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## EVALUATION OF GEODIVERSITY OF THE WESTERN BAČKA DANUBE REGION IN THE PLANNING DOCUMENTS AND OPPORTUNITIES FOR IMPROVEMENT

**Abstract:** In the contemporary concept of nature preservation, the preservation of geodiversity slowly becomes normative, although geodiversity is still considered as a geotope in the function of biotope. Because of that it was analyzed geodiversity in the protected areas and the areas earmarked for protection in the Western Bačka Danube Region, in refer to five municipalities along the Danube (Sombor, Apatin, Odžaci, Bač and Bačka Palanka). Selected area is recognized by two protected natural assets – special nature reserve “Gornje Podunavlje” (Upper Danube Basin) and “Karadordevo” represent unique wetland of flood plains in the Danube Region. Within the scope of its main values, it hasn't been selected many localities that are typical for plain morphology. Within the scope of geodiversity of the region, 11 sites belong to the potentially protected areas, differing in type, genesis and morphology. A better approach to their evaluation can be achieved by a local action plan for geodiversity.

**Key words:** geodiversity, geoheritage, land planning, conservation, Bačka

### Introduction

A long tradition of the nature protection based on the specific geological and geomorphological phenomena (Salisbury Crags, Scotland – 1819; Siebengebirge, Germany – 1836; Yellowstone, USA - 1872) has not had a lot of influence on the contemporary trends of nature protection (Gray, 2004). This statement points out a disturbed balance within the nature protection policy where the protection of all living things is primary if compared to the protection of inanimate nature. Even the popularisation of the notion geodiversity, used to describe the diversity of abiotic nature, during the 1990s, has not balanced the protection of biodiversity and geodiversity. More precisely speaking, geodiversity and elements of geoheritage have most frequently been described as geotopes in the function of biotopes and as such represent habitats. (Mijović et al, 2005).

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Despite the fact that the first decision document about putting under protection a natural site by the Institute of Nature Protection of Serbia was made in 1949 and included the protection of waterfalls Mala Ripaljka and Velika Ripaljka on the mountain of Ozren near Sokobanja, showing the importance of the protection of inanimate nature in the nature protection of Serbia (Janković et al, 1998), it still leaves the impression that this kind of protection is also marginalised and neglected in our country.

Similar tendencies can be seen in the example of the region of the Western Bačka Danube Basin, more precisely in the example of the Danube region to the border of Hungary near Bačka Palanka, which covers the area of five municipalities: Sombor, Apatin, Odžaci, Bač and Bačka Palanka. Although this area has already been famous for the designated natural heritage, mainly for the special nature reserves "Gornje Podunavlje" ("Upper Danube Basin") and "Karadorđevo", this region possesses a list of geodiversity sites which would in the future receive a protected status, even for the reason of the improvement of the environment.

### **The diversity of abiotic nature of the Western Bačka Danube Basin**

In the analysis of basic landscape characteristics of the Western Bačka, two landform entities are prominent: the alluvial plateau of the Danube and the Bačka Loess Terrace.

The alluvial plateau of the Danube has two levels. The higher represents an alluvial terrace, and the lower inundation plateau. The alluvial terrace stretches to the west of the Bačka Loess Terrace and is sloping towards the Danube. Its beginning is marked at the imagined line Bogojevo-Karavukovo and is descending to Plavna and Mladenovo. The main surface flow of this area is the river Mostonga, channelled in the first half of the twentieth century. The inundation plateau of the Danube is situated between the river bed and the alluvial terrace. Its borders feature gentle slopes 2 to 5 metres high. In the area, a larger number of depressions and embankments, which interchange, depicting a picturesque character of microrelief, occasionally filled with water. There are numerous ponds and lakes, as well as abandoned river beds. These features are especially prominent for Sonćanski rit (also known as Apatinski rit).

The loess terrace, more precisely its western part - within the region of Bačka, spreads between the Bačka Loess Terrace and the alluvial plateau of the Danube. The relative height above the alluvial plateau is 5 to 6 metres, with a line of

settlements because of which it is called "Town Terrace" in geographic reference books.

