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PLANT ASSOCIACIONS OF FLOOD PLAINS ALONG THE MIDDLE TISZA AND THEIR AGRICULTURAL UTILIZATION

A. KOZMA and GY. TÖLGYESI

University of Veterinary Sciences Budapest, Hungary
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Abstract

The authors have investigated some flood-plain areas belonging to the Middle Tisza Region and extending south of Kisköre and Abádszalók till Pusztataksony, from the points of view of their economic usefulness, as well as the macro- and micro-element content of the plant associations. The soil of the river-side and the flood-plain areas is a middling acid fresh alluvial soil. The humus content and the flood-plain areas is a middling acid fresh alluvial soil changes between 1 and 1.42 percent, the pH between 5.3 and 5.6 (measured in nKCL).

According to the establishment of the authors, the investigated areas are utilized first of all forest-economically and only 10—12 percent grassy area utilized with mowing, resp. paturing. With the intensive Canadian poplar plantation the original willow-poplar-ash plant association strongly decreases and the original plant cover of the shrub and herb stratum of the forest association also considerably changes. As a result of the more and more frequently arising region conservation problems, it is pressing and justified, to declare these areas a Region Conservation District!

In the course of investigating into the macro- and micro-element content of plant species of the plant association in the flood-plain areas, the authors have ascertained that the mean values of the macro- and micro-element content of the plant associations the river-side and in the flood-plain exceeded in every case the mean values of the meadow-hay of good quality. The authors have examined the plant species 6 macro- and 7 micro-elements in a double repetition (in spring and autumn aspects).

The flood-plain areas of the Danube and the Tisza come to 10 percent of the territory of this country even to day. The agricultural utilization of the Danube and Tisza flood-plains — wich can be regarded as considerable compared with the territory of the country — may be very much varied, depending on the character of the flood-plain area. In the Danube flood-plains, less protected with artificial dams, the field growing of plants can be carried out without any major danger even in the immediate flood-plain. The Danube flood-plains can be utilized in a large measure as pastures and grass-lands, too. At the same time, their utilization in forestry by means of planting of trees is also not negligible. And, particulary at present, even the recreation areas spring up like mushrooms in the Danube flood-plains. Along the Tisza, well-protected with dams, the afforestation of flood-plains prevalls while the flood-plain areas utilized as pasturages and grass-lands are of much smaller size.

Before the protection against floods and the river control works started in the Eighteen-Forties, vast areas are inundated by the floods of the Danube and particularly of the Tisza. In case of the Tisza and its tributaries the extension of the annually

inundated areas reached 30,000 square km. All this already belongs to the past today. The meandering Tisza was made straight with 300 short cuts, its flowing was forced into a deeper riverbed, flowing more rapidly.

The enormous social intervention after the liberation of the country made the Tisza a real "canalized artificial river" for our days, satisfying the requirements prescribed by the up-to-date agriculture and the other branches of peopel's economy. The river barrage built in 1954 at Tiszalök and the 108 km long Eastern Main Channel of about 650 cubic m/sec. transportability and the Kisköre River Barrage, finished in 1976, the huge reservoirs in the flatlands, all are important chain-links of the work the aim of which is to make the Tisza one of our most useful rivers for a long time.

The fluviatile deposit of the Tisza water is of mildly acid reaction and in the water of the river the amount of solute salts and other floating-matters is remarkably large. The different salts make about 66 percent of the solid suspension passing with the water (MIHÁLZ, 1939). The analysis of the floating-matter of the Tisza (BABOS, 1952) is the following: feldspar 66.56 percent, kaolin 12.51 percent, sand 2.30 percent, calcium-carbonate 2.82 percent, ferric oxide 3.19 percent, humidity 4.43 percent, organic matter 8.29 percent. In the organic matter, nitrogen is represented with 0.15 percent. One cubic m Tisza water carries 324 g silt on the average and in that the amount of potassium is 0.9 percent, that of lime 37.5 g averagely. The overweight of the non-decomposed feldspar in the floating-matter of the Tisza is particularly important because this — owing to its low clay content — does not stop the gap-system of the ground in the course of floods, and after being decomposed it increases the productivity of soil at a rapid pace. Not less important is the favourable quantity of lime in the silt of the Tisza which has a useful effect on the physical properties of the floating-matter (loosening, capacity of taking up water) and makes advantageous to introduce intensively calcium-demanding fruit and poplar-species in the flood-plains and river flats. The total salt content of the floating-matter of the Tisza was at Kisköre, in river-km section 404, on the basis of the data recorded by the "VITUKI" between 1973–1976: maximum 486 mg/l, mininum 142 mg/l, on average: 292 mg/l. ("VITUKI" data, 1 March 1978.)

It has been generally known for long that the alluvial grounds are much richer in mineral matters than the other grounds. The floating-matter of the Tisza covers at flood 1 ha inundated area with 48–103 kg vegetable nutritive matter. The productive effect of the deposit is commonly known.

As the Tisza regularly inundates the flood-plain areas at least once a year — if not twice-even today —, we may draw conclusion that in these areas the base-destroying processes are lasting even at present. It is known that in the direction of the flowing of rivers upper, middle and lower reaches and in perpendicular direction to that, departing from the riverbed: (1) the presentday flood-plain or immediate river flats, (2) the older or secondary flood-plain beyond the protecting dam, and (3) the dry river terrace may be distinguished. In the latter two — as these had no more obtained any regular overflow — the processes of soil formation could already begin in the alluvium. In the direct flood-plain is, however, the river in a standing activity, even at present. It carries away a considerable part of the material is deposited at the former inundation — although today this is already considerably diminished by the trees of the thickly afforested flood-plains — and deposits new matters. In the immediate flood-plain can, therefore, the formation of a ground type not begin.

Plant coenological and ecological investigations were performed in large numbers in the flood-plain areas both of the Danube (KÁRPÁTI 1963, SOÓ 1958, 1960, 1961, 1964, TÓTH 1958, 1959, ZÓLYOMI 1967, ZSOLT 1943) and of the Tisza (BODROGKÖZY

1961, 1962, 1966, 1967, 1968, 1972, 1974, HORVÁTH 1974, MÁTHÉ–SOÓ 1939, SIMON 1957, TIMÁR 1939, 1954, 1956, UJVÁROSI 1940, 1941, ZÓLYOMI 1945, 1947). Since 1975, we also carried out investigations into some plant associations found in several flood-plains at the Danube (Sződliget, Verőcemaros, Tát, Almásfüzítő) and the Tisza (Tokaj, Tiszafüred, Tiszasüly, Nagykörű, Csataszög), first of all from the point ofi view of their macro- and micro-element content.

