-organisms. The growth of

Table 1. *Distribution according to species of the fish caught at the river-bed, on the basis of data of probe fishings with fish-trap. A: before damming, B: bed-damming, C: filled up storage tank*

	A	B	C
Acipenser ruthenus	20	—	1
Esox lucius	233	597	1194
Leuciscus cephalus	32	2	2
Leuciscus idus	46	49	40
Rutilus rutilus	59	33	151
Ctenopharyngodon idella	2	95	16
Scardinius erythrophthalmus	—	2	40
Aspius aspius	5	17	29
Abramis brama	570	521	1829
Abramis ballerus	988	766	965
Abramis sapa	849	84	35
Blicca bjoerkna	3169	398	703
Vimba vimba	3	2	—
Pelecus cultratus	38	14	13
Tinca tinca	—	—	10
Chondrostoma nasus	77	6	5
Barbus barbus	271	2	5
Carassius auratus gibelio	292	4074	1667
Cyprinus carpio	143	569	379
Hypophthalmichthys molitrix	1	211	20
Aristichthys nobilis	1	2	2
Silurus glanis	227	74	36
Ictalurus nebulosus	54	38	55
Lota lota	86	1	3
Perca fluviatilis	21	3	30
Stizostedion lucioperca	393	328	408
Stizostedion volgensis	—	3	12
Zingel zingel	53	3	—
	7633	7894	7650

the brood becomes faster, so that period of life shortens during which the fish are the most sensitive to diseases and unfavourable environmental effects.

The *Rutilus rutilus,* the *Carassius auratus* gibelio and the *Esox lucius* rapidly increased under the new conditions. Similar increase was also experienced in the case

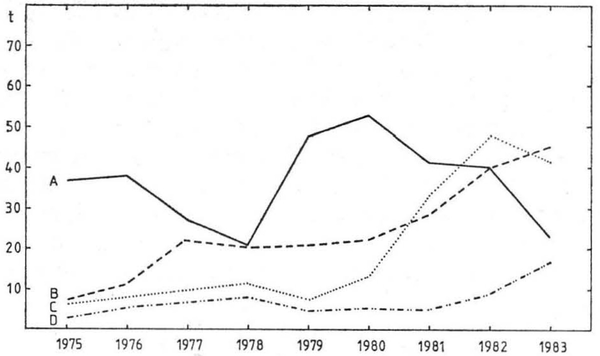

Fig. 3. Development of the joint hauls by fishers and anglers in respect to the most significant fish species (in tons). A: pike, B: carp, C: pike-perch species, D: silure

of other species, too: *Abramis brama, Cyprinus carpio, Stizostedion lucioperca,* etc. These changes can mostly be seen from the results of the probe fishings (Table 1) and from the total catching data for the more important species, respectively (Fig. 3). Data on species of small measures — e.g. *Alburnus alburnus, Rutilus rutilus,* etc. — were mainly obtained during the course of our fishings with 1 cm mesh square fishing-nets.

Where marsh-like living places developed at the storage area, the earlier repressed stagnophyl species also started to increase: *Tinca tinca, Carassius carassius, Misgurnus fossilis,* however, their stock is still not significant.

On the basis of the changes taking place in the fish stock, it could be determined that the studied section of the Tisza river no longer belongs to the upper part of the carp-region, but to the lower, and this should be taken into consideration regarding the fish economy interventions.

Problems related to fish economy

Approximate picture of the fish amount caught from the water basin could be formed on the basis of the catching registers kept by the anglers and the statistics of the fishery co-operative functioning at the water area. It can be seen from Fig. 2. that the caught amount of fish significantly increased following the embankment of the storage area.

The carp found favourable conditions at the storage tank, and its catching showed steady increase (Fig. 3B). The experiences of the labellings performed in 1972 provided basis for their growth and migration. The labelled fish averagely weighing 400 g were set out in April, and by the beginning of August in the following year they reached an average body mass of 2040 g, and several individuals weighing around 4 kg were found in the Summer of 1974 (Harka 1975).

The number of carps staying at the reach where they were introduced could be concluded on the basis of the individuals found at the area one year after labelling. Two-thirds of these originated from the water flows belonging to the area of the water basin. The farthest notifications proved the covering of about a 100 km long path both up and down the river. Nevertheless, this labelling was performed before the barrage was set into operation, therefore it cannot be regarded as authentic in respect to the present situation, however, the newer labellings have not yet provided evaluable results.

The banking up of the storage-tank was also favourable for the pike-perch. Although the species could be found in unchanged amount at the bed, its catching greatly increased at the storage area (Fig. 3C). Studies on the development of this species were carried out at the time when only the bed's banking up was being performed at the reach (Harka 1977). In that period the growth rate of the pike-perch from the Tisza river surpassed that of the slowly growing stock from Lake Balaton (Bíró 1970), but as a matter of fact it appeared to be rather moderate. Since the banking up of the storage tank, however, the experiences have manifested considerable improvement of their condition, as well as their faster growth. The newer studies on growth should determine the degree of changes. It is worth mentioning in connection with the results of pike-perch hauls (Fig. 3C) that these also include the data of the Stizostedion volgensis, which come to about 5% of the whole.

The annual amounts of hauls regarding the pike were in general characterized by large fluctuations, and this characteristic feature could also be followed from the data gained during the course of the past decade (Fig. 3A). In the years following the banking up of the storage tank the ratio of pikes from the hauls increased here as well, but this — as also experienced in the case of other storage tanks (Bogdanov and Lifsic 1976) — was only a transitional phenomenon.

The pike is a species capable of fast accommodation and great tolerance, playing pioneer role in the stocking of new living places, besides the *Rutilus rutilus* and the *Carassius auratus* gibelio of similar character. Its development is fast (Ristič 1963, Balon 1967) and our studies on the local population (Harka 1983a) showed that the pikes brooded in the Summer of 1978 — growing under favourable conditions — could be hauled in the Autumn of 1979.

The great migration as well as the increasing competition of the pike-perch starting to grow with about 2 years' delay played significant role among the causes of the regression. The pikes getting into the river-bed at the time of the Autumn draining of the storage tank's water, set off in search for spawning-ground swimming up-stream at the time of the Spring overflow, but in such manner their route did not lead to the storage area, but to the upper reaches. The migration is not a new phenomenon, however, its effect is felt better since the river barrage hinders the swimming up of the new generation.