The morphology of the terrain, the first and second natural site, is prominently determined by the flow of the rivers Mostonga and Plazović, whose individual parts are situated in the protected assets of the area. Both rivers have lost their original features and their appearance and regime are more a result of anthropisation, than natural processes and phenomena.

In the Western Bačka Danube Basin, two biggest and most important protected natural sites:

- Special nature reserve "Gornje Podunavlje" (Upper Danube Basin) has been declared in 2001 (Official Gazette of the Republic of Serbia No. 45/2001), spreads on the area of 19 648 ha, comprising the areas of the municipalities of Sombor and Apatin;
- Special nature reserve "Karađorđevo", declared in 1997. (The Official Gazette of the Republic of Serbia, No. 37/1997) covering the area of 2 955 ha, on the territories of the municipalities Bač and Bačka Palanka.

These protected areas mainly represent the last remnants of the flood plains in the Bačka Danube Region. The appearance of microrelief with interchanging depressions and embankments are of key importance for the collection of the flood wave of the Danube, which maintains the fundamental values of the ecosystems in the Apatinski rit (Upper Danube Basin) and the Bukinski rit (Karađorđevo). The river Mostonga flows across the strip Guvnište - Vranjak, comprising the fragments of wetlands in the vicinity (Stojanović, 2005).

Although according to the protection regulations of these reserves, the importance of the original features being preserved has been emphasized, as well as the imminence of the hydrological conditions, a detailed evaluation study of the elements of geodiversity has not been conducted.

Similar situation of neglecting fundamental features of geodiversity in terms of its assets, usage and total evaluation, has been observed in natural entities earmarked for assessment and protection.

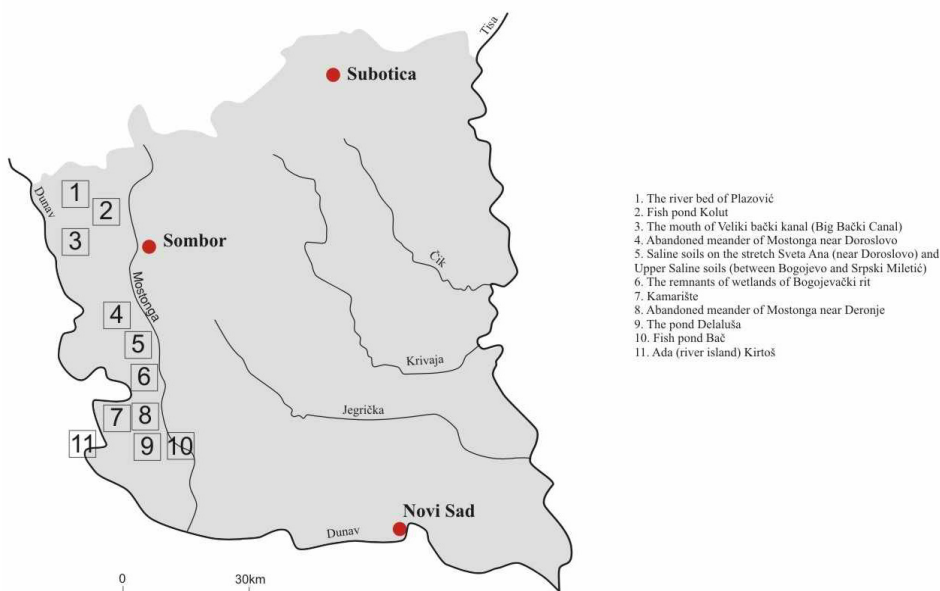


Figure 1. Geographical position of important geodiversity sites in potentially protected natural sites in the Western Bačka Danube Basin.

Interestingly, in the Inventory of the Geoheritage of Serbia (eds Karamata and Mijović, 2005) not one sites has been found in the subject matter.

### **The geodiversity sites in the potentially protected regions**

Based on the documents of the Institute for Nature Protection of Serbia, done for the purpose of spatial planning of the municipalities of Sombor, Odžaci, Bač and Bačka Palanka, a more detailed insight has been offered about the sites earmarked for protection. The list includes a total number of eleven sites with a dominant feature of abiotic nature, representing geodiversity in this part of Bačka (map 1, table 1).

