

Additional information

Ecological features:

Due to the sedimentation of the new layers, in a prograding succession, this association in time shifts into the white willow association, with which it is usually in spatial

and ecological contact. The white willow association (Ass. *Salicetum albae pannonicum* Parabućski (1965) 1972) also represents a pioneering forest association, which occurs on banks of ponds and river arms. The white- and black poplar association (*Salici-Populetum nigrae* Parabućski (1965) 1972) is developed on banks of the Danube, on islets, and on banks of river arms. It represents a pioneering association on sand deposits, which, due to the intensive covering and sedimentation of large quantities of deposits, quickly rises above the regular reach of flood waters. The white poplar and Hungarian hawthorn association is developed on ridges, the direction of which corresponds with that of river arms, as well as on elevated areas of the terrain in swales overgrown with swamp vegetation. The basic physiognomic feature of the stands from this association is the white poplar - *Populus alba*. However, the greatest significance as the differential species has the Hungarian hawthorn - *Crataegus nigra*, a Pannonian sub-endemic species that is in the same time the characteristic species of this association. This association is specific for hydrophilous, marsh forests of Podunavlje and Posavina. The common elm association (Ass. *Ulmum campestre* Parabućski (1965) 1972) is developed on high ridges, which are built of alluvium with a large content of sand. The distribution range of its stands is small. Floristically, the common elm dominates, followed by, in order of significance, white poplar, common oak, black poplar, white willow, narrow-leaved ash etc. The common elm also occurs in the bush layer, along with the viburnum, black poplar, desert false indigo, common dogwood, blackthorn etc. This is the association that has the narrowest amplitude in relation to flooding in the area of Koviljski Rit.

Anthropogenous forest communities – Large areas in Koviljski Rit are occupied by planted forests of Euramerican hybrid poplars. They were planted on various places, from lowest to highest ridges, and, related to that, the soil humidity and other ecological factors vary in their intensity. Being careless about this, man has, in his effort to build trees that grow quickly in short time, planted the same species in different habitats. These were mainly *Populus euramericana* and *Fraxinus americana*. Only the forests of white poplar were planted on proper habitats (low and wet places), and they do not differ in any aspect of species or habitat characteristics from natural forests.

Aquatic and swamp vegetation – Submersed and floating stands represent the aquatic vegetation of the analysed area, and they belong to different more or less complex associations from several alliances and orders in scope of the classes *Lemnetea*, *Utricularietea intermedio – minoris*, *Ceratophylletea*, *Ruppialia*, *Potamogetonetea*, and *Nymphaeetea*.

Surfaces of shallow ponds, inshore areas of oxbows and river arms, and slow-flowing channels are covered with associations of lesser duckweed, water ferns and mosses, as well as of the common bladderwort (*Lemno minoris-Spirodeletum polyrrhizae*, *Lemnetum minori – gibbae*, *Salvinio-Spirodeletum polyrrhizae*, *Lemno minoris-Azolletum filiculoides*).

Different from these floating associations, the stands *Lemnetum trisulcae* *Lemno minoris* - *Riccietum fluitantisi* and *Lemno-Utricularietum vulgaris* are associated with shallow waters overgrown with dense stands of tall emerged species *Phragmites communis* (reed). The association of hornwort, pondweed and spiked water-milfoil (*Potamogetono* – *Ceratophylletum demersi*, *Myriophyllo-Potametum*, *Najado* – *Potametum acutifolii*, *Potametum lucentis*, *Hottonietum palustris*), which are species of submersed aquatic vegetation type, is associated with calm, deep, and relatively warm water such as the water in river arms and ponds. A specific phase in the process of natural overgrowing of ponds and river arms that have lost their permanent connection with the mainstream is the association of frogbit and water-lily – *Hydrochari-Nymphoidetum peltatae*. The association of spiked water-milfoil and pond-lily (*Myriophyllo* – *Nympharetum*) is frequent in standing waters, and it decorates the ponds with large white water lily and yellow pond lily - *Nymphaea alba* and *Nuphar luteum*. The association *Trapetum natantis* in Koviljsko- Petrovaradinski Rit has a smaller distribution range. The association of submersed small pondweed was found not only in Karlovački Dunavac, but in the following ponds: Sarka,

Carinova, and Svinjaruša. It is marked by the characteristic edicator species – the shining pondweed, after which the entire association is named *Potametum lucentis*.