The hauling results of the silure had only started to improve in the recent years. Its growth falls behind that of the silures in the Don river (Bizjaev 1952) and at the Danube section in Yugoslavia (Ristič 1972), but is faster than in the Slovakian waters (Sedlár and Gecző 1973), thus it is not unfavourable (Harka 1983b). Being a favorite sport fish, it is desirable to keep the level of the stock.

Possibilities for increasing the fish stock

The utilizer of the water area — the Hungarian National Association for Fishing — firstly aims at the increasing of the carp stock from our useful fish, in the interest of which it allots considerable amounts to carp introductions year by year. These introductions play role in the continuous increase of the hauls, nevertheless, according to our opinion the increase of the stock under present circumstances should firstly be achieved by the better utilization of the possibilities, the promotion of natural increase as well as by the protection of the progeny. The most important conditions for this are the followings:

1. The best spawning-grounds should be determined and care should be taken not to damage these during the course of adjustments at the area of the storage tank.

2. The beginning of spawning should be followed with attention, and at this period — for the promotion of spawning — the water level should be raised by a few centrimetres.

3. The raised water level should be kept till the larvae brood, to prevent the roe of fish from getting on dry surface.

4. At present, it is of negative effect on the complete fish stock that numerous fish — mainly offsprings — remain outside the plains without any outlet and die on the occasions of the Autumn drainings. To prevent this, the area adjustments and canal-buildings should be further continued, making it possible for the brood to reach deep waters as well as for the sake of their safer over-wintering.

5. The periodicity of the drainings would serve the same purpose, during the course of which faster and slower decreases in level would alternate. The aim of the faster fall would be to prompt the fish to flight, while the slower decreasing of the level would give them possibility to find their way of escape. The period and degree of the fall should be chosen on the basis of practical experiences, since the lower and upper part of the storage tank reacts differently to the same intervention.

6. For the purpose of maintaining the fish productivity of the storage tank it would be desirable to have the mud at the bed bottom dry out and aired through at times. At present this only takes place in part, since after draining rainy, then frosty periods arrive soon. Therefore it should be investigated from what time the water demand of the utilizers could be met from the completely filled canals, and the time-point of draining should be brought forward as much as possible. The aerobic processes taking place in the drying out mud layer greatly contribute to the maintenance of the storage tank's productivity.

The water basin firstly serves watering purposes, thus the viewpoints of fish economy can only be taken into consideration in the second place. Nevertheless, with the better harmonizing of the demands and with tighter co-operation it is accessible to have it contribute to the enrichment of the Tisza river's fish stock, to a larger extent than at present.

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A Kiskörei-víztározó ichthyológiai és halászati problémái

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Kivonat

A tanulmány a Tisza folyó Kisköre fölötti 30 kilométeres szakaszának, illetve az ennek hullámterén kialakított víztározó halállományának változását elemzi.

A területről az utóbbi 15 év során 49 halfaj jelenlétét sikerült kimutatni. A duzzasztás óta a reofil és limnofil fajok arányában igen jelentős eltolódás történt az utóbbiak javára. Míg korábban a folyószakasz a pontyrégió fölső szakaszába tartozott, ma az alsó szakaszába sorolható, a tározótérben pedig a stagnofil fajok állománya is növekedésnek indult.

A jelenlegi körülmények — a gazdaságilag fontos fajok közül — főként a ponty és a süllő számára kedvezőek.

A tározóban elsősorban a pontyállomány növelése kívános, de ezt — a korábbi gyakorlattól eltérően — nem telepítésekkel, hanem a lehetőségek jobb kihasználásával kell elérni. Ennek megfelelően a tanulmányban megfogalmazott javaslatok is főként a természetes szaporodás elősegítésére és az ivadék védelmére vonatkoznak.

Кишкерейское водохранилище Ихтиология и проблемы рыбоводства

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Резюме

Исследования анализируют рыбный состав водохранилища реки Тисы, расположенного на 30 км выше Кишкера. За последиие 15 лет здесь обнаружено 49 видов рыб.

После запруда водохранилища в нем произошли значительные сдвиги в направлении реофильных и лимнофильных видов особенно со значительным перевесом последних. Раньше этот отрезок реки относилься к коропному вернему региону, а в настоящее время его следует зачислить к нижнему отрезку, где началось развитие стегофильных видов.

В современных условиях для рыбного хозяйства особый интерес представляет развитие коропа и судака. В хранилищах в первую очередь желательно разводить коропа путем естественного размножения (охраны мальков).

Ihtiolo ki i ribolovni problemi akumulacije Kisköre

Harka Á.

Gimnazija „Kossuth Lajos", Tiszafüred

Abstrakt

Na oko 30 km dižinskoj deonici reke Tise, odnosno izgradjenoj akumulaciji iznad naselja Kisköre, utvrdjeno je prisustvo 49 vrsta riba, tokom zadnjih 15 godina. Usled akumulacije znatno se povećao broj limnofilnih vrsta, dok su reofilne vrste potisnute. Ova deonica reke ranije je pripadala gornjem regionu šarana, dok se danas već uvrštava donjoj regiji. U akumulaciji se i stagnofilne vrste brojnije javljaju. Postojeći uslovi su povoljni za šarana, smudja, štuku i soma, od ekonomski značajnih vrsta riba. U cilju rastenja njihovih populacija, autor, umesto dosadašnje prakse naseljavanja, predlaže poboljšanje uslova za reprodukciju u prirodnim uslovima, i zauzima se za stvaranje uslova za uspešnije prezimljavanje mladji.

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ORNITHOFAUNA OF CARSKA BARA SWAMP

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Abstract

This paper presents the ornithofauna of Carska Bara, a significant ornithological region in Banat, that spreads at the mouth of the River Begej into the River Tisza. The aim of this paper is to help protect and further develop this significant ornithological region.

Introduction

Carska Bara lies in Banat, SAP Vojvodina. It spreads on the left right of the dried old bed of the River Begej, between the old and the new protection dam (latitude 45°16′ N, longitude 20°25′ E). The surface of the whole region is around 1.000 ha (2,5 acres). The left part of the swamp ends with the Zrenjanin's loess terrace, the fertile agricultural soil. On the right of the dam spreads the famous fish-pond of Echka, having the total surface of 2.000 ha (5 acres). The swamp itself has formed on the alluvial deposits of the River Begej.

According to its pedological structure, the narrower region of Carska Bara end Tiganjica is swamped alluvium, poorly salted, with the pathches of soloti soils; on the other hand, Perlez's boggy region is a typical alluvium of heterogeneous mechanical structure (NEJGEBAUER at *all.* 1958).

In 1880 the wider region of Carska Bara was named as the outermost northeastern part of so called Dugo Blato. The Perlez's boggy region had been called Fehér mocsár — The White Swamp. Dugo Blato spreaded along the left bank of the River Tisza, from its mouth to the hillside of loess terrace — to the village of Lukácsfalu, today known as Lukino Selo. In the second half of the 19th century on the other side of the River Tisa were swamps. The writers who wrote about their travels (MARSILI, BALDAMUS, LÁZÁR, HODEK, MADARÁSZ) described this region as the immense sea of reed, interrupted by the free water surfaces and the "oasis" of willow and white poplar woods.

In the 18th century, began the hydromelioration works, first in the upper stream of the River Begej, and then on the Rivers Danube and Tisza. During the 1960's the works on digging of the new bed of the River Begej were being carried out. In order to preserve the region, the new bed went left to the old one, across the loess terrace. The new dam divides the wider region of Carska Bara and the new bed of the River Begej. Hydrological conditions of the Carska Bara region are influenced, in the first place, by the River Begej and Tisza, but the influence of the Danube, when its water level is high, is also felt. For water regime regulation, two devices have been built.

Today, water surfaces, swamps and bogs (old bed of the River Begej with stagnant tributaries, Carska Bara and the part of Tiganjica) make aproximately 40% of the wider Carska Bara region; 20% of the region are covered with the boggy region woods of willow and white poplar; the rest 40% are meadows and pastures (Perlez's boggy region and part of Tiganjica).

Materials and Methods

In order to have the accurate insight in ornithofauna of Carka Bara we used all avilable materials and informations on this region (refer to the references), as well as the original informations collected on the numerous field visits.

The Results

Ornithofauna in Vojvodina includes araund 320 bird species. The total number of registrated nesting species is 199; from that number, 13 species do not nest any more, 32 are sporadic nestlers and newcomers represented by small number of nesting pairs (Table 1).

In Carska Bara regin 145 species have been registrated, that makes 73% of the whole Vojvodina. From the aspects of nature protection, of great importance are the nesting species that are endangered or rarified. The first "Red list" of birds in Vojvodina (Garovnikov, Ham 1980—1981) gives the preliminary list of the endangered bird species.

Tab. 1. *Comparative review in number of nesting species in Vojvodina and on Carska Bara swamp*

	Vojvodina	Carska Bara swamp
nesters	199	145
one-time nesters	13	3
newcomers	32	14
regular nesters	154	128
nonendangered and potentially endangered species	75	64
"Red list"	79	60
the most endangered	22	17
significantly endangered	20	14
endangered	37	29

All regular nesting species in Vojvodina are, according to the degree of their endangerance, divided into nonendangered group and potentially endangered group (75 species); 75 species make the "Red list" (Table 1). The "Red list" includes three groups of species: the most endangered (22 species), significantly endangered (20 species) and endangered (37 species). In Carska Bara region 17 species of the "most endangered", 14 species of the "significantly endangered", and 29 species of "endangered" have been registrated.

The current situation is the result of the various conditions. Hydromeliorasation in 60's preserved the region, and at the same time no significant cutting of woods has been undertaken. During the last few years, some problems connected with the hunting have been settled, and planned investment projects stopped. The regulations concerning the birds protection are obeyed, but there are still problems concerning the fish breeding.

Conclusion

When giving the final opinion on the ornithofauna of Carska Bara, it should be emphasized that the number of species is mainly constant, with the tendency of numerical growth of the species, specially those whose habitat is water (swamps and bogs). In order to protect the nature in general, specially the birds, it is necessary to protect the whole region, as well as to build the development programs.

According to the published information and the information collected on the terrain, it has been ascertained that in the Carska Bara ragion live 196 species of birds. 145 species of nesting birds have been registrated, that make 73% of the ornithofauna of the whole Vojvodina. 27 species appear as overfliers, 11 species are winter visitors, 11 species are wanderers, and two species are irregular visitors. Almost 76% of the regular nestlers belong to the "Red list". Seventeen species belong to the "most endangered", 14 species belong to the "significantly endangered", and 29 species are "endangered".

Today under protection is only the part of Carska Bara-Vojtina Mlaka. In order to preserve and enlarge the number of bird species, it is necessary to put under protection the whole region.

The list of bird species from carska bara region

Nestlers
newcomers—sporadic

1. *Podiceps griseigena*
2. *Anas crecca*
3. *Milvus milvus*
4. *Aquila clanga*
5. *Circus cyaneus*
6. *Falco peregrinus*
7. *Charadrius dubius*
8. *Tringa hypoleucos*
9. *Chlidonias leucopterus*
10. *Sterna albifrons*
11. *Asio flammeus*
12. *Pastor roseus*
13. *Cisticola juncidis*
14. *Carduelis spinus*

Regular nestlers
potentially endangered

1. *Podiceps fuficollis*
2. *Podiceps cristatus*
3. *Ixobrychus minutus*
4. *Ardea cinerea*
5. *Anas platyrhynchos*
6. *Anas querquedula*
7. *Aythya ferina*
8. *Aythya niroca*
9. *Phasianus colchicus*
10. *Rallus aquaticus*
11. *Porzana porzana*
12. *Gallinula chloropus*
13. *Fulica atra*
14. *Vanellus vanellus*
15. *Columba palumbus*
16. *Streptopelia decaocto*
17. *Streptopelia turtur*
18. *Cuculus canorus*
19. *Asio otus*
20. *Picus viridis*
21. *Picus canus*
22. *Dendrocopos major*
23. *Riparia riparia*
24. *Hirundo rustica*
25. *Delichon urbica*
26. *Galerida cristata*
27. *Alauda arvensis*
28. *Motacilla alba*
29. *Motacilla flava*
30. *Sturnus vulgaris*
31. *Garulus glandarius*
32. *Pica pica*

33. *Coloeus monedula*
34. *Corvus frugilegus*
35. *Corvus cornix*
36. *Troglodytes troglodytes*
37. *Locustella luscinioides*
38. *Acrocephalus arundinaceus*
39. *Acrocephalus palustris*
40. *Acrocephalus scirpaceus*
41. *Acrocephalus schöenobaenus*
42. *Hippolais icterina*
43. *Hippolais pallida*
44. *Sylvia atricapilla*
45. *Sylvia curruca*
46. *Philoscopus collybita*
47. *Philloscopus sibilatrix*
48. *Muscicapa striata*
49. *Erithacus rubecula*
50. *Luscinia megarhinchos*
51. *Luscinia svecia*
52. *Turdus meruna*
53. *Aegithalos caudatus*
54. *Parus caeruleus*
55. *Parus major*
56. *Remiz pendulinus*
57. *Passer domesticus*
58. *Passer montanus*
59. *Fringila coelebs*
60. *Carduelis chloris*
61. *Carduelis carduelis*
62. *Coccothraustes coccothraustes*
63. *Emberiza shöeniclus*
64. *Emberiza citrinella*