*The river bed of Plazović.* Plazović<sup>1</sup> is situated mainly in Hungary. The river source is to the east of Baja and consists of two streams: Bačkokodski and Bačalmaški, which are united in Vojvodina near Ridica. In the area between Serbia and Hungary, the river is extremely meandering and is intersected by the

<sup>1</sup> Kidoš is a Hungarian name for this river.

border seven times. In the northwestern Bačka, Plazović flows from north to south, parallel with the Danube.

Table 1. A list of the most important geodiversity sites on the list of the potentially protected natural sites in the Western Bačka Danube Basin

No	Site	Municipality	Short description
1.	The river bed of Plazović	Sombor	Meandering flow of a typical lowland river.
2.	Kolutski ribnjak (fish pond)	Sombor	Flood plain of the river Plazović, whose depression contains a fish pond today.
3.	The mouth of Veliki bački kanal (Big Bački Canal)	Sombor	The bed of the canal with the confluence of Plazović and a stretch of wetlands on the left bank.
4.	Abandoned meander of Mostonga near Doroslovo	Sombor	Meander of the river Mostonga left after its channelling.
5.	Salt marshes on the stretch Sveta Ana (near Doroslovo) and Upper Salt Marsh (between Bogojevo and Srpski Miletić)	Sombor Odžaci	The heath with saline soil, with a specific microrelief.
6.	The remnants of wetlands of Bogojevački rit	Odžaci	Reeds landscape, with an embankment in the dammed area, with alluvial lakes.
7.	Kamarište	Odžaci	Inundation plain of the Danube, with the river bed of a small river Živa and Lake Provala.
8.	Abandoned meander of Mostonga near Deronje	Odžaci	Meander of the river Mostonga left after its channelling.
9.	The pond Delaluša	Odžaci Bač	Pond depression in the developed stadium of overrunning.
10.	Fish pond Bač	Bač	Lake complex to the west of the channelled Mostonga, functioning as a fish pond.
11.	Ада (river island) Kirtoš	Bač	The Danube river island sedimented in the meandering river flow.

The total length of Plazović is 126.47 km, and in our country 52.47 km. High watertable is present in spring, when pond vegetation is booming, making a waterflow more difficult. In summer, there have been the cases of river drying out (Tomić et al, 1996).

Plazović in the length of 4 km flows through the area of SNR "Gornje Podunavlje" (Upper Danube Basin), where the width of the river valley is 80 to 100 metres, and of the river bed 3 to 4 metres.

*Kolutski ribnjak.* Fish pond "Kolut" is situated in the territory of Koluta and represents a former part of the flood valley of Plazović. In this area there was one big depression and several smaller flood depressions. Most probably, this was Kolutska pond, one of many in the vicinity of Sombor.

*Part of the flow of Veliki bački kanal.* Veliki bački kanal (Big Bačka Canal) is part of the channel network Danube-Tisza-Danube. From Bački Monoštor to Vrbaš it is cut into the higher grounds of the loess plateau, and from Vrbaš in the bed of Crna bara. One part of its flow, upstream from the part earmarked for protection, is protected under the second degree regime of protection as part of SNR "Gornje Podunavlje". Downstream from the border of the reserve, the canal flows into Plazović. From this point onwards, comprising the big meander, on the left bank of canal, there is a strip of wetlands. Taking into account of those facts, this landscape is one of the most important hydrological characteristics of the western part of the loess terrace in Bačka.

*The abandoned meander of Mostonga near Doroslovo.* Mostonga is on the three most important rivers in Bačka, which flows along the entire western Bačka. Mostonga has a dispersed source which is formed in several depressions in the northwestern part of Bačka. The main source is near Ridica. The ponds which create it, are referred to by different names: Severna Mostonga, Koć Mostonga, East Mostonga, Šikara Mostonga. Although in the period of high watertables they have a tendency to flow toward the south, in the northern part they still do not form a real river flow. This happens only a few kilometres to the north of Sombor, where the streams are united thus forming a single riverflow (Milošev, 1998). Going around Sombor from the western and southwestern side, the river flows towards the south up to Mladenovo, where it flows into Bukinski rit. Its flow in the sector from Sombor to Bač is channelled and connected to the network of the Hydrosystem Danube-Tisza-Danube. Because of this, and other meliorative and regulative works, this river and its regime do not exist in their original features.