In 1977, we investigated into about 4 km long flood-plain areas, extending from, Kisköre and Abádszalók, belonging to the Middle Tisza Region, till Pusztataksony on the basis of the points of view given in the title of our paper. On the plant cover of the perambulated and investigated areas, the settlements and establishments to be found an information is furnished in the annexed sketch map (Fig. 1). It is shown

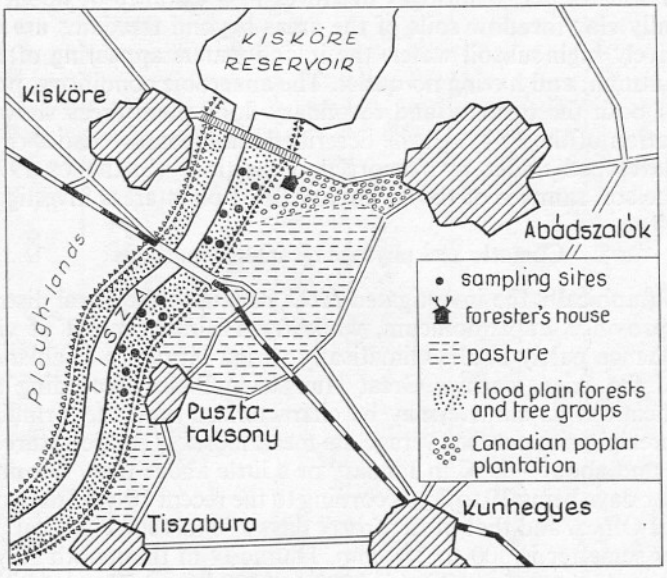

Fig. 1

in the sketch map that of the flood-plain areas, inundated by the Tisza regularly every year mostly the forest association in the secondary flood-plain areas outside the protecting dam however, the grassy associations and the field growing of plants are characteristic. Investigating into the sketch map, it can also be seen that, because of the intensive expansion of human settlements (particulary at Kisköre) as well as of the building of the Kisköre River Barrage, the landscape of the region and its natural primary plant cover change in a short time. And by this, inevitably, more and more nature conservation problems are raised. This is otherwise shown by the masses of rubbish, building debris, branches of trees broken off, empty cans, waste paper seen at our visit in the Kisköre flood-plain areas. We can only speak in superlatives of the measures of our Government with wich it will, in the next future, declare nature conservation area this district together with the whole Middle Tisza Region.

Geological and soil conditions of the investigated areas

The areas lying on the right river-side (Kisköre and its environs) belong geomorphologically to the Zagyva–Tarna basin of the open flood-plain of Heves–Borsod, and that being on the left river-side (Abádszalók–Pusztataksony) to the geomorpho-

logical district named Nagykunság. The flatness of the areas, seeming to be monotonous, is variegated at the right river-side by the new-Pleistocene alluvial cones of a comparatively very low difference in level, while at the left river-side by the original and artificial hillocks of not higher difference in level than 5 to 10 m from the Nagykunság "clod" left out of the Holocene settling (kunhalmok = tumuli, barrows). (BULLA 1962).

The soils of the investigated areas are according to STEFANOVITS (1963), structureless, fresh alluvial soils of mildly acid reaction in the flood-plain. In the secondary flood-plain areas, they are partly meadow soils of alluvial character, containing islandlike about 10 percent of alkali soils partly those very much disposed to sodification. These meadow soils form a transition through a series of grades to the more middle-hound soils of the sandridges in Heves in a distance of about 15 km. The characteristically clay meadow soils of the areas beyond the dams are explained by the comparatively high subsoil water, the inland waters appearing often in Spring, Winter and Autumn, and having no outlet. The anaerobic conditions, predominating in the soils of both the primary and secondary flood-plain areas shown by the increasing gleization of the soils. All the described main characteristics of the meadow soil having developed under hydromorphic conditions (SZABOLCS 1974) could be observed in the soil samples of the secondary flood-plain areas investigated.

Climatic and phytogeographic conditions

Phytogeographically the investigated areas belong to the floral district Crisicum of the floral province Eupannonicum, while from climatic point of view they are under the influence partly of the climatically varied Northern Highlands, partly of the climate of the drier, warmer Great Hungarian Plain. According to Köppen's climate classification, its climate may be characterized with the formula Cbfx, with 550–580 mm precipitation on the average, its mean monthly temperrature being below 22 °C in July, and about −2 °C in January or a little above that. The number of the very cold winter days being 30 to 35, according to the recent 10-year data of the Centra Meteorological Office, and that of the frosty days 170 to 180. The total precipitation of the summer semester is 300 to 350 mm. Humidity in the month July is 60 to 65 percent. The annual sum of sunshine is 2000 to 2200 hours. The prevailing direction of wind is north, north-east, and in a smaller degree west, southwest. Strenght of the wind is $>3°$.

Hydrographical conditions

The water quality of the Tisza was, according to the data of "VITUKI", at Kisköre, in the sector of river-km 404, in the years 1973–1977, according to the water-quality classification COMECON, "second class", "a little polluted", and according to its mineralmatter content "first water-quality class", "clear". Here are the mean values of the inorganic-matter content, measured in the Kisköre region of the Tisza water between the years 1973–1977:

Calcium ion	49.2 mg/l average
Magnesium ion	10.6 mg/l average
Sodium ion	22.– mg/l average
Potassium ion	4.1 mg/l average
Chloride ion	36.– mg/l average
Sulphate ion	43.7 mg/l average
Manganese ion	0.29 mg/l average
Methylorange alkalicity mg equ./l	2.49 mg/l average
Total solute matter	292.– mg/l average

Table 1. *Basic research values of soil samples from the river-side and flood-plain of the Tisza at Abádszalók*