"Red list"
the most endangered

1. *Phalacrocorax carbo*
2. *Phalacrocorax pygmaeus*
3. *Egretta alba*
4. *Platalea leucorodia*
5. *Plegadis falcinelus*
6. *Ciconia nigra*
7. *Anser anser*
8. *Milvus migrans*
9. *Haliaetus albicila*
10. *Hieraetus pennatus*
11. *Aquila heliaca*
12. *Aquila pomarina*
13. *Falco cherrug*
14. *Tringa totanus*
15. *Limosa limosa*
16. *Himantopus himantopus*
17. *Recurvirostra avosetta*

significantly endangered:

1. *Anas acuta*
2. *Anas strepera*
3. *Anas clypeata*
4. *Circus aeruginosus*
5. *Accipiter nisus*
6. *Perdix perdix*
7. *Coturnix coturnix*
8. *Chlidonias hybrida*
9. *Tyto alba*
10. *Sterna hirundo*
11. *Coracias garrulus*
12. *Merops apiaster*
13. *Corvus corax*
14. *Phoenicurus phoenicurus*

endangered:

1. *Podiceps nigricollis*
2. *Botaurus stellaris*
3. *Nycticorax nycticorax*
4. *Ardeola ralloides*
5. *Egretta garzetta*
6. *Ardea purpurea*
7. *Ciconia ciconia*
8. *Accipiter gentilis*
9. *Buteo buteo*
10. *Falco subbuteo*
11. *Falco vespertinus*
12. *Falco tinnunculus*
13. *Porzana parva*
14. *Crex crex*
15. *Larus ridibundus*
16. *Chlidonias niger*
17. *Columba oenas*
18. *Strix aluco*
19. *Caprimulgus europaeus*
20. *Alcedo atthis*
21. *Upupa epops*
22. *Dendrocopos syriacus*
23. *Dendrocopos minor*
24. *Lanius collurio*
25. *Lanius minor*
26. *Oriolus oriolus*
27. *Sylvia communis*
28. *Certhia brachydactyla*
29. *Emberiza calandra*

Bird of passage:

1. *Anas penelope*
2. *Pandion haliaëtus*
3. *Circus macrourus*
4. *Otis tetrax*
5. *Charadrius hiaticula*
6. *Pluvialis apricaria*
7. *Pluvialis squaterola*
8. *Calidris minuta*
9. *Calidris temminckü*
10. *Calidris alpina*
11. *Calidris ferruginea*
12. *Philomachus pugnax*
13. *Tringa erythropus*
14. *Tringa glareola*
15. *Tringa stagnatilis*
16. *Tringa nebularia*
17. *Tringa ochropus*
18. *Limosa lapponica*
19. *Numenius arquata*
20. *Numenius phaeopus*
21. *Scolopax rusticola*
22. *Gallanigo gallinago*
23. *Gallinago media*

24. *Larus argentatus*
25. *Larus minutus*
26. *Hydroprogne caspica*
27. *Acrocephalus paludicola*

Winter visitor:

1. *Gavia arctica*
2. *Anser albifrons*
3. *Anser erythropus*
4. *Anser fabalis*
5. *Aythya fuligula*
6. *Bucephala clangula*
7. *Mergus albellus*
8. *Mergus merganser*
9. *Buteo lagopus*
10. *Mergus serrator*
11. *Larus canus*

Accidental;

1. *Phoenicopterus ruber*
2. *Branta leucopsis*
3. *Melanitta fusca*
4. *Cygnus olor*
5. *Somateria molissima*
6. *Haematopus ostralegus*
7. *Limicola falcinellus*
8. *Phalaropus lobatus*
9. *Glareola nordmanni*
10. *Stercorarius parasiticus*
11. *Gelochelidon nilotica*

Irregular visitor

1. *Netta rufina*
2. *Numenius tenuirostris*

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A Carska bara ornitofaunája

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Kivonat

A Carska bara térségében irodalmi adataink és megfigyeléseink alapján összesen 196 madárfaj jelenlétét tartjuk nyilván. A gazdag fajlista 145 képviselője a fészkelő madarak csoportját képezi, ami a Vajdasági madárvilág 73% teszi ki. Az átvonuló madarak állományát 27 faj képezi. Téli' vendégként ismeretes 11 faj. További 11 faj nomádfaj, míg kettő ritka vendégfaj. A Carska bara fészkelő fajai 76% a „Vörös Lista" madarai. A különösen veszélyeztetett kategóriába 17 faj, a veszélyeztetett állományt 14 faj, míg 29 faj a veszélyezett madarakat képezi.

Jelenleg a Carska bara csak egy elenyésző részlege a „Vojtina mlaka" védett területének. A madárállomány gyarapodásának és megőrzésének elengedhetetlen föltétele a védelem kiterjesztése a Carska bara egész térségére.

Орнитофауна карской бары

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Резюме

На основании литературных источников и собственных исследований в окрестностях Карской Бары насчитывается 196 видов птиц; из них 145 видов относится к гневдующим, что составляет 73% всех видов птиц Войдошага. Количество перелетных птиц составляет 27 видов. Количество птиц, прилетающих на зимовку в данную местность — II видов. Столько

же видов относится к кочующим птицам, два вида из которых очень редкие. 76% всех гнездующихся видов птиц Карской Бары зтнесены в Красную книгу. Под угрозой уничтожения находятся 17 видов, под опасностью уничтожения 14 видов, а 27 видов, в угрожающем положении. В настоящее время только небольшая часть Карской Бары ("Войтина Млака") является заповедной.

Ornitofauna Carske bare

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Rezime

Na osnovu literaturnih podataka i obilazaka terena konstatovano je bogatstvo od 196 vrsta ptica na području Carske bare. Registrovano je 145 vrsta gnezdarica, što čini 73% u odnosu na ornitofaunu Vojvodine. 27 vrsta se pojavljuje u preletu, 11 vrsta su iz grupe zisski gosti, 11 vrsta spada u grupu lutalica, a 2 vrsta u retke goste. Skoro 76% redovnih gnezdarica Carske bare pripadaju „crvenoj listi". U grupi „najugroženijih" utvrdjeno je 17 vrsta, u grupi „ugroženijih" 14, a 29 vrsta u grupi „ugroženih".