The abandoned meanders of Mostonga are situated to the north east of Prigrivica, then next to Doroslovo, Deronje and Bač, and almost all of them are in a very bad state. Because they represent a landscape testimony about former characteristics of the flow of Mostonga, two of the total of four meanders are on the list of potential natural heritage properties.

*Salt marshes on the stretch between Sveta Ana (near Doroslovo) and Upper Salt Marsh (near Bogojevo and Srpski Miletić).* In the area between the Danube and the former bed of Mostonga, in the surroundings of the settlements of Sonta, Doroslovo, Bogojevo and Srpski Miletić, there is a stretch of saline soils with solončak as the dominant soil type. These soils have a decreased saline quantity, because of which they are overgrown with more diverse and richer vegetation, getting green in spring, and completely dry in summer. Grazing land is often used. The relevant reference books leave an impression that the biological reference is more abundant than the geographical, despite the fact that biogeographical research could produce a more thorough review. Salt marshes often have an outstanding microrelief, with interchanging depressions with typical vegetation, and a small elevation with islands of steppe vegetation.

These natural sites are accompanied by a specific way of life related to traditional cattle breeding. In Hungary salt marshes are known as heath. In Serbia salt marshes do not receive enough attention as valuable natural sites, in spite of the fact that some of these complexes are within certain protected natural sites. In the European Union, salt marshes represent a priority for protection, while in our country, insufficient planning has caused the transformation of the sites into fish ponds or other different ways of degradation.

*Bogojevački rit.* As natural sites, reeds areas are related to alluvial plateaus, and according to the type of their outstanding characteristics they belong to the group of the so-called wetlands. On the area of Bogojevački rit, a number of specific forms of microrelief are still dominant. Similar to the main tendencies in the rest of Vojvodina, original natural values in Bogojevački rit have undergone serious changes. The building of the embankment and the digging of the Bogojevo - Odžaci Canal, have finally shaped this natural site.

Despite the newly formed changes in the Danube Basin, some of the original geomorphologic values have been preserved up to date. Holcer Pond and Lake Papić represent bodies of water typical for the alluvial plateau of the Danube and form part of the abandoned, once unified river bed or effluent. It had a continuum of approximately 1.365 of the river kilometre, then making an arch up to Karavukovački rit, parallel with the current flow of the Danube. This

effluent is intersected by the Canal Bogojevo-Odžaci and by a smaller meliorating canal Toporniča, situated in the natural depressions of the Toporniča Pond and Black Pond. The abandoned river beds, ponds, lakes, as well as parts of the melioration canals in natural depressions, represent strong evidence of the evolution of natural environment in these parts of the municipality of Odžaci.

*Kamarište.* To the south-west of Bogojevački rit, in the alluvial plateau of the Danube, there is another reeds complex - Kamarište, which is the basis for the hunting grounds of the same name. This entire area is next to the left bank of the Danube, although it has lost its original features of the flood plain due to the built embankment. The relief characteristic of this site is a small river island Golić, unique on the territory of the river Danube on the territory of Odžaci. Outstanding hydrological activity of Kamarište can be seen in its surface hydrography. The river Živa, according to Bogdanović (1985), represents an abandoned bed of the Danube, from which it was separated through hydro-technical works in 1911. The second important body of water within Kamarište is a fluvial lake Provala, to the south of the river island Golić.

*The abandoned meander Mostonga near Deronje.* With a small discrepancy, this meander of Mostonga stretches to the direction north-south, in the length of about three kilometres. By mid-twentieth century, Mostonga was flowing on the western border of the village, but due to the urban development, part of its former flow entered the settlement. On the strip to the north of Deronje, the meander is almost parallel with the canal Karavukovo-Bački Petrovac. The negligence of this body of water and its environment, is reflected in the idea of its usage as a dumping ground for the construction waste. The meander of Mostonga provides an opportunity for reconstruction of geographical sites in this part of Bačka, but it also contributes to the landscape diversity of the Western Bačka, which is extremely important in the monotonous agricultural surroundings.

*Bara Delaluša* is situated in the border areas of the municipalities of Odžaci and Bač, to the south of the channelled Mostonga. Apart from being known as an important bird habitat, it has not been thoroughly investigated so far.

*Lakes of the fishpond Bač* have spread on the area of 581 ha, which puts them on the second place according to the size of the lake complex in Bačka (Bugarčić, 2007). The fish pond was built in 1972 near Belo polje, to the south of the forest Branjevina, and to the west of the channelled flow of Mostonga.

*Ada Kirtoš* is one of a few river islands on the territory of the municipality of Bač. The Danube has a meandering characteristics in this section. Immediately



after entering the territory of this municipality its mainstream hits the left bank. On the right bank, opposite Kamarište, is the river island Tanja. Continuing toward the south, on the 1.348 of the river kilometer it turns toward south-east, creating a meander, the mainstream hits the bank of Bačka narrowing its alluvial plateau near Vajska. The embankment turns the mainstream to the west, towards Borovo. Here the bank is protected by the stone. Opposite the right bank near Borovo, there is the river island Kirtoš, three km long and 0.6 km wide.

The analysis of the geodiversity of the mentioned sites, according to the documents suggesting their assessment as natural properties in the spatial plans of the municipalities, has not clearly been presented. Just as in the case of the existing protected natural sites, it is the living nature that is mainly analysed in these areas. It is evident that Plazović is the habitat of the autochthonous aquatic and semiaquatic vegetation (water chesnut, white lily, yellow lily) and autochthonous dendoflora (white willow, abele, black poplar). The fish pond Bač is standing out as an important habitat of ornithofauna with over 100 bird species. On the Delaluša there is a colony of purple heron. The meanders of the river Mostonga are significant for biodiversity and represent an ecological corridor. An important landscape for birds is the river island Kirtoš. The complex Kamarište is important for the remaining groups of old oaks.

Flora and fauna are important properties leading to the protection of the mentioned land forms, but, on the other hand, the analysis of geodiversity points to other values that should be protected. In the situation of the prevailing agricultural character, meandering waterflows, abandoned meanders, salt marshes, river islands and reeds - contribute, above all, the the landscape diversity. In some cases they can be of scientific importance for resolving the questions about landscape history (meanders of Mostonga, pond Delaluša, Bogojevački rit) which is the assessment goal of geodiversity and geoheritage. Finally, human activities like fishing, cattle breeding, hydro industry and tourism, impose the need for protection and preservation of these outstanding landscapes and environments.

### **Conclusion**

The situation in which the importance of geodiversity is insufficiently appreciated during the processes of declaring new protected nature sites, can be seen through the analysis of the areas earmarked for protection in the Western Bačka Danube Region. Although the importance of geodiversity in the region has multiple importance from the point of view of economic, functional and esthetic evaluation, there have not been any serious evaluation of the area. The

circumstances can be overcome through the application of the basic guidelines of the local geodiversity action plans which are applied in the European countries (Local geodiversity action plans – Sharing good practice, 2004), with basic guidelines being the following:

- Revision of the evaluation processes of geodiversity in different areas and on different levels, i.e. determining sites of different geophenomena in regional, national and international system;
- Determining the relationship between geodiversity and the landscape properties, biodiversity and economic and cultural history;
- Increasing the awareness about the essential values of geodiversity in the sustainable development of the region;
- Education in the function of promotion, understanding and spreading the awareness of geodiversity;
- Providing popular scientific guides that can be easily understood and publications about the geodiversity of the region;
- Identifying the phenomena and topic which contribute to the sustainable development;
- Encouraging economy (fishing, cattle breeding, tourism) of the local communities and volunteer groups in becoming aware of the geodiversity and its importance.

The mentioned activities with educational programmes which would be included in the school system, could contribute to the awareness of the society in the geodiversity of the region. This is not only useful from the point of view of general education, but for the rational usage of natural resources, which local communities have always depended on.

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