Samples: I-III depth: cm	pH		$CaCO_3$ p.c.	Humus content p.c.	Total N gN	Phen. alkalinity sodic p.c.	Q	Arany's fixity No	Fe^{++} p.c.	5 h cap Water raising mm	Plant association from which the soil sample originates
	H_2O	n KCL			1000 g soil		450 650 mμ				
I.					(0–80 cm)		(0—80 cm)				Upper one-third of the Tisza river-side 1977. VI. 1.
0–40 cm	6.2	5.6	1.7	1.05	1.7	–		44	7.2	180	*Rorippo-Agropyretum repentis* (Timár 47)Tx 50)
40–80 cm	6.1	5.6	1.1	1.0	1.7	–	0.310 0.221	40	4.8	202	
II.					(0–80 cm)		(0–80 cm)				Primary flood-plain 1977. VI. 1.
0–40 cm	6.0	5.5	1.92	1.21	1.85	–	0.337 0.302	50	7.8	158	*Salicetum albae-fragilis* (Issler 26 et Soó 57)
40–80 cm	5.7	5.2	1.05	1.42				47	6.5	167	
III.					(0–80 cm)		(0–80 cm)				From the grassy area close to the protective dam in the primary flood plain
0–40 cm	6.4	5.8	2.27	1.30	1.63	–	0.565 0.633	46	5.6	195	*Carici-Alopecuretum*
40–80 cm	6.2	5.6	1.72	1.41				44	4.1	200	(Soó 71)

The mean water level of the Tisza in the area investigated was 187 cm, taking into consideration the data of the last five years. (Point "0" of the water-gauge was 81.71 m above the Adriatic). The highest water-level observed in this area in the past five years was 887 cm, having occured on 4 March 1977. Since the beginning of the observations (1889) the highest water in the Tisza, the area of Kisköre, was 902 cm, having occured on 27 May 1970. The protected dam was not overflown by the flood-wave. The Tisza leaves its middle-water bed in the stretch at Kisköre–Pusztataksony in case of 650 cm water-level.

At the record in May 1970, the flood-plain was covered by the inundation of the Tisza for 92 days. The lowest water observed in the Tisza at Kisköre in the last five years was −214 cm, on 5 October 1973.

The Tisza shows — similarly to our other home rivers — seasonal periodicity. There occur systematically a spring-summar largewater period (March–July) and an autumn small-water period (August–November). In the winter months, the water of the Tisza is generally low. In cretin years, however, owing to the melting on the snow, following the quick rise in temperature, the winter small-water period may be interrupted by a violent flood-wave (Aujeszky, 1941).

Methods of the investigation

The survey of plant associations was carried out 2×2 m squares. The plant species and associations follow the nomenclature of Soó–Kárpáti: Növényhatározó (Handbook of plant identification II (1968). On the riverside plant associations there were taken in the spring (1 June) and autum aspects (22 September) at 3 sites in each case, i. e. totally, 12 surveys, and on the flood-plain plant associations, at two sites each, together 4 surveys. For indicating the covering value the modified Braun-Blanquet-scale was used. From the stand types of plant associations on the Tisza river-side the soil samples were taken, till 80 cm depth, with drillhole, in the flood-plain with pit-digging, on the 1. June 1977. Soil properties were examined with complex agrochemical methods, in conformity with the Hungarian Methodological Directives on soil examinations (basic research). The mobile nutritive matters of the soil were determined with two kinds of methods: (1) in 0.1 n hydrochloric acid of room-temperature, dissolved at 1 to 10 soil-solvent ratio, (2) in ammonium lactate, dissolved according to Egne–Ruehm–Domingo, partly with atomic absorption, partly colorimetrically. The measuring of pH took place with H_2O and in n KCL solution. The determination of humus content was carried out with ignition weight losses, that of $CaCO_3$ content with the method of Mrs. Sátori, that of the total nitrogen content after Kjeldahl's decomposition with Nessler's colour-reaction.

The macro- and micro-element content of plants was determined after incinerating ignition at 600 °C, and after preparing partly with nitric acid — perchloric acid, partly with ammonium-lactate, on the basis of atomabsorptive measuring (K, Ca, Mg, Na, Mn, Zn), as well as colorimetrically (P, S, Cu, Mo, Al, Fe, B).

For information we make known the basic research values of the soil samples taken from three plant associations of the flood-plain of the Tisza at Abádszalók and the values of their mobile nutritive matters measured with two methods.

Investigation into the plant associations

In the 3–400 m broad flood-plain extending from the river-side of the Tisza at Abádszalók, the following plant associations can can be separated zonally:.

(1) Plant associations closely at the riverside: There were found two of these on the river-side at Abádszalók:

(a) in the lowest, silty section of the river-side: the mud-lover association *Bidentetum* (Koch 26) Libbert 32 (pp) *Dichostyli–Gnaphalietum uliginosi,* being a transition towards the *Bidentetum tripartiti* association,

(b) in the middle and upper sections of the river-side: the hydrophilic association Rorippo Agropyretum repentis (Timár 47) Ty. 1950.

Table 2. *Values of the mobile nutritive matter of the soil samples taken from the riverside and flood-plain areas of the Tisza at Abádszalók, dissolved in hydrochloric acid and ammonium lactate solution*

Samples I–III 0–80 cm	Dissolved in 0.1 n hydrochloric acid with 1:10 soil solutio ratio						Dissolved in ammonium- lactata-te solution				Plant assoc. from the soil-sample of which the investigation took place
	K	Ca	P	Mg	Fe	Cu	K	P	Mn	Zn	
	mg/kg soil						mg/kg soil				
I.	223	5 080	24	654	11 000	32.5	225	23	140	49.6	*Rorippo-Agropyretum repentis* (Timár 47) Tx 50 1 June 1977
II.	205	4 850	20	550	12 200	39.4	210	20	154	69.2	*Salicetum albae-fragilis* (Issler 26 et Soó 57) 1 June 1977
III.	235	5 220	26	642	10 600	32.7	238	27	136	56.3	*Carici-Alopecuretum* (Soó 71) 1 June 1977

(2) Plant association in the soft-wood gallery forest of the flood-plain. Two of this were found in the area at Abádszalók:

(a) The original *Salicetum albae-fragilis* (ISSLER 26 et Soó 57) association, and:

(b) The artificially planted Canadian poplar association: *Populus canadensis* MÖNCH. var. *marylandica* (BOSC) RHEDER et var. *serotina* (HARTIG) RHEDER.

The latter one being an artificially planted plant association, we do not deal with it in detail.

(3) In a mesohygrophilous, grassy, half-ruderal area, in some plots planted with very young Canadian poplars extending 40 to 50 m broad between the soft-wood gallery forest and the protecting dam: *Carici-Alopecuretum* (Soó 71) association.

The plant associations made known are spatially illustrated by the sample spot and cross-section from the river-side of the Tisza at Abádszalók in Fig. 2.

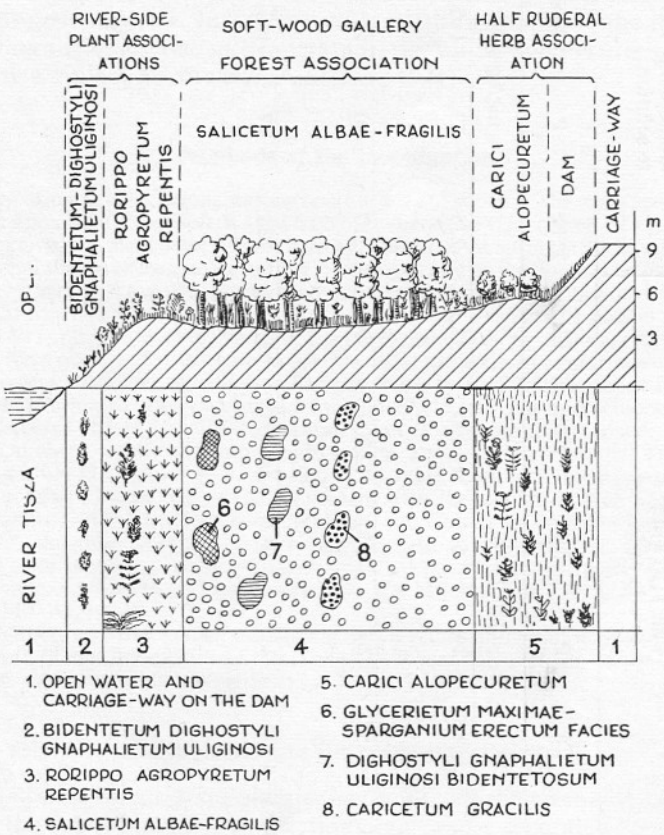

Fig. 2

A brief characterization of the plant associations investigated

(1) (a) *Bidentetum* (KOCH 26) LIBBERT 32 (pp.) *Dichostyli–Gnaphalietum uliginosi* mud-lowing tansitional association. It is a plant association of the about 1.5 m broad, moderately ascending, muddy (troubled by the wawes and standingly wet), lowest

section of the river-side. Its species number is, because of the permanent motion and eluating effect of water, low enough. We could count not more than 19 species. The degree of covering is 60 percent. It cannot be utilized agriculturally. In the area no soil examination was performed. K index: 60 percent.

(1) (b) *Rorippo–Agropyretum repentis* (TIMÁR 74) Tx 50: hygrophilous association on the river-side.

It is an association taking place from the wet middle section of the river-side till the top of bank, and even jutting out here and there, in a breadth of 1.5 m, to the flood-plain, as well, which is characteristic of almost the full length of the investigated reaches. In the Canadian poplar grove planted about 1 km long, beginning from the highway bridge at Kisköre, Agropyron repens-Heleochloa alopecuroides forms a nice stock. Covering in this association is everywhere 100 percent. Its species number is richer than that of the former river-side association: 28. Because of its strongly ruderal species elements, this association can only be utilized in a small degree agriculturally altough, at the time of our visit, some grazing cows could be seen in this area. Soil properties can be found in Tables 1. 2. K index in 80 to 85 percent. (Figs. 3–4).

(2) (a) *Salicetum albae-fragilis* (ISSLER 26) et SOÓ 57 association.

This is an original plant association which can be found fragmented in some sections of the flood-plaint at Abádszalók. In the Kisköre flood-plain, howerer, this association is the dominant one. It occurs in the rather wet areas of the flood-plain. Its dominant tree species are: *Salix alba* et *fragilis* 4, *Populus canadensis* 2, *Fraxinus*

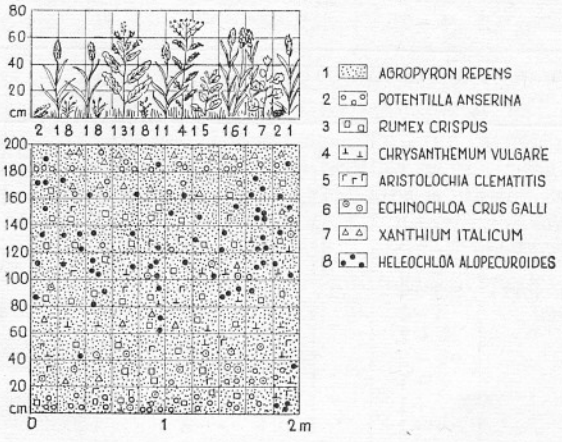

Fig. 3—4

pensylvanica var. *subinterregima* 3. The covering degree of crown stratum is — as a result of the intensive woodfelling and cutting-only 60 percent. Shrub stratum is formed by the younger slender individuals of *Amorpha fruticosa* 2, *Salices* and *Fraxini*. This stratum is here and there made so thick by these and the many *Rubi caesii* 4–5 that walking in the forest may raise serious difficulties. In the association the grass stratum is for med by the real grass-covered areas extending in smaller and larger

stripes and spots, the exuberant spots of high, ruderal, dry stalk-like plants under willows and ashes, and in the water-covered minor spots: *Carex gracilis, Sparganium erectum* and *Gyceria maxima*. Three of these were investigated and are briefly characterized as follows.

(a) *Glycerietum maximae-Sparganium erectum* (HUECK 31) facies.

It occurs in water-covered areas of 50 to 100 square m size, in cavities below willows. Characterizing species: *Sparganiun erectum* 4, *Carex gracilis* 2, *Glyceria maxima* 4, *Eleocharis palustris* 3, *Schoenoplectus lacustris* 1 (+2), *Angelica silvestris* 2.

Table 3. *River-side plant associations on the Abádszalók side of the Tisza*

Name of the plant association	Date of the survey 1 June 1977		Date of the survey 22 September 1977		Site of the survey and percentage of covering
	A–D	K	A-D	K	
I. *Bidentetum, Dichostyli-Gnaphalietum uliginosi* (KOCH) 26/LIBBERT 32 (pp) Its characteristic species:					
Polygonum hydropiper	2–3	III	+–3	III	1.5 km south of the highway bridge of the Tisza at Kisköre, on the lower riverside section 1.5 to 2.5 m from the Water level. Covering: 60 percent
Gnaphalium uliginosum	4–5	V	+–4	IV	
Polygonum lapathifolium	1–2	II	2–3	III	
Polygonum minus	+–2	I	+–1	I	
Chenopodium rubrum	1–2	II	3–4	III	
Potentilla anserina	+–1	I	+–1	I	
Prunella vulgaris	+–1	I	+–2	I	
Xanthium italicum	1–2	II	+–3	II	
Rumex crispus	+1	I	+–1	I	
Bidens tripartitus	2–3	III	2–3	III	
Echinochloa crus-galli	+–2	I	+–3	II	
II. *Rorippo-Agropyretum repentis* (TIMÁR 47)TX 1950 Its characteristic species:					
Agropyron repens	4–5	V	4–5	V	bridgeKálkápolna–Kisújszállás, on the middle and upper sections of the riverside of the Tisza. Covering: 100 percent
Rumex crispus	2–3	III	+–3	III	
Rumex obtusifolius	+–1	I	+–2	I	
Aristolochia clematitis	+–1	I	+–2	I	
Chrysanthemum vulgare	2–3	II	2–3	II	
Potentilla anserina	2–3	III	+–3	III	
Heleochloa alopecuroides	3–4	IV	+–2	II	
Echinochloa crus-galli	1–2	I	+–3	II	
Xanthium italicum	+–2	I	2–(3)	II	
Lycopus exaltatus	+–2	I	2–(3)	II	
Lycopus europaeus	+–1	I	+–1	I	
Prunella vulgaris	+1	I	+–1	I	
Inula britannica	+1	I	+–2	I	
Bidens tripartitus	+–2	II	+–3	III	
Typhoides arundinacea	+–2	II	+–2	II	

Accident species of plant association I. on the river-side: *Carex gracilis Rorippa amphibia, Agrostis alba, Alopecurus pratensis, Inula britannica Phragmites communis, Rhinantus minor, Chenopodium polyspermum.*

Accident species of plant association II on the river-side: *Euphorbia lucida, Chrysanthemum serotinum, Lotus corniculatus, Glycyrrhiza echinata, Centaurea jacea, Trifolium patens, Galium uliginosum, Salix triandra, Amorpha fruticosa, Plantago media* et *major, Dipsacus laciniatus, Mentha piperita.*

(b) *Dichostyli Gnaphalietum uliginosi, Bidentetosum* HORVÁTH 31, SOÓ et TIMÁR 47).

They occur in the wet areas below ashes, in 50 sq. m spots. Characteristic species: *Bidens tripartitus* 4, *Gnaphalium uliginosum* 5, *Carex gracilis* 2, *Prunella vulgaris* 1, *Chenopodium polyspermum* 3, *Iris pseudacorus* 2.

(c) *Caricetum gracilis* (GRAEBNER et HUECK 1931) Tx 37 and its mini-associations which may be considered as almost entirely homogeneous. Its dominant species are: *Carex gracilis* 5, *Eleocharis palustris* 2, *Schoenoplectus lacustris* 1. It forms spots of more sq. m size likewise in the wet areas under the willows. The presence of these mini-associations and species supports very well the observation of the botanist, I. TÓTH, that the presence of *Glyceria maxima, Carex gracilis, Sparganium erectum* makes only possible-owing to the water-covering of lasting and even permanent character- in areas like this the plantation of willow and ash and not of Canadian poplar.

From among the plants of the herb stratum of the willow-poplar forest we are only enumerating the species occuring in the largest masses and the most characteristic species combinations: *Lysimachia vulgaris* 3, *Leucojum aestivum* 2, *Solidago gigantea* 2, *Symphytum officinale* 3, *Glycyrrhiza echinata* 2, *Rubus caesius* 4, *Echinochloa crus-galli* 2, *Iris pseudacorus* 2, *Althaea officinalis* (1) 2, in the downtrodden places and on the way-sides: *Plantago media* 3, *Malva neglecta* et *silvestris* (1) 2. The fringe of the soft-wood forest is closed towards the protecting dam in 2 to 3 m breadth by the thick schrubs of *Amorpha fruticosa* 4. These are crept by *Echinocystis lobata* 3, and *Rubus caesius* 4.

(3) *Carici–Alopecuretum* (SOÓ 71), half-ruderal grass association.

It is the plant association of the 40 to 50 m broad area extending from the fringe of the soft-wood forest association till the dam (Table 4). Its species number is the largest from among the plant associations investigated in the river-side and flood-plain areas: with 38 species. It is a plant association characteristic of the entire lenght of the 4 km long section which can be considered sporadically as a strong, in its bulk as a half-ruderal grass-association. The cover is, with the exception of ways, everywhere 100 percent. The grassy association is because of its strong weed infestation, often known. Its K index is 80 to 85 percent. The area is utilized by grazing, as well. Its soil properties can be found in Tables 1 and 2. Longer and shorter parts of the association were planted with Canadien poplar saplings about 3 to 4 years ago. These exert, however, no effect on the constant and accident species of the association are published here for giving information (Fig. 5).

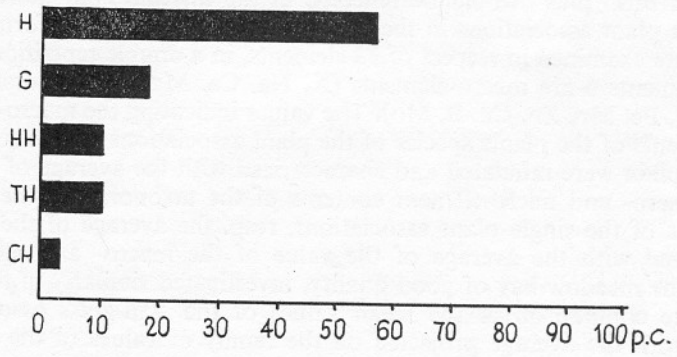

Fig. 5

Table 4. *Herb association of the 40 to 50 m broad area of the Tisza flood-plain at Abádszalók near the protecting dam*

Name of the plant association	Date of the survey 1 June 1977		Date of the survey 22 September 1977		Site of the surwey and percentage of covering
	A–D	K	A–D	K	
Carici-Alopecuretum (Soó 71) Its characteristic species:					
Alopecurus pratensis	3	IV	3	IV	On the 40 to 50 m broad grass area expanding from the edge of the flood-plain associations of soft-wood gallery forest to the protecting dam. Covering 100 percent
Agrostis alba	2	III	+–2	III	
Festuca pratensis	+–1	II	+–2	III	
Festuca arundinacea	+	I	+(1)	I	
Typhoides arundinacea	+–1	I	1	I	
Dactylis glomerata	2	II	2	II	
Phleum pratense	+–1	I	+–1	I	
Poa trivialis (pratensis)	+–2	I	+–1	I	
Carex gracilis	+	I	+	I	
Thypha angustifolia	+	I	+–1	I	
Iris spuria	+	I	+	I	
Glycyrrhiza echinata	+–2	II	+–2	III	
Dipsacus laciniatus	+–2	II	+–2	II	
Chenopodium polyspermum	2	III	+–2	III	
Prunella vulgaris	+–2	II	2	III	
Plantago media	+–2	II	+–2	II	
Symphytum officinale	+–2	II	+–2	II	
Chrysanthemum vulgare	3	III	3	III	
Galium mollugo	+–3	II	+–2	II	
Silene cucubalus	+	I	+–1	II	
Rorippa silvestris	+	I	+	I	
Xanthium italicum	+–1	II	+–2	III	
Echinochloa crus-galli	+–2	I	+–2	II	
Lotus corniculatus	+–1	I	+–1	I	
Mentha pulegium	+—1	I	+—1	I	

Accident species of plant association: *Euphorbia lucida, Centaurea jacea, Althaea officinalis, Solidago virga-aurea, Leucojum aestivum, Iris pseudacorus, Rorippa amphibia, Carex hirta, Juncus articulatus, Angelica silvestris, Agropyron repens, Cirsium canum, Lysimnachia nummularia.*

Macro- and micro-element content of the species of plant associations

The flood-plain soils are — in spite of their several bad properties — rich in mineral nutritive matters. It seemed therefore obvious at the beginning of our investigations that this "plus" would be reflected in the internal content of the plants species of the plant associations in the flood-plain. Similary to our former exercise, the plants were examined in respect of 13 elements, in a double repetition. Of the 13 examined elements 6 are macro-elements (K, Na, Ca, Mg, P, S) and seven micro-elements. (Al, Fe, Mn, Zn, Cu, B, Mo). The values indicating the macro- and micro-element contents of the plants species of the plant associations on the river-side and in the flood-plain were tabulated and characterized with the average of the association. The macro- and micro-element contents of the taxonomically heterogeneous plants species of the single plant associations, resp. the average of the association were compared with the average of the value of the macro- and micro-element contents of the meadow-hay of good quality, investigated similarly in respect of 13 elements. The comparison of the mean values of the acid-grass association was carried out with the average projected on the family of values of the macro- and

micro-elemental contents of the acid-grass species found in the already examined flood-plains of the Tisza. The macro- and micro-element contents of the ligneous plants of the forest association were averaged entirely separated, because we thought that is was not helpful to compare the woody-stalked and soft-stalked plants from the point of view of macro- and microelement content. At the associations of the soft-stalked plants we have considered one or two plants of outstandingly high macro- and micro-element content (e.g. *Malva neglecta,* etc.) as of outstanding values according to Dixon's prove, and left them at the calculation of averages out of consideration.

At the first of the river-side plant associations it is shown by the averages that — with the exception of magnesium — in respect of every macro- and micro-element, the averages exceed the mean values of the meadow-hay of good quality. Strikingly much iron, manganese, zinc and molybdenum accumulates in the bodies of *Polygonum hydropiper, Gnaphalium uliginosum.* Similarly high boron-concentration, zinc and copper content are shown in *Xanthium italicum* as well. It is interesting that in every plant species of the association the K content is high.

The mean values of the species of the second plant association of the river-side — with the expection of manganese — are identical with the mean values of the micro-element content, in case of iron, zinc and sulphur, exceedig the mean values of these many times. There is here, too, a fairly much number of species that excelled in its capacity of accumulating macro- and micro-elements *(Symphytum officinale, Lycopus exaltatus, Rumex obtusifolius* etc*)*.

The mean values of the macro- and micro-element contents of the ruderal, soft-stalked plant species belonging to the forest associations in the flood-plain are similary at the level of mean values of the meadow-hays of good quality but their interestingly contain less K and much more Na than the meadow-hays. There are also here a large number of zinc, manganese, aluminium, iron and molybdenum containing plants. (*Lythrum salicaria* contained 700 mg zinc, 570 mg manganese, Lycopus europaeus contained 400 mg zinc. *Lysimachia vulgaris* contained 240 mg manganense, *Rubus caesius* and *Echinocystis lobata* contained molybdenum in a quantity over 1 mg.

The plant species of the acid-grass associations — as it was to be expected — excelled with their high zinc, manganese and molybdenum values. *Typha latifolia* contained 1800 mg, *Sparganium erectum* 830 mg, *Typha angustifolia* 700 mg manganese, *Schoenoplectus lacustris* 16 mg molybdenum!) The mean values of the plant association esceeded in case of every macro- and micro-element, with the expection of Na, the mean values of the family, ascertained with repeated measurings.

The plant species of the soft-wood forest association are characterized by a low K, Ca and P content and very high zinc, iron, copper and boron concentrations.

Table 5. *Macro- and micro-element content of the plant associations of the Tisza flood-plain area at Abádszalók-Kisköre*

Name of the association	Soil pH	K	Ca	P	Mg	S	Na	Al	Fe	Mn	Zn	Cu	B	Mo
		g/kg						mg/kg						
Average of the meadow hay of good quality	6—7.5	20.0	10.0	2.5	3.0	2.0	0.20	200.0	180.0	80.0	30.0	7.0	20.0	0.5
River-side plant associations I II	6,1													
Polygonum hydropiper L.		27.0	6.8	3.5	3.0	4.0	0.50	261.0	574.0	300.0	196.0	7.8	26.0	9.0
Polygonum lapathifolium L.		20.7	10.6	2.3	–	2.4	0.10	142.0	221.0	16.0	115.0	176.0	–	–
Rumex crispus L.		20.6	6.4	3.6	2.6	2.7	0.34	172.0	208.0	83.0	180.0	11.6	22.0	0.75
Gnaphalim uliginosum L.		40.0	14.4	5.7	2.7	6.0	0.28	660.0	2170.0	98.0	420.0	22.0	42.0	6.60
Xanthium italicum MOR.		22.0	20.6	4.3	3.9	6.7	0.09	150.0	280.0	39.5	174.0	29.9	76.0	0.39
Chenopodium rubrum L.		47.0	8.0	1.7	5.0	2.2	0.28	306.0	1720.0	63.0	46.0	8.3	28.0	0.18
	Average I:	30.0	11.1	3.5	2.9	4.0	0.27	315.0	862.0	99.8	188.5	16.2	32.3	2.82
Agropyron repens P. B.	6.2	18.9	9.0	3.1	–	3.6	0.16	162,0	254.0	30.0	32.0	8.3	5.1	0.48
Plantago major L.		23.1	20.0	4.0	–	5.5	0.08	132.0	220.0	12.0	74.0	15.1	21.0	0.03
Prunella vulgaris L.		17.1	14.0	2.4	–	4.6	0.12	610.0	870.0	52.0	93.0	8.0	37.0	1.08
Rumex obtusifolius L.		34.5	9.2	4.0	–	2.5	0.08	74.0	181.0	20.0	46.0	12.0	28.0	0.51
Lycopus exaltatus L.		23.7	13.4	6.6	–	5.4	0.28	123.0	400.0	45.0	218.0	28.7	32.0	0.27
Aristolochia clematitis L.		27.0	17.2	2.9	–	4.8	0.12	200,0	348.0	35.0	122.0	17.9	44.0	0.25
Chrysanthemum vulgare (L.) BERNH.		27.0	18.0	3.7	–	2.9	0.08	248.0	410.0	90.0	158.0	16.9	36.0	0.31
Chrysanthemum serotinum L.		20.9	12.4	4.4	–	1.9	0.41	394.0	418.0	50.0	112.0	23.9	28.0	0.27
Potentilla anserina L.		23.1	14.0	4.2	–	6.4	0.08	153.0	252.0	40.0	78.0	12.9	44.0	0.60
Bidens tripartitus L.		18.9	11.8	5.4	–	5.7	0.16	222.0	166.0	41.0	160.0	19.2	47.0	0.28
Euphorbia lucida W. et K.		22.5	17.4	3.9	–	5.5	0.16	148.0	215.0	29.0	75.0	7.6	36.0	0.47
Chenopodium polyspermum L.		33.0	7.2	1.7	–	2.8	0.68	370.0	430.0	45.0	46.0	8.5	26.0	0.38
Symphytum officinale L.		53.1	16.8	4.1	–	2.7	2.50	209.0	370.0	22.0	76.0	16.6	42.0	0.17
Xanthium italicum MOR.		18.3	20.2	3.7	–	5.4	0.08	172.0	272.0	19.0	60.0	13.0	65.0	0.27
Heleochloa alupecuroides (PILL. et MITTERP.)		15.4	9.0	2.0	2.1	3.8	0.31	720.0	672.0	69.0	64.0	4.9	6.7	0.86
Setaria lutescens HUBBARD.		24.3	4.2	3.3	3.4	1.8	0.10	510.0	980.0	53.0	124.0	10.3	9.1	0.50
Echinochloa crus-galli P. B.		27.4	9.2	1.3	1.8	4.7	0.80	433.0	483.0	240.0	106.0	3.6	7.7	0.88
	Average II:	25.7	13.2	3.5	2.4	4.1	0.32	286.0	385.0	54.0	100.0	12.5	38.1	0.48
Flood-plain association	5,9													
Rubus caesius L.		10.0	10.5	2.6	4.4	4.1	0.10	241.0	385.0	54.0	62.0	12.2	36.0	1.62
Iris pseudacorus L.		27.6	24.0	1.9	2.5	1.0	0.56	124.0	150.0	19.0	19.0	4.3	22.0	0.13
Iris spuria L.		26.7	20.4	3.3	3.0	2.1	0.08	60.0	142.0	30.0	31.0	7.1	24.o	0.23

Lythrum hyssopifolia L.	9.3	8.8	1.9	2.9	2.9	1.88	221.0	230.0	110.0	89.0	8.1	20.0	0.35
Lythrum salicaria L.	14.6	22.0	1.9	3.8	5.6	0.44	180.0	420.0	570.0	700.0	6.7	22.0	0.44
Glycyrrhiza echinata L.	12.8	19.1	2.1	2.2	4.2	0.22	157.0	217.0	54.0	28.0	11.8	26.0	0.40
Tiphoides arundinacea DUM.	11.1	4.8	0.9	2.3	6.6	0.08	7.0	110.0	15.0	32.0	5.5	1.0	0.47
Lysimachia vulgaris L.	18.8	13.4	2.3	2.1	4.5	0.42	465.0	530.0	240.0	60.0	7.0	21.0	1.37
Althaea officinalis L.	5.7	28.4	1.7	6.2	7.9	4.80	615.0	517.0	33.0	30.0	7.3	49.0	0.46
Echinochloa crus-galli P. B.	26.7	4.4	3.6	2.8	7.8	0.56	134.0	189.0	24.0	108.0	11.4	9.0	0.53
Echinocystis lobata TORR. et GRAY.	22.0	23.8	3.2	4.4	6.7	0.08	76.0	545.0	75.0	162.0	10.9	47.0	1.04
Lycopus europeaus L.	21.2	19.4	5.8	2.8	7.0	0.44	199.0	462.0	53.0	400.0	12.7	29.0	0.58
Chenopodium polyspermum L.	31.6	10.1	1.9	3.4	4.6	0.74	384.0	430.0	52.0	44.0	10.2	29.0	0.42
Dipsacus laciniatus L.	8.4	12.0	4.1	2.9	2.0	0.08	213.0	183.0	21.0	32.0	9.3	23.0	0.04
Average:	16,7	15.8	2.7	3.3	4.8	0.75	220.0	322.0	97.0	128.0	8.2	27.0	0.58
Acid grassy associations 5.5													
Glyceria maxima HOLMBG.	19.8	3.4	3.1	2.0	3.5	0.16	67.0	149.0	32.0	28.0	6.2	4.0	0.43
Sparganium erectum L.	24.6	13.0	1.5	1.5	4.7	0.16	267.0	294.0	830.0	44.0	3.1	15.0	2.20
Carex grcilis CURT.	26.8	4.6	1.6	1.2	3.7	0.04	161.0	189.0	260.0	88.0	5.0	3.0	0.21
Schoenoplectus lacustris PALLA	7.2	4.2	0.6	0.6	3.6	3.00	254.0	276.0	400.0	20.0	7.5	25.0	16.30
Eleocharis palustris R. et S.	27.4	9.2	1.3	1.8	4.7	0.80	433.0	486.0	240.0	106.0	3.6	8.0	0.88
Typha latifolia L.	16.2	13.4	1.8	1.6	2.4	1.30	285.0	368.0	1800.0	20.0	5.8	11.0	1.60
Typha angustifolia L.	14.5	10.2	2.2	2.1	2.7	0.96	310.0	376.0	700.0	24.0	7.2	10.0	0.76
Sium latifolium L.	33.0	34.0	3.4	3.5	11.5	0.34	535.0	518.0	295.0	208.0	10.6	25.0	2.15
Average:	21.2	11.5	1.9	1.8	4.6	0.80	289.0	332.0	570.0	67.0	6.1	14.0	3.07
Acid grass average of the Tisza flood-plains, family:	18.4	6.7	1.6	1.7	2.5	1.65	150.0	263.0	449.0	45.0	5.5	13.0	1.88
Arborescent plants of forest association 5.6													
Amorpha fruticosa L.	10.5	13.2	2.4	1.0	2.3	0.07	152.0	208.0	59.0	37.0	17.6	39.0	1.09
Salix alba et fragilis L.	7.9	11.5	2.1	3.7	3.1	0.08	385.0	150.0	82.0	253.0	8.4	43.0	0.24
Populus canadensis MÖNCH.	9.2	15.2	1.9	3.5	3.5	0.05	91.0	160.0	50.p	301.0	11.7	72.0	0.29
Fraxinus pensylvanica MARSCH.	13.8	14.2	2.8	1.8	3.6	0.16	114.0	350.0	36.0	52.0	37.3	42.0	0.42
Acer pseudoplatanus L.	10.2	14.0	2.6	2.1	2.3	1.88	196.0	357.0	93.0	25.0	7.3	88.0	0.52
Salix triandra L.	8.4	15.0	1.9	3.7	3.8	0.06	306.0	412.0	225.0	340.0	8.6	45.0	0.34
Average:	10.0	13.9	2.3	2.6	3.1	0.38	207.0	273.0	91.0	168.0	15.2	55.0	0.48

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KÖZÉP-TISZAI HULLÁMTEREK NÖVÉNYTÁRSULÁSAI ÉS AZOK MEZŐGAZDASÁGI HASZNOSÍTÁSA

KOZMA A. és TÖLGYESI GY.
Állatorvostudományi Egyetem, Budapest

Kivonat

Szerzők a Középső-Tisza-i tájhoz tartozó Kiskörétől és Abádszalóktól délre, Pusztataksonyig húzódó hullámtéri területeket vizsgálták gazdasági hasznosíthatóságuk, valamint a növénytársulások makro- és mikroelemtartalma szempontjából. A folyópart és a hullámtéri területek talaja közepesen savanyú, friss öntés talaj. Humusztartalom 1—1,42%, a pH 5,3—5,6 (n KCL-ban mérve) között változik.

Szerzők megállapítása szerint a vizsgált területeket elsősorban erdőgazdaságilag hasznosítják és csak 10—12%-nyi gyepes terület az, amely kaszálással, illetve legeltetéssel kerül mezőgazdasági hasznosításra. Az intenzív nemesnyár telepítéssel erősen csökken az eredeti fűz-nyár-kőrises növénytársulás és lényegesen megváltozik az erdőtársulás cserje és gyepszintjének eredeti növénytakarója is. Az egyre gyakrabban felmerülő környezetvédelmi problémák miatt, a területet védetté nyilvánítása halaszthatatlan és indokolt!

A hullámtéri területek növénytársulásai növényfajainak makro- és mikroelemtartalmi vizsgálatai során a szerzők megállapították, hogy a parti és hullámtéri növénytársulások makro- és mikroelemtartalmi átlagértékei minden esetben elérték, sőt felül is múlták a jó minőségű rétiszénák átlagértékeit. Szerzők a növényfajokban 6 makro és 7 mikroelemet vizsgáltak meg kétszeres ismétlésben, tavaszi—őszi aszpektusban).

Biljne zajednice plavnih zona srednjeg toka reke Tise i njihovo korišćenje u poljoprivredi.

A. Kozma i Gy. Tölgyesi
Veterinarski fakultet, Budapest

Abstract

Autori su sa stanovišta makro i mikrosastava biljnih zajednica i mogućnosti ekonomskog korišćenja ispitivali plavnu zonu južno od Kisköre i Abádszalók do Pusztataksony, koje područje pripada srednjem toku reke Tise. Tlo plavne zone i obala reke je srednje kiselo. Vrednosti humusa su izmedju 1—1,42%, a pH 5,3—5,6 (merena u n KCL).

Autori su utvrdili da se ispitivano područje u prvom redu koristi u šumskoj privredi, a da livade zahvataju svega 10—12% površine, koja se u pogledu poljoprivrede koristi za proizvodnju sena, odnosno ispašu. Intenzifikacija monokultura topole jako smanjuje autohtone zajednice vrbe-topole-jasena uz istovremenu bitnu promenu i sprata šiblja i zeljastog pokrivača. Zbog sve aktuelnije problematike zaštite životne sredine, zaštita ovih područja je opravdana i ne trpi odlaganje.

Po pitanju makro i mikroelemenata biljnih zajednica autori su ustanovili da su oni u proseku, kako na obalnoj tako i na plavnoj zoni u svim slučajevima dostigli, pa čak i premašili ritske livade u kvalitetu. Autori su na dva navrata (prolećni i jesenji aspekat) utvrdili 6 makro i 7 mikroelementa.

Растительные сообщества пойм средней Тисы и их сельскохозяйственное использование

СА. КОЗМА Д. ТЁЛДЕШИ

Ветеринарный Университет, Будапешт

Резюме

Авторы проводили исследование пойменных территорий, относящихся к Среден-тисайскому краю, — от Кишкёре и дальше на юг, до Пустатакшоня, — с точки зрения их хозяйственного использования, а также макро- и микроструктуры растительных сообществ. Почва побережья и пойменные территории является среднекислой, свеженасыпной. Содержание гумуса в ней составляет 1—1,42%, а pH = 5,3—5,6 (в^{n} KCL).

Авторами установлено, что исследуемые территории используются в первую очередь как лесные хозяйства, и только 10—12 % дернистой территории используется в сельском хозяйстве на сенокос и как пастбище. Интенсивным насаждением благ.тополя можно значительно снизить преобладающее здесь растительное сообщество ива-тополь-ясень и существенно изменить кустарниковый состав лесных сообществ и первоначальный растительеый покров дёрна. Исходя из всё большей актуальности проблем защиты окружающей среды, объявление этих территорий заповедниками является обусловленным и не терпящим отлагательства!

В ходе анализа макро- и микроэлементарного состава разновидностей растительных сообществ авторы установили, что средние показатели макро- и микроэлементарного состава растительных сообществ побережья и пойм во всех случаях были не ниже, а часто и превышали средние показатели лугового сена хорошего качества. В разновидностях растений авторы исследовали 6 макро- и 7 микроэлементов в двух повторностях (весной и осенью).