Danas se pod zaštitom nalazi samo deo Carske bare „Vojtina mlaka". U cilju očuvanja i povećanja brojnosti ptičijih vrsta, neophodno je proširiti zaštitu na celo područje.

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COENOTIC RELATIONS OF SMALL MAMMALS ALONG THE RIVER TISZA

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Abstract

The research of coenotic relations of small mammals along the periodically inundated zone of the river Tisa was performed in four diverse habitats. By the method of capturemarked-recapture, in addition to the faunistic list, data on the spatial aspects of individuals and species, as well as on their day-night activities were obtained. The total of 231 animals belong to 5 genera and 7 species. It has been stated that each habitat has its particular faunistic composition, both in quantitative and qualitative respect. Namely, the greatest numerousness of small mammals has been stated in the forest community, *Clethrionomys glareolus* being the dominant one. *Adodemus agrarius* appears in the mesophyllic vegetation on the foot of the dam, while *Microtus agrarius* has been found in the meadow community of the dam. *Apodemus sylvaticus* and *Microtus arvalis* inhabit agrobiocoenoses.

Introduction

Although the Yugoslav section of the river Tisza cuts Vojvodina along the longer side, its fauna of vertebrates, with the exception of fish, has not been elaborated so far. Sporadic works on vertebrates touch other regions of Vojvodina. On the other part, the existing publications on birds and mammals do not represent detailed ecological studies, and they primarily have a faunistic character.

Works on small mammals have also, in the first place, a faunistic character and to a lesser degree an ecological one. MIRIĆ 1961 elaborated the fauna Chiroptera of the fortress of Petrovaradin. In 1975 he gave data on ermine, and in 1976 on the polecat of the steppe from the Pannonian recess. PETROV 1949, and HAM 1980, 1980/81 described the mammals the Deliblato Sand, and TVRTKOVIĆ and DŽUKIC 1979 the small mammals of Slano Kopovo. Autecological studies are the works of RUŽIĆ—PETROV 1950, 1979 on European souslik, MIKES 1966, 1971 on *Mus musculus hortulanus,* SAVIĆ 1973 on mole rat. The works of SAVIĆ and MIKES 1966, HABIJAN et *al.* 1982, MIKES et *al.* 1982 deal with the density and distribution of the mole rat population. RUŽIĆ 1978 described the diffusion area of the common hamster in Yugoslavia, and KRSMANOVIĆ 1984 its reproductive activity. SAVIĆ 1960 presented the expansion of the muskrat in Yugoslavia. MIKES 1958 and KRSMANOVIĆ 1979, 1980 elaborated the biology of the nutrition of some species of small mammals. The works of SAVIĆ et *al.* 1976 and MIKES et *al.*, 1977 are studies on the populations of small mammals in the agrobiocoenoses of Vojvodina.

Some data on the wild cat and the small mammals of the river Tisza may be found in the works of DIMITRIJEVIĆ and HABIJAN 1976, 1977, HABIJAN and DIMITRIJEVIĆ 1977, 1979 and MIKES et *al*. 1983.

It is quite understandable that many question related to the investigations of the terriofauna of the river Tisza region has still to be answered, in particular, if we start from the results of the numerous investigations in the section of the river Tisza in Hungary, primarily from the ecofaunisticterriologic aspect (CSIZMAZIA 1980).

Terriological investigations of the region of the river Tisza are of manifold importance as regards the research work on mammals in Vojvodina. Namely, on a relatively narrow area along the river Tisza one may find diverse habitats. The numerousness and the development of the populations of small mammals on these habitats and ecotones, beside biological factors, depends, in the first place, on drastic periodical changes of the physical conditions of habitats. The role of the small mammals on these habitats, in relation to the economical and sanitary importance of the mouselike rodents from the fields under crop, has primarily been manifested in communityc relations. Through nutrition chains the small mammals have been an important factor in the biology of the nutrition of carnivorous mammals and birds of prey.

Material and Methods

We investigated the small mammals of the periodically inundated territory of the river Tisa in the estuary region at the end of August 1983 (Fig. 2(. The capture period lasted four days (25—28 August). It has been worked on four clearly separated habitats (Fig. 4), and that:
1 — in the forest community, about 100m wide, comprizing all typical components between the bank and the protective dam under this habitat (CSIZMAZIA 1980);
2—on the narrow girdle of the mesophyll component of herbaceous plants on the ecotone alongside the foot of the dam;
3— in the grass community under mowing on the protected zone out of the dam, and
4 — in agrobiocoenoses which extend immediately alongside the dam.

On the marked habitats the small mammals were captured by live traps of the longworth type the standard linear method being used, and the traps being placed at 10m distance each. The capture was checked every two hours, except from 9 a. m. to 5 p.m. in the daytime and from 9 p.m. to 3 a.m. at night. All together 231 animals were registered, belonging to 5 genera and 7 species (Tab. 1). After having been elaborated (determined according to the species and sex, body length and weight measured, marked) each captured animal was released at the place of capture. In this way, by applying capture and marking, not only the faunistic composition has been stated, but data on spatial aspects inside the habitat and data on day-night activity of the animals have also been obtained.

It should be mentioned that because of the application of this method data on the presence of other members of the terriofauna of the respective communities from the examined territory (Chiroptera, common mole, hedgehog, European polecat, wild cat, fox, wild boar, roe deer) have not been taken into consideration. The analysis of the presence and numerical relations of some of the mentioned mammals, first of all the Chiroptera, Insectivora and small Carnivora, would have presented a more integral picture of the cenotic relations of the given communities.

Results and Discusion

By applying the method of capture-marked-recapture in a four-day period it has been stated that the relatively high number of small mammals is due to rodents in 95,67% (Tab. 1). Among Insectivora the presence of the species *Sorex araneus* has been stated, and among Carnivora two protected species *Mustela nivalis* and *Mustela erminea* have been present. Mice and voles have been reperesented by two species each: *Apodemus agrarius* and *Apodemus sylvaticus,* respectively *Clethrionomys glareolus* and *Microtus arvalis*. Mice have been present in a greater number — 64,9%.

