

### Additional information

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#### Ecological features:

##### Aquatic vegetation

This type of vegetation is mostly present in the waterway of the rivulet Zasavica, and it occasionally occurs in the pond Ribnjača, during flooding periods when the water levels of the Drina and Sava are high, filling the pond with water through the channel Jovača. Open water surfaces with this vegetation type are noticeably reduced, since the waterway of the Zasavica is highly overgrown with tall emerged vegetation.

The representatives of aquatic macrophytes build various communities from several orders and alliances within the classes *Lemnetea* and *Potametea*.

The class *Lemnetea* includes a group of freely floating flowering plants, which represents the pioneering vegetation that is overgrowing the waterway. In the area of Zasavica, the community of duckweed and swollen bladderwort (*Lemno-Utricularietum vulgaris*) was recorded so far. It is developed in fragments in smaller inlets of the waterway, and it is in direct contact with the vegetation of reeds. It is characterised with the presence of ivy-leaved duckweed (*Lemna trisulca*) which actually floats under the water surface, and alternates the light and temperature regimes of the habitat. The presence of the insectivorous swollen bladderwort (*Utricularia vulgaris*) is characteristic for this community.

The class *Potametea* includes several associations from the alliance *Potamion eurosibiricum*. In the area of Zasavica, the most numerous is the community of the white water lily and yellow pond lily (*Nymphaeetum albo-luteae*), which appears along the entire waterway, and it is inhibited only in parts where the pure alliances of water-soldier have completely overgrown the water surfaces of the river. It is built of the most beautiful and the biggest aquatic macrophytes, the white water lily (*Nymphaea alba*) and the yellow pond lily (*Nuphar luteum*). The large amount of the plant biomass produced by these plants triggers high organic production and induces siltation of the riverbed. Usually, groups of white water lily and yellow pond lily grow separately, creating in this way two subassociations, *nymphaetosum* and *nupharetosum*.

In a very confined area in Zasavica, in inlets where small bridges were built, the community of frogbit and fringed water-lily (*Hydrocharo-Nymphoidetum peltatae*) was found. This phytocoenosis is an indicator of the late phase of turning into pond and of the high level of eutrophication.

Only in a small area, below the bridge near the settlement of Ravnje, the presence of a stand of small pondweed and hornwort (*Potamogeto pusilli-Ceratophylletum demersi*) was observed.

Newer studies revealed that the stands of the water violet (*Hottonietum palustris*) are numerous, which points to a specific richness of the ecosystem biodiversity in the area of Zasavica.

The most striking plant cover of Zasavica is the one dominated by a species of the water-soldier (*Stratiotes aloides*). The water-soldier is the main feature of the vegetation of this area, and it grows over large surfaces of the waterway. This is, in the same time, its richest find in our country.

##### Swamp vegetation

The semi-aquatic vegetation of the class *Phragmitetalia* and the alliance *Phragmition communis* is developed in the riparian part of the riverbed of Zasavica, to which the community of reeds (*Scirpo-Phragmitetum*) represents the main trait. The typical stands of this association-subassociation (*phragmitetosum*) are present along the shore as wide areas of pure reeds on higher terrains, which are occasionally and rarely flooded. Such complexes of reeds in the area of Zasavica can also be found at localities Sadžak, Vrbovac, and Valjevac.

In habitats that are constantly humid and wet, another sub-association of reeds is developed, with the narrowleaf cattail and broadleaf cattail – *typhaetosum (angustifoliae- latifoliae)*. The stands of this subassociation with broadleaf cattail are the most distinct in the place where the channels Jovača and Prekopac meet and form the waterway of the Zasavica. Large floodable areas are here densely overgrown

with pure stands of the broadleaf cattail, which is an indicator of deep layers of deposited silt. A rare species of spearwort, the greater (*Ranunculus lingua*), was found in this subassociation, which is enlisted in the "Red List of the Flora of Serbia" and is protected as a natural rarity. It is significant that this plant occurs, within the protected area, exclusively in the subassociation *typhaetosum angustifoliae*, which shows that its ecological characteristics are linked to this more humid variant of the reed communities.

The stands of the subassociation of reeds with the common club-rush – *schoenoplectosum lacustris* dominate in the riparian part of the riverbed of Zasavica, in the channel Bakreni Batar, and in the pond Ribnjača. It is built by tall emerged plants, reed (*Phragmites communis*) and common club-rush (*Schoenoplectus lacustris*), which dominate over the landscape of the riparian area of the Zasavica.

The vegetation of reeds is accompanied by the community of the sweet flag *Acoro- Glycerietum maximae*. It has a limited distribution; it is very rare in Vojvodina and it has a differential character in comparison with the same vegetation type in central Europe. The presence of this community within the protected zone is of great importance for the conservation of the ecosystem diversity of this area. This community develops only where the level of ground waters is high, and it needs frequent floodings, therefore it is linked to the waterway of Zasavica. The richest stands of this phytocoenosis are developed in Valjevac, and within the narrow riparian belt it occurs at a restricted number of localities.

#### Meadow vegetation

According to the preliminary study of this protected natural asset, the presence of certain types of the meadow vegetation was also observed. Although this type of vegetation is under the strong human influence, due to the cattle grazing, some elements of wet and moderately wet meadows were detected, and in their degradation phases.

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### Noteworthy fauna:

#### Invertebrata

The characteristics of the aquatic ecosystem of Zasavica are favourable for many species of invertebrates, such as: the freshwater sponge (*Spongilla lacustris*), jellyfish (*Craspedacusta sowerbii*), oligochaeta (*Rynchelminis limnosela*), and many species of planaria. All these organisms are good bioindicators of water quality.

Five species of Amphipoda, three species of Branchiopoda, and nine species of Ostracoda were found in Zasavica.

Of molluscs, 37 species of snails and four species of slugs, of which *Tandonia kusceri* is a Balkan endemic, were found.

During the field studies in the thickets along Zasavica, an endemic bush-cricket *Zeuneriana amplipennis* was found.

So far, recorded number of butterflies in Zasavica is 56 species, with eight internationally threatened species, such as: *Zerynthia polyxema*, *Lycaena dispar*, and *Melitaea aurelia*. The fauna of Odonata has 37 species, among which *Epithea bimaculata*, which was considered

extinct from the territory of Serbia, and *Somatochlora flavomaculata*, which was found only in Zasavica and in eastern Serbia. The previous studies revealed the presence of 31 species of ants (Formicidae), three species of stem sawflies (Cephididae), eight rare species of longhorn beetles (Cerambycidae), eight species of water mites (Hydracarina), and 41 species of weevils (Curculionidae).

### Vertebrata

#### Ichthyofauna

Specific hydrological and hydrobiological features indicate that these waters are mainly inhabited by species of the cyprinid family, and that the area represents a lowland cyprinid region. A total of 23 fish species from 8 families and 20 genera were found, of which 20 are autochthonous, and 3 allochthonous species, of which two species are from North America and one species from Asia. Among the recorded species, 7 are on the list of protected species as natural rarities, such as the bitterling (*Rhodeus sericeus amarus*), weather loach (*Misgurnus fossilis*), and spined loach (*Cobitis taenia*). The wels catfish (*Silurus glanis*) was reintroduced into the Zasavica as part of the realisation of the project "Return of the autochthonous fish species".

#### Herpetofauna

The area offers optimal conditions for the survival of herpetofauna, both for terrestrial and for species that live in aquatic habitats. Of a total of 27 recorded taxa, all amphibians and 4 reptiles are legally protected as natural rarities, and some of them are on the preliminary list of species and subspecies for the Red Book of Vertebrates of Serbia. Six taxa of amphibians and seven taxa of reptiles, threatