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General review of the vegetation along the lower course of the Tisa river

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ABSTRACT: Important characteristics of recent autochthonous vegetation along the Tisa river are outlined. The investigations include aquatic, marsh, meadow, meadowsteppe and forest vegetation types.

KEYWORDS: vegetation, phytosociology, Tisa river, south Pannonian region - Vojvodina

This paper review all former knowledge about the vegetation concerning the unprotected plant of Potisje in Vojvodina (Yugoslavia), including the bank and adjacent vegetation.

Herbaceous Vegetation

Within the class *Lemnetea* W. KOCH et TX. 1954, order *Lemnetalia* W. KOCH et TX. 1954 and alliance *Lemnion minoris* W. KOCH et TX. OBERD. 1958 (vegetation of floating flowering plants), in shallow, stagnant water that usually dries up during summer, SLAVNIĆ recorded in 1956 association *Wolffio-Lemnetum gibbae* BENNEMA 1943 and *Riccietum fluitantis* SLAVNIĆ 1956 (in shady places among reed). The edificators of these phytocoenoses *(Wolffia arrhiza,* species of the genus *Lemna, Spirodela polyrrhiza)* present the most tiny anthophytes in vegetation of Potisje. After preliminary investigation of aquatic vegetation in Regional Park "Stari Begej", including river bed of Stari Begej and its flood areas, BUTORAC and STOJŠIĆ (1992) paid attention to association *Wolffietum arrhizae* MYAWAKI et TX. 1960 of this class. It includes floating species of small flowering plants found in this area (Stari Begej on the basin of the Tisa river) for the first time.

In water biotopes in Regional Park "Stari Begej", aquatic macrophytes were found for the first time belonging to the following associations: *Salvinio-Spirodeletum polyrrhizae* SLAVNIĆ 1956, *Lemnetum trisulcae* SOÓ 1927 and *Lemno-Utricularietum vulgaris* SOÓ (1928) 1938 (BUTORAC, 1992).

Vegetation of large macrophytes in stagnant and slow running fresh waters of the class *Potametea* TX. et PRSG. 1942 is united with the order *Potametalia* W. KOCH 1926 and alliance *Potamion eurosibiricum* W. KOCH 1926. Within this syntaxonomy category SLAVNIĆ described three associations characteristic of the region of Vojvodina: *Myriophyllo-Potametum* SOÓ 1934, *Myriophyllo-Nupharetum* W. KOCH 1926 *(syn.: Nymphaeetum albo-luteae* NOWINSKI 1928) and *Hydrocharo-Nymphoidetum peltatae* SLAVNIĆ 1956. The first one is specific for Pannonian depression being dependent on slow running and relatively warm waters of big plain rivers. On the basis of existing floristic characters SLAVNIĆ (1956) separates the sub-association *Myriophyllo-Potametum potametosum acuminati* SLAVNIĆ 1956 as a south Pannonian variant of the association. The other phytocoenosis (association of *Nuphar lutea)* is abundant in stagnant, shallow waters. In the ecological succession it is followed by *Hydrocharo-Nymphoidetum peltatae* SLAVNIĆ 1956 requiring a lot of organic detritus for its survival. Biological production of this vegetation type is relatively high, and it plays a significant role in overgrowing water biotopes and swamps.

On the area of present Regional Park "Stari Begej" (in the basin of the Tisa river) GIGOV and DJERFI (1960) noted four associations belonging to the class *Potametea.* Three of them are present today as well, exepting the association of *Myriophyllo-Potametum* SOÓ 1934 (BUTORAC, 1992). Data given by BUTORAC (1992) include further aquatics communities: *Nymphaeetum albo-luteae* NOWINSKI 1928 (syn.: *Myriophyllo-Nupharetum* W. KOCH 1926), *Hydrocharo-Nymphoidetum peltatae* SLAVNIĆ 1956 and *Trapetum natantis* MULLER et GORS 1960.

Stagnant brackish water vegetation (of continental mineral soils) is represented by associations of the alliance *Ruppion maritimae* BR.-BL. 1931, order *Ruppietalia* TX. 1960, classes *Potametea* TX. et PRSG. 1942. In shallow depressions, with soils of heavier mechanical composition, there are good conditions for association *Batrachio (aquatili)-Ranunculetum polyphylli* SOÓ (1933) 1961, according to SLAVNIĆ (1956). In shallower depressions the latter author separates association *Naiado-Potametum acutifolii.* Because the overgrowing of water basins on places with low salinity is a slow process, this association is present permanently. As the vegetation belonging to this order develops in the conditions of intensive insolation, it is the main cause of its gradual disappearing in deeper waters, where such compositions, according to SLAVNIĆ (1956) are gradually transformed into vegetation of association of the alliance *Potamion.*

The general character of the vegetation of the classes *Lemnetea* and *Potametea* is its occurrence in pools and swamps of Potisje, branches and stagnant meanders of the Tisa, as well as in the channels linking the Tisa with other rivers. We should emphasize that, during the water course regulation of the river Tisa in several past years, many habitats of the above phytocoenoses have been destroyed and their distribution is now more reduced in comparison to those mentioned by SLAVNIĆ (1956) in his paper titled "Vodena i barska vegetacija Vojvodine" (Aquatic and Marsh Vegetation in Vojvodina).

The above land reclamation measures and watercourse regulation significantly

reduced large swampy territories to a small area in the unprotected region of the Tisa covered with vegetation of helophytes of the class *Phragmitetea* TX. et PRSG. 1942. The largest part of the existing swamps are inhabited by associations of the order *Phragmitetalia* W. KOCH 1926, alliance *Phragmition communis* W. KOCH 1926. In the investigated area of the Tisa course association *Scirpo-Phragmitetum* W. KOCH 1926 is the most widespread, especially in habitats where water is stagnant for a longer period (according to PARABUĆSKI et al., 1989). Considering the difference in habitat ecology as well as the depth of water within the reed vegetation, the authors record the following sub associations: *Scirpo-Phragmitetum phragmitetosum* SCHMALLE 1939, *Scirpo-Phragmitetum typhetosum (angustifoliae-latifoliae)* SOÓ 1973 and *Scirpo-Phragmitetum bolboschoenetosum maritimi* UBRIZSY 1961 (slight soil salinity)(according to STOJANOVIĆ et al., 1987). In the north Banat region of Potisje (Miloševo - Novi Bečej)SLAVNIĆ reported in 1956 the following communities indicated as *Scirpo-Phragmitetum chrysanthemetosum uliginosi* with differential characters in relation to analogous vegetation in Hungary; but they have not been found during this research. PARABUĆSKI et al. (1989) point out that, within the ecological succession, reeds are followed by stands of the association of *Glycerietum maximae* HUECK. 1931 in deeper waters along the banks of Tisa. Its physiognomy is defined by the edificator, *Glyceria maxima,* which could be easily noticed near Sanad (in the vicinity of Novi Kneževac). This association is of the same syntaxonomy as the reeds. Association of *Polygono-Stratiotetum aloidis* SLAVNIĆ 1956 is included in the alliance *Phragmition communis* differencing the swampy vegetation of Vojvodina from that of central Europe. According to the authors of the association and according to the statements in paper "Prodromus vegetacije Vojvodine" (Prodromus of the vegetation of Vojvodina) (PARABUĆSKI et al., 1986) it represents a phytocoenosis of the most shallow river-bank zone of swampy vegetation in the whole Vojvodina. During the studies of vegetation in lower course of the river Tisa, this association has not been recorded which, to acertain extent, coresponds to observations made by STOJANOVIĆ et al. (1987) who found that it is of a limited distribution.

Vegetation of tall sedges (order *Magnocaricetalia* PIGN. 1953) along the Tisa belongs the alliances *Magnocaricion* W. KOCH 1925 and *Caricion gracilis* NEUHÄUSL 1959. The authors of the paper "Vegetacija donjeg toka Tise" (Vegetation of the lower Tisa river) (PARABUĆSKI et al., 1989) also report ass. *Heleocharo-Caricetum nutantis* R. JOV. 1958 within the former alliance, on drier soils and in contact zone with the association of *Glycerietum maximae,* while within the other alliance they record the association *Caricetum gracilis* R. TX. 1937. Contrary to the two previous phytocoenoses, the latter is of wider distribution, inhabiting the fringes or open spaces in autochthonous willow forests. Certain variations depending upon habitat conditions are found. According to the specific ecological conditions, that are followed by floristical composition, the authors of this paper separate three subassociations (Tab. 1):

- ***Caricetum gracilis salvinietosum natantis* subass. nova** (in the shallow stagnant waters and on the organic-mineral substrate when stagnant waters are retained),
- ***Caricetum gracilis rumicetosum hydrolapathi* subass. nova** (on the open places in auchthonous willow forest) and
- ***Caricetum gracilis lysimachietosum vulgaris* subass. nova** (fringes of autochthonous willow forest).

Tab. 1. Caricetum gracilis R. Tx. 1937

	salvinietosum natantis subass. nova			*rumicetosum hydrolapathi* subass. nova			*lysimachietosum vulgaris* subass. nova				
Relevé	1	2	3*	1	2	3*	1*	2	3	4	
Number of species	5	7	11	11	8	16	10	7	15	7	
Characteristic species of association											
Carex gracilis CURT.	1.1	1.2	+.2	4.2	2.1	3.3	+.2	2.2	1.2	+.2	V +-4
Diferential species of subassociation											
Salvinia natans (L) ALL.	4.4	3.3	3.4	-	-	-	-	-	-	-	II 3-4
Rumex hydrolapathum HUDS.	-	-	-	1.2	3.2	3.2	+	-	+.1	-	III +-3
Iris pseudacorus L.	-	-	1.2	-	3.2	3.2	-	1.1	-	-	II 1-3
Senecio paludosus L.	-	-	-	1.1	+.2	1.1	-	-	-	-	II +-1
Euphorbia palustris L.	-	-	-	-	1.2	2.2	-	-	-	-	I 1-2
Agrostis alba L.	-	-	-	2.2	-	1.2	-	-	-	-	I 1-2
Thalictrum flavum L.	-	-	-	-	+.2	1.1	-	-	-	-	I +-1
Lysimachia vulgaris L.	-	-	-	+	-	+.1	3.1	1.1	2.1	2.1	III +-3
Myosotis palustris (L.) NATH.	-	-	1.1	-	-	-	1.3	-	2.2	+.1	II +-2
Mentha aquatica L.	-	-	-	-	-	-	1.3	+.1	2.1	+.1	II +-2
Caricion gracilis, *Magnocaricetalia* et *Phragmitetea*											
Sium latifolium L.	-	+.1	2.1	+.1	-	3.2	1.1	2.2	1.1	-	IV +-3
Oenanthe aquatica (L.) POIRET in LAM.	+.2	+.2	1.1	-	2.2	-	1.2	-	1.2	-	III +-2
Alisma plantago-aquatica L.	+	-	+.+	-	-	+.1	1.1	-	1.1	-	III +-1
Rorippa amphibia (L.) BESS.	-	-	-	2.2	-	1.2	-	-	1.1	+.1	II +-2
Stachys palustris L.	-	-	-	-	1.1	2.1	-	2.1	-	3.1	II 1-3
Lythrum salicaria L.	+.1	1.1	-	-	-	-	+.1	-	1.1	-	II +-1
Heleocharis palustris (L.) R.BR.	-	+.2	1.3	+	-	+.2	-	-	-	-	II +-1
Lycopus europaeus L.	-	+	-	-	-	-	-	1.2	-	-	I +-1
Bidens tripartitus L.	-	-	+.1	-	-	-	-	-	-	1.1	I +-1
Typha angustifolia L.	-	-	1.2	-	-	-	-	-	-	-	I 1
Lysimachia nummularia L.	-	-	-	-	-	-	-	-	1.2	-	I 1
Solanum dulcamara L.	-	-	-	-	-	-	-	-	1.1	-	I 1
Alisma lanceolatum WITH.	-	-	-	-	-	-	-	-	+.1	-	I +
Scutelaria galericulata L.	-	-	+	-	-	-	-	-	-	-	I +
Companion species											
Polygonum hydropiper L.	-	-	-	1.1	-	1.1	-	-	-	-	I 1
Rumex crispus L.	-	-	-	-	-	-	+	-	+.1	-	I +
Lemna minor L.	-	-	-	2.2	-	-	-	-	-	-	I 2
Amorpha fruticosa L.	-	-	-	-	-	+.2	-	-	-	-	I +
Rubus caesius L.	-	-	-	-	-	+.2	-	-	-	-	I +
Rorippa austriaca (CRANTZ.) BESS.	-	-	-	+	-	-	-	-	-	-	I +

* - holotypus

These communities are rich in floristic elements and present the thickest herbaceous vegetation in more shallow depressions of forest clearings in unprotected course of the river Tisa.

Periodically flooded habitats between the banks of Tisa (i.e. the protecting zone of planted woods) and adjacent belts as well as the localities within the willow wood are covered with communities of damp floody meadows of the class of *Molinio-Arrhenatheretea* R. Tx. 1937, order *Deschampsietalia* Horvatić (1956) 1958 and alliance *Deschampsion caespitosae* Horvatić 1930. Parabućski et al. in their paper (1989) discusses only the alliance without mentioning the association, observing that the meadows are physiognomically characterized by species: *Scutellaria hastifolia, Lysimachia vulgaris, Thalictrum flavum, Thalictrum lucidum,* etc.

The embankments along the Tisa are inhabited by mesophytic vegetation of the order of *Arrhenatheretalia* Pawl. 1926 and alliance *Arrhenatherion elatioris* Br. - Bl. 1925, Koch 1926. They are anthropogenous, regularly mown meadows, floristically rich; they belong to ass. *Arrhenatheretum medioeuropaeum* (Scherr 1925 (non Br. - Bl. 1915)) - (according to Parabućski et al., 1989). Besides typically meadow plants, due to specific ecological conditions of the habitat (intensive insolation, porosity of slopes and exposition to the influence of continental climate and winds) in stands of this phytocoenosis there are also meadow-steppe elements of class *Festuco-Brometea* Br. Bl. et R. Tx. 1943. This xerphilous variant of the association is widespread along banks of Potisje while on their higher and more porous parts its presence is common.

Within the vegetation of temporary flooded habitats of the same class *(Molinio-Arrhenatheretea),* zoo-anthropogenous pastures with alliance *Agropyro-Rumicion crispi* Nordh. 1940 (order *Agrostietalia stoloniferae* Oberd. 1967) are spreading. These communities are also described by Parabućski et al. (1989) only at the alliance level, the following pasture species of this community being given by him: *Rumex crispus, Alopecurus geniculatus, Rorippa silvestris, Rorippa austriaca, Mentha pulegium* and some other weeds and ruderal plants.

Communities of meadow-steppe character are reported, though only exceptionally, on the highest parts of the embankments, and present the fragments of association *Coronillo - Festucetum sulcatae* Parabućski 1982 (according to Parabućski et al., 1989). They belong to the following higher syntaxonomic categories: *Festuco-Brometea* Br. Bl. et R. Tx. 1943, *Festucetalia valesiacae* Br. - Bl. et R. Tx. 1943, *Festucion rupicolae* Soó 1940. In the lowest part of its course the river Tisa crosses the loess plateau known as "Titelski breg" (=Titel hill), creating steep loess sections 121-130 m high, forming the right bank of the river. The highest parts of these sections are inhabited by vegetation of meadow-steppe character of alliance *Artemisio-Kochion* Soó 1959 (according to Stojanović, 1983), almost directly related to geological substate (typical loess) on slightly developed chernozem. They belong to association *Agropyro-Kochietum prostratae* Zólyomi 1958.

Forest Vegetation

The majority of autochtonous forests in the region of Potisje belong to the class *Salicetea purpureae* Moor (1958) 1960, order *Salicetalia purpureae* Moor (1958) 1960, alliance *Salicion triandrae* Malcuit 1929, Muller et Gors 1958 (non Br. - Bl.

1956) and *Salicion albae* Soó (1930) 1940. The communities of the former alliance are related to a primary forest association, *Salicetum triandrae* MALCUIT, 1929. They are found close by the running water of the Tisa on limited area (PARABUĆSKI et al., 1989). In floristical composition, in addition to *Salix triandra, Salix alba, Amorpha fruticosa* and some others are also important, while the herb layer is rather poor in floristical elements. The structure of the forest actually consists of two layers: one consists of low trees and shrubs, the other of herbs.

Among natural forest associations in the investigated unprotected area of the river Tisa, most common communities belong to the latter alliance *(Salicion albae),* described by SLAVNIĆ (1952) as association *Salicetum albo-amygdalinae* (syn.: *Salicetum albae - fragilis* Soó 1971). These forests have a distinct tree layer, with a poor diversity of plant species due to predominance of silky willow *(Salix alba).* Shrub layer exists only in some communities, consisting of *Fraxinus lanceolata, Fraxinus americana, Amorpha fruticosa* etc. Vegetation of periodically flooded forests of alliance *Alno-Quercion roboris* HORVAT 1938, order *Populetalia albae* BR. - BL. 1931 and class *Querco-Fagetea* BR. - BL. et VLIEGER 1937, consists of very sparse fragments of association *Fraxino-Ulmetum effusae* SLAVNIĆ 1952, found only exceptionally. This vegetation has been substitused by floristically poor and degraded communities of poplar wood ass. *Populetum nigro-albae* SLAVNIĆ 1952 (according to PARABUĆSKI et al., 1989). They appear like spots among wide spread Euro-American poplars, willows and American ashes.

Generally, it can be said that forest vegetation in the lower course of the Tisa consists mainly of anthropogenic phytocoenoses with simple structure, poor floristic diversity and no specific characters. Contrary to this, fragments of autochthonous forests (as well as recent herbaceous vegetation) though with limited distribution, retained to some extent its basic characters.

Summary

The results of the investigation of autochthonous vegetation of lower part of the Tisa river are presented. The investigations included aquatic, marsh, meadow, meadow-steppe and forest vegetation.

Genesis and survival of floristic composition of the associations of class *Lemnetea* is conditioned by characteristics of water environment, where leading ecological factors are water depth, eutrophicity, light and thermic regime, slow or none waterflow and other changing parameters of water regime. This vegetation is represented by the associations *Wolffietum arrhizae, Salvinio-Spirodeletum polyrrhizae, Lemnetum trisulcae, Lemno-Utricularietum vulgaris* and *Riccietum fluitantis.*

Vegetation of the class *Potametea* includes the aquatic communties of two order. Order *Potametalia* and alliance *Potamion eurosibiricum* is represented by the vegetation of large macrophytes in stagnant and slow running fresh water. They are flotant communities: *Myriophyllo-Potametum potametosum acuminati, Nymphaeetum albo-luteae* (syn.: *Myriophyllo-Nupharetum), Hydrocharo-Nymphoidetum peltatae* and *Trapetum natantis.* Stagnant water vegetation of continental saline soils is represented by associations *Batrachio (aquatili) - Ranunculetum polyphylli* and *Naiado-Potametum acutifolii* of alliance *Ruppion maritimae* and order *Ruppietalia.*

The present marsh vegetation on the largest complexes include reed thickets (= ass. *Scirpo-Phragmitetum).* The division to subassociations: *phragmitetosum, typhetosum (angustifoliae-latifoliae), bolboschoenetosum maritimi* and *chrysanthemetosum uliginosi* is in correlation with the synecological conditions of the sites. *Scirpo-Phragmitetum chrysanthemetosum uliginosi* is characterized by the presence of species with differential character in relation to analogous vegetation of Central Europe. This marsh vegetation of class *Phragmitetea* includes stands of associations *Glycerietum maximae, Heleocharo-Caricetum nutantis* (with florogenetic and ecological similarity with marsh vegetation valley of Velika Morava) and *Caricetum gracilis.* Floristical composition and other characteristics of the association *Caricetum gracilis* on localities analyzed are the variations depending upon habitat conditions, indicated as: *salvinietosum natantis subass. nova, rumicetosum hydrolapathi subass. nova* and *lysimachietosum vulgaris subass. nova* (Tab. 1).

Periodicaly flooded habitats between the banks of Tisa and its embankments are covered with fragmentarily developed stands of the community of the allinace *Deschampsion caespitosae* (order *Deschampsietalia* and class *Molinio-Arrhenatheretea).* Vegetation of the above class includes also two associations, *Arrhenatheretum medioeuropaeum* (alliance *Arrhenatherion elatioris* and order *Arrhenatheretalia)* with typical meadow character and zoo-anthropogenous pastures alliance *Agropyro-Rumicion crispi* (order *Agrostietalia stoloniferae).*

Meadow-steppe vegetation is composed of the stands of two communities of the class *Festuco-Brometea* and order *Festucetalia valesiacae.* On the highest parts of the embankments another community is found in fragments, *Coronillo-Festucetum sulcatae* of alliance *Festucion rupicolae.* The stands of the association *Agropyro-Kochietum prostratae* (alliance *Agropyro-Kochion)* are developed at the edge of the loess plateau of Titel hill wich partly forms the right bank of the Tisa river.

The majority of autochthonous forests in the region Potisje belong to the following higher syntaxa: *Salicetea purpureae, Salicetalia purpureae, Salicion triandrae* and *Salicion albae.* Auchthonous forests have very limited distribution only the associations *Salicetum triandrae* and *Salicetum albo-amygdalinae* (syn.: *Salicetum albae-fragilis),* have been preserved.

Vegetation of periodically flooded forests of the alliance *Alno-Quercion roboris (Populetalia albae, Querco-Fagetea)* consists of very small fragments of association *Fraxino-Ulmetum effusae.* This vegetation has been substituted by degraded stands of poplar wood - ass. *Populetum nigro-albae.* They appear like spots among common Euro-American poplars, willows and American ashes.

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