Tab. 1. *The survey of captured animals per habitats*

TISZA, 1983

HABITAT		A. agr.	A. sylv.	C. glar.	M. arv.	S. aran.	M. niv.	M. erm.	Σ
SYLV.	I	31	29	36	2	6	1	1	106
GLAR.	II	36	8	1	28	·	·	·	73
	III	3	16	·	5	·	·	·	24
AGR.	IV	·	11	·	15	1	1	·	28
Σ		70	64	37	50	7	2	1	231

By the analysis of spatial aspects of the small mammals, the distribution of the dominant species of rodents, members of the communities on the examined habitats, has been stated. Namely, *Apodemus agrarius* lives at the brink of the forest and in the mesophyll community of the herbaceous plants on the ecotone alongside the dam. *Apodemus sylvaticus* is less numerous than the former species, but its presence is characteristic for all four habitats. It is the most numerous in the forest community (Tab. 1).

A similar relation has also been stated among the voles. While *Clethrionomys glareolus* is only a member of the forest community, *Microtus arvalis* lives not only in forest but on other habitats, too, although its presence is characteristic, in the first place, for the steppe-grass community (habitat II and IV, Fig. 3).

By further analysis of cenotic relations, a close connection between the small mammal species and the habitat which they live on has become obvious. Namely, while *Clethrionomys glareolus* appears with *Apodemus agrarius, Microtus arvalis* lives together with *Apodemus sylvaticus* in a community (Fig. 4).

Finally, these investigations have proved that the presence of the species *Clethrionomys glareolus,* stated for the first time when the biology of the nutrition of the wild cat from this region was being investigated (HABIJAN and DIMITRIJEVIĆ 1979), as well as by the occasion of control capture (MIKES et *al.* 1983), is not accidental. The presence or the absence of this palearctic species inside an ecological area entirely depends on the degree of drastic changes conditioned by the impact of antropogenous

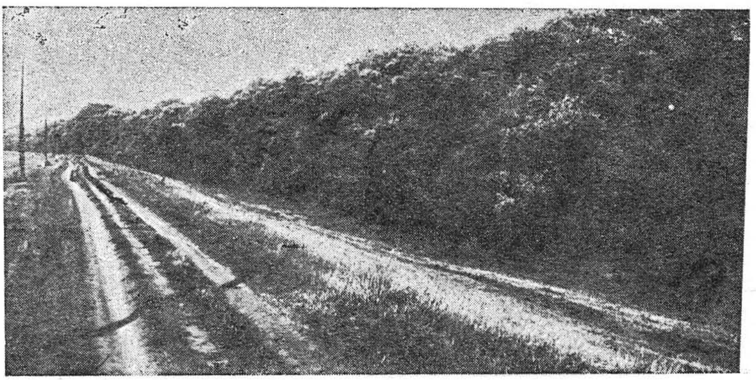

Fig. 1. The habitats alongside the river Tisza

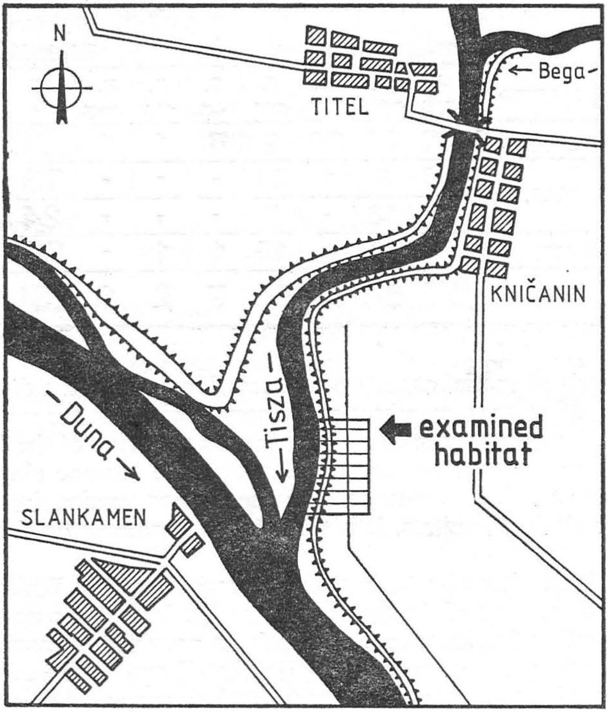

Fig. 2. The research territory at the estuary of the river Tisza

Fig. 3. The colony of Microtus arvalis on the dam

factors on the given habitat. Namely, although the examined territory along the river Tisza is not spacious, the structural organisation of the forest community provides for the presence and development of the populations of the species *Clethrionomys glareolus* on this habitat.

Having in mind that on a relatively narrow territory we can find diverse habitats, and that inside the same habitat diverse species may appear, the knowledge of spatial aspects of the small mammals and their activities in function of time is important not only in view of the species which have similar ecological niche but with regard to the other member of the communities too.

The time distribution of the small mammals on the examined habitats has been analysed on the basis of the daynight activities of the animals. The method of capture-marked-recapture has given the oportunity for the analysis of this time distribution. On the basis of the previously presented data we have analysed the time distribution of the animals on two characteristic habitats of the examined region of the river Tisza (habitat I and III, Fig. 4). On these habitats two dominant species of rodents live together: *Clethrionomys glareolus* with *Apodemus agrarius*, respectively *Microtus*

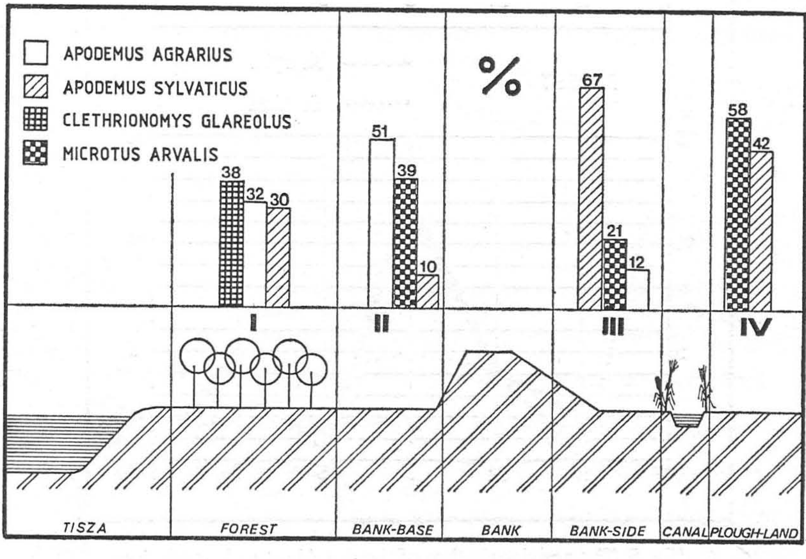

Fig. 4. The dispersion of rodents per habitats

arvalis with *Apodemus sylvaticus*. The time of the release of the animals has been taken as the indicator of the activity rhythm. The results of the time diffusion of the mentioned species in the habitat are presented on graphs (Fig. 5). The numerical values of the dominant species of rodents from the respective habitat are presented on the ordinate, while the activity rhythm in two-hour intervals in noted on the abscissa for the whole capture period.

The analysis of the obtained data clearlyshows that in competitive relations the time diffusion of the voles living in the some habitat with mice comprizes the morning and evening hours (*Clethrionomys glareolus* in the forest, *Microtus arvalis* in the grass communities), while the members of the genus *Apodemus* appear at typically night animals. The relations we stated are surely conditioned by the morphophy-

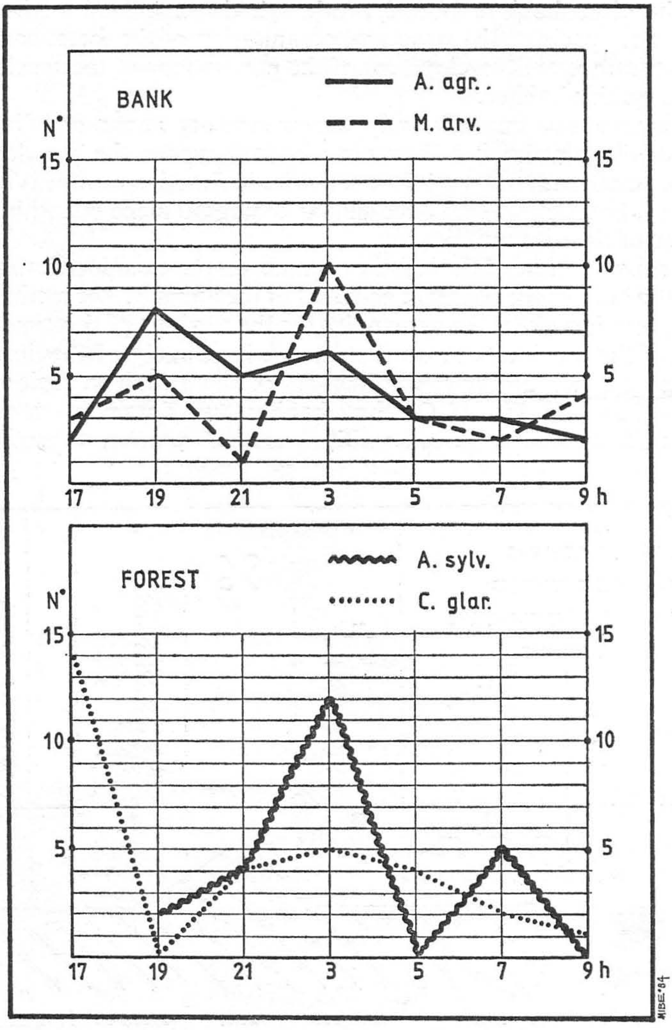

Fig. 5. The activity rhythm of the dominant rodent species

siological organization of the species wich have similar ecological niches, first of all, in relation to the behaviour and the mode of nutrition. This statement entirely confirms the findings of TODOROVIĆ et *al.* 1966, in relation to the species *Apodemus flavicollis* and *Clethrionomys glareolus,* the dominant rodent species of the forest community *Querceto-Carpinetum petree* in Fruška Gora. Namely, in our case, too it has been stated that the rhythm of the time activity of the two dominant rodent species entirely depends on the density of their populations, the members of the genus *Apodemus* retaining their stable rhythm of night activity and the voles changing it.

The quantitative and qualitative composition of the fauna of small mammals we have stated is the result of the optimal impacts of biotical and abiotical ecological factors in the autumn type of low water level on the examined habitats of the periodically inundated zone (I and II habitat) and the protected zone (III and IV habitat, Fig. 4).

After having analysed the cenotic relations of the small mammals, we may suppose that, due to the regulatory interventions along the whole Yugoslav flow of the river Tisza, the typical habitats we have mentioned in this work appear alongside the river on a narrow territory. On the other hand due to the complex impact of microclimate factors some species of small mammals as well as certain communities have an island character conditioned by the mosaic distribution of their habitats. Having in mind that the small mammals are very plastic representatives of the terriofauna, we may conclude, on the basis of the results of our investigations, that they are very sensitive indicators of the state in some habitats or the changes of the life environment entirely.

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A kisemlősfauna cönotikus viszonyai a Tisza árterületén

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Kivonat

A Tisza árterületén jelentkező négy különböző élettéren vizsgáltuk a kisemlősfauna cönotikus viszonyait. A jelölés és újrafogás módszerét alkalmazva a faunalista mellett az egyedek és fajok térbeli megoszlását, valamint éjj-nappali aktivitását is figyelemmel kísérhettük. A 231 befogott egyed 5 nem és 7 faj képviselője. Megállapítást nyert, hogy az eltérő élőhelyek kisemlősfaunája úgy minőségi mint mennyiségi összetételében jellemző. Nevezetesen az erdőtársulás kisemlősfaunája a legnépesebb, a *Clethrionomys glareolus* dominációjával. A töltésláb lágyszárú mezofil vegetációját az *Aphdemus agrarius,* míg a gyepszinti részt a *Microtus arvalis* népesíti be. A kultúrtáj szántóira az *Aphdemus sylvaticus* és a *Microtus arvalis* jelenléte jellemző.

Ценотические отношения в фауне мелких млекопитающихся, обитающих в пойме Тисы

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Резюме

Авторы исследовали ценотические отношения в фауне мелких млекопитающихся, обытающих в четырёх разных биотопах поймы Тисы. Применяя методы мечения и нового отлова наряду с переписью фауны, мы могли наблюдать распределение по площади отделных экземпляров и видов, а ракже их активность в ночное и дневное время. 231 отловленный экземпляр относится к 5 родам и 7 видов.

Было установлено, какая именно мелких млекопитающихся характерна как количественно, так и качественно для различных биотопов. Например, фауна мелких млекопитаящихся в лесовой артели растений наиболее обширна, с преобладанием *Clethrionomys glareolus* Мезофиллную вегетацию травянистых растений у подошвы насыпи населяют *Aphdemus agrarius* а в дерновом горизонте *Microtus arvalis* Для агробиоценоза характерно присуствие *Aphademus sylvanus* и *Microtus arvalis.*

Cenoticki odnosi sitnih sisara duz reke tise

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Abstrakt

Ispitivanja cenotičkih odnosa sitnih sisara duž plavne zone reke Tise vršena su na četiri različita biotopa. Metodom markiranja i ponovnog ulova dobijeni su, pored utvrdjivanja faunističke liste, podaci o prostornim aspektima jedinki i vrsta, kao i o njihovoj niktohemeralnoj aktivnosti. Ukupno ulovljenih 231 životinja pripadnici su 5 rodova sa 7 vrsta. Utvrdjeno je da svaki ispitivani biotop ima specifični faunistički sastav, kako u kvantitativnom, tako i u kvalitativnom pogledu. Naime, najveća brojnost sitnih sisara konstatovana je u šumskoj zajednici, sa dominacijom *Clethrionomys glareolus*. U mezofilnoj vegetaciji u podnozju nasipa javlja se *Apodemus agrarius,* dok se u livadskoj zajednici samog nasipa susreće *Microtus arvalis.* Agrobiocenoze naseljavaju *Apodemus sylvaticus* i *Microtus arvalis.*

Tiscia (Szeged) Vol. XX, pp. 145—147 (1985)

FROM THE LIFE OF THE TISZA-RESEARCH WORKING COMMITTEE, WHICH HAS BECOME INTERNATIONAL

TISZA-RESEARCH CONFERENCE XV (1984)

Compiled by

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Fulfilling the request of the members, the time-point of our working committee's regular annual conference has been modified and put to the Autumn period. Accordingly, in 1984 it was held on November 29—30. Its aims were the delivering and critical evaluation of reports on the latest results given by the coworkers performing studies at the three Tisza-reaches, furthermore the collation of the applied study methods for the sake of being able to compare the results. The following lectures were held at the Conference:

November 29

After the presidential address the secretary set forth the report of the Executive Committee.

I. Reports from the Tisza-research in the Soviet Union

1. KOMENDAR, V. I. and KRICSFALUSIJ, V. I.: The ecological characteristics, protection and possibilities for the replantation of the *Narcissus angustifolius* CURT.
2. KOMENDAR, V. I. and SZABADOS, V. I.: The ecology, biomorphological characteristics of the *Leucoium aestivum* L.
3. FODOR, I. and JANCO, L. I.: *Helianthus decapetalus* L. in the Tisza-valley.

II. From the Hungarian Tisza-research

4. KISS KEVE, T.: Thalassiosiraceae species (Bacillariophyta) from water samples from the Eastern main canal and the Tisza river.
5. ALBERT, A. and WOLLEMANN, MÁRIA: Acoustical and ethological observations at heron colonies.

Studies performed at the Alpár-basin

6. FEKETE, E.: Heavy metal analysis in the backwater at Bokros.
7. HEGEDŰS, MÁRIA and KAJÁRY, IRÉN: Hygienic water quality of the backwaters of the Tisza river and the Alpár basin.

8. Mrs. L. DOBLER: Seasonal dynamics of the phytoplankton of the ecosystem of the backwater at Bokros.
9. KISS, I.: Relationships between many algal mass productions and the showery weather during the Spring of 1984.
10. GÁL, D.: Seasonal changes of the zooplankton at the Bokros-backwater in the year 1983.
11. BÁBA, K.: Malacological studies on the aquatic- and terrestrial snails at the areas of the Basin at Tőserdő and Bokros.
12. FARKAS, Á.: Newer data to our knowledge on the ihthyological changes of the backwaters between Tiszaalpár and Tőserdő.
13. MOLNÁR, GY.: Ecological and predational relations of the heron colony at Alpár.
14. GYOVAI, F.: The ecology of *Anura* species in the regions of Tiszaalpár.
15. AVASI, Z., GALLÉ, L. and KEREKES, J.: Some characteristics of the reconstruction of epigeous carnivore communities following inundation.
16. CSIZMAZIA, GY.: Results of mammalogical studies in 1984.
17. SZALMA, E.: Phytocenological and element-content analysis in respect to the *Wolffietum arrhizae* MIYAWANI et J. TX. 60. association.
18. BAGI, I.: Vegetation-dynamic studies in Nanocyperion stands. I. Ordination and characteristic indicator values.

November 30

The tenth anniversary of the studies at the Kisköre storage tank

19. BANCSI, I.: Development of the water quality at the storage tank and the irrigation-system between 1973—1984.
20. GYŐRI, ZS.: Natural relations of the Kisköre river barrage and storage tank, with special regard to the hydrological conditions.
21. VÉGVÁRI, P.: Development of the storage tank's water chemical relations.
22. B. TÓTH, MÁRIA: Development of the water quality by means of the changes in the bacteriological parameters.
23. HAMAR, J.: The effect of banking up on the seasonal dynamics of the storage tank's phytoplankton between 1973 and 1984.
24. BANCSI, I.: Ten years changes in water quality in the light of the qualitative and quantitative development of the zooplankton.
25. HARKA Á.: The changes in composition, characteristics of the seasonal dynamism and the nutriment-chain composition of the fish stand during the course of the past ten years.
26. STERBETZ, I.: Report on the ten years bird alimentation studies performed at the region.
27. KOVÁCS, G.: Study results of heron colonies developed at the protected area of the storage tank.
28. TANÁCS, L.: Apoidea structure analysis reflected in their anthropogenic influence.
29. KOZMA, A.: Phytocenological changes in the ecosystems at the storage tank area, taking place on anthropogenic effect.
30. TÖLGYESI, GY.: Summarizing evaluation of vegetationanalyses peformed at the area.
31. KATÓ, E.: Water quality aspects of the storage tank's complex utilization.

III. From the Yugoslavian Tisza-research

32. GAJIN, SLAVKA, PETROVIĆ, OLGA, GANTAR, M. and MATAVULJ, M.: Microbiological studies on the Carska bara.
33. BOŽIČIĆ, BLANKA: Mosquito-fauna (Culicidae, Diptera) researches alongside the Tisza river.
34. PUJIN, VLASTA, RATAJAC, RUŽICA and DJUKIČ, NADA: Data to the limnology of the Carska bara.
35. MALETIN, S. and BUDAKOV, LJILJANA: The growth and productivity of the *Carassius auratus gibelio* BLOCH 1783 at the Dead-Tisza.
36. GAROVNIKOV, B. and POPOVIĆ, ESZTER: The ornitofauna of the Carska bara.
37. MIKES, M. and HABIJAN—MIKES, VERA: The cenotic relations of the small mammalian fauna at the flood-plain of the Tisza river.

Presidential closing speech

Following the lectures the forthcoming complex researches were discussed and co-ordinated with the participation of the co-workers.