Swamp stands from higher syntaxonomic categories in scope of the class *Phragmitetea* are of the tall, emerged vegetation type. Reed association habitats are related to low terrains of the former Danube river arms, as well as of the river arms that are being intensively covered, and where the soil is of the pond alluvium type. Stands in which reed and sedge dominate occupy smaller areas in this marsh, and, depending on how long the water stays, either the reed (*Phragmitetum communis*), cattail (*Typhaetum latifoliae*, *Typhaetum angustifoliae*) or bulrush (*Scirpetum lacustris*) dominate. A special feature of the reeds in Petrovaradinski Rit are the stands distinguished by the species *Tanacetum serotinum* (syn: *Chrysanthemum serotinum*; *Chrysanthemum uliginosum*). The associations of tall sedges give the characteristic look to ponds, covering their surfaces (*Caricetum gracilis*, *Caricetum elatae*). The association *Glicerietum maximae* is developed in fragments.

Vegetation of silty banks – It is represented by the class *Isoeto-Nanojuncetea*, order *Nanocyperetalia*, and alliance *Nanocyperion flavescens*, and it includes semi-aquatic associations that inhabit silty banks of ponds and river arms, namely the habitats from which the previously dominating aquatic vegetation has retreated. These are ephemeral phytocoenoses since their development lasts shortly, from the end of the summer until the middle of the autumn, which is associated with the medium and low water levels of the Danube. The following associations were described: *Dichostylidi-Gnaphalietum uliginosi*, which is characterised by species of small growth and short vegetation period, *Marsilio-Heleocharetum palustris* and *Heleocharetum acicularis*. The association *Marsileo-Heleocharetum palustris* (the association of the four-leaved clover and common spikerush) occurs after the water has withdrawn from the Krčedinska Ada islet, and *Marsilea quadrifolia* on such places builds a dense cover resembling a green carpet. On the banks of river arms, where the covering is intensive and the quantity of sand deposits large, the stands of the needle spikerush association were found - *Heleocharetum acicularis*. The characteristic and, in the same time, the most important species of this association is *Heleocharis acicularis* (needle spikerush).

Meadow vegetation – It occurs on clayed-sandy soil, in the zone of periodically flooded banks of ponds and river arms. It is conditioned by fluctuations of ground- and flood waters in the beginning of the vegetation period, when the substrate is very moist, as well as by the fact that the soil is completely dried until the autumn when it becomes compact. The

natural potential vegetation of these habitats is represented by occasionally flooded forests. The space for the new secondary vegetation, whose stands belong to the associations of the class *Molinio-Arrhenateretea*, is created by their cutting. In scope of this class, only degradation stages of meadows from the order *Agrostietalia stoloniferae* and the alliance *Agropyro-Rumicion crispae* are developed. A particular association is that of the quackgrass and narrow-leaved meadow-grass - *Agropyro-Poaetum angustifoliae*.

The vegetation of flood meadows is also represented by spatially limited stands of slender tufted-sedge and fowl bluegrass associations (Ass. *Carex gracilis - Poa palustris*, Ilijanić, 1967 – from the alliance *Molinion caeruleae* W. Koch, 1926). Its floristically rich stands are developed in fragments on wet habitats of low ridges, which are exposed to floods shortly during spring, and which are in immediate contact with reeds and swales or forest stands on higher ridges. The stands of wet meadows are from the order *Deschampsietalia*, alliance *Deschampsion caespitosae*.

Nitrophilous vegetation - It includes weeds on arable lands, vegetation around human habitats, near stables and watering places, and along roads and levees, vegetation of pastures overgrown with weeds and vegetation on pond banks. Nitrophilous vegetation on pond banks belongs to the central-European type, i.e. to associations from the alliance *Bidention tripartiti*, order *Bidentetalia tripartiti*, and class *Bidentetea tripartiti*. This is the vegetation of heavily trampled, wet habitats, which are silty and humid during most of the year, and they desiccate at the end of the vegetation period, becoming dry, hard, and dense. The association *Agrostideto-Polygonetum hydropiperi* (the association of the common sundew and marshpepper knotweed) is found on the banks of river arms that are filled with river water already during the medium water levels of the Danube. At typical swampy places around standing waters (ponds), and not around running waters (river arms), the alliance from the association of the three-lobe beggarticks and common silverweed *Bidenteto-Potentilletum anserinae* has found conditions for its development. It occurs on elevated terrains, in contact with meadows. The vegetation of sands on high ridges is closest to the weed vegetation of grains from the class *Secalietea*. It belongs to the order *Eragrostietalia* and alliance *Consolido-Eragrostion poidis*. The specific association of this type of vegetation is the association *Cynodonto-Erodietum cicutariae*.

Noteworthy fauna:

Invertebrates

A total of 158 species of zooplankton were recorded in Koviljski Rit, of which 25 species of Protozoa, 104 species of Rotatoria, 18 species of Cladocera and 11 species of Copepoda.

The bottom fauna (Oligochaeta) comprised 12 species from 8 genera and 2 families.

The mosquito larvae (Diptera, Culicidae) are present in water and in extremely wet habitats, as well as mayfly (Ephemeroptera), dragonfly and damselfly (Odonata) larvae, water beetles (Coleoptera: Dytiscidae, Gyrinidae, Hydrophilidae, Hydraenidae, etc.), e.g. great diving beetle and water scavenger beetle, aquatic Hemiptera (Notonectidae, Nepidae, Corixidae, Gerridae, Veliidae), e.g. water scorpion and water stick-insect etc. Among hoverflies of swampy meadows there are rare species such as *Epistrophe melanostoma* and *Neoascia interrupta*.

Vertebrates

Ichthyofauna

Among the most important fish species, from the aspect of fish conservation, are the Eurasian ruffe (*Gymnocephalus cernuus*), weather loach (*Misgurnus fossilis*) and bitterling (*Rhodeus sericeus amarus*).

Of allochthonous species, the following are present in this area: the crucian carp (*Carassius auratus gibelio*), topmouth gudgeon (*Pseudorasbora parva*), brown bullhead (*Ictalurus nebulosus*) and pumpkinseed (*Lepomis gibbosus*).

Herpetofauna

A total of 11 species of amphibians (class Amphibia) were recorded in Koviljsko-Petrovaradinski Rit. The most frequent components of the batrachofauna are three species from the family *Ranidae*: *Rana kl. esculenta* (green frog), *Rana lessonae* (pool frog) and *Rana ridibunda* (marsh frog), which are also the most important species in the food webs of pond-swamp habitats. Newts (*Triturus vulgaris* and *Triturus cristatus*) are present among tailed amphibians.

Seven species of reptiles (class Reptilia) were recorded: the European pond turtle (*Emys orbicularis*), grass snake (*Natrix natrix*), dice snake (*Natrix tessellata*), lizards (*Lacerta agilis*, *Lacerta viridis*, and *Podarcis muralis*) and Aesculapian snake (*Zamenis longissima*).

Ornithofauna

The universal asset of the ornithofauna of Koviljsko-Petrovaradinski Rit comprise 206 species of birds. Of this number, 94 species are recent nesting species, and others are transient species, winter guests and irregular and possible visitors. Among important species are the black kite (*Milvus migrans*) and ferruginous duck (*Aythya nyroca*). Three mixed colonies of herons and cormorants are currently known within the protected area, in Kozjak, at the rim of the Krčedinska Ada islet, and in Petrovaradinski Rit (Karlovačka Bara). The colony in Kozjak is old, and the following species have nested there depending upon the research period: the spoonbill, grey heron, little egret, and great cormorant. The colony at the western rim of the Krčedinska Ada islet was formed during the year 2000, and around 60 pairs of the great cormorant are nesting there. In the colony in Karlovačka Bara, the night heron (*Nycticorax nycticorax*) is nesting.

Theriofauna

The diversity of natural conditions necessary for the survival of mammals is preserved in this area, particularly of those associated with aquatic and swamp habitats, reeds and marsh forest, such as the Miller's water shrew (*Neomys anomalus*), European wildcat (*Felis silvestris*), stoat (*Mustela erminea*) and martens (*Martes martes*, *M. foina*).

Ecosystem services:

Social and cultural values:

The social and cultural life of the local inhabitants in the surrounding settlements is greatly associated with the wetlands. This association reflects mainly through fishing, usage of forests and cattle breeding. The everyday activities of many inhabitants of Kovilj, Gardinovci, Petrovaradin and Sremski Karlovci are even today still linked with the wetlands. Most numerous among them are fishermen, who also come from the wider surroundings. Some commercial fishermen occasionally live in huts in the wetland. The significance of the marsh for cattle breeding is particularly noticeable in Kovilj, where there is even an association of cattle breeders. The Krčedinska Ada islet is the most important cattle breeding stronghold since it does not have a connection with the mainland, and the majority of the cattle is kept there, wandering around freely. Frequent changes of the ownership, along with the several centuries long usage of the marsh by local inhabitants,

even today have the consequence of frequent cases of forest theft, and fish and game poaching.

The most important historical event associated with this area is the Battle of Petrovaradin, also known as the Battle on Vezirac, which happened in 1716 at the edge of Petrovaradinski Rit. This was one of the important battles in Austrian-Turkish wars, in which the Austrian-Hungarian army under the command of Prince Eugene of Savoy defeated the Turkish army led by Damad Ali Pasha. In honour of the victory, the Church of Snowy Mary was built on the lookout above the marsh. There is a legend that a huge Turkish treasure lies sunken at the bottom of the marsh.

In immediate vicinity of the marsh is the settlement of Sremski Karlovci, the seat of the Serbian Archbishopric in the 18th century, which today represents an important cultural-historical complex.

At the left river bank, near the marsh, is the Monastery of Kovilj, which is protected by the State as a cultural monument.

Current scientific research and facilities:

The vicinity of Novi Sad, which represents an administrative and university centre, is an important reason for which this area is one of the most extensively studied wetlands in Serbia. Natural assets and biota of Koviljski Rit were the subject of many scientific and expert studies, as well as bachelor and master theses. Particularly numerous were the studies of the flora and vegetation, as well as of the zooplankton, ichthyofauna and ornithofauna. The period of the most intensive research was in the second half of the 20th century. Recently, the extent of research has decreased, but the effects of mosquito control products on biota, first of all fishes, amphibians and birds, are regularly monitored.

Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

The Institute for Nature Conservation of Serbia and the Management Authority, the Public Enterprise "Vojvodinašume", permanently inform the local community, all interested parties and users of the natural asset on values and importance of conserving "Koviljsko-Petrovaradinski Rit". Information boards are placed within the Reserve near Kovilj and Petrovaradin. Workshops are organized in Kovilj and Sremski Karlovci, as well as free public lectures, with topics on the conservation improvement of the Reserve and on the influence of invasive species.

Current recreation and tourism:

Tourist routes and lookouts were traced during the period 2005-2008, and information boards were placed. The recreational fishing is the main purpose of visits to this area. It is present on all waterbodies, and the visitors are both from the places around the wetland and from the wider surroundings. A significant number of sport fishermen stay camping for a longer periods in the marsh during the summer. A part of the marsh named Šlajz, near Kovilj, is used during the summer as a local swimming place. The entire area is famous for its *csárda*-type taverns, tambura players, and fish soup. The most famous is the *csárda* tavern "Na kraj sveta" (*At the end of the world*), whose onetime owner, Pera Varenika, became the world champion of fish soup cooking in a competition in Vienna in 1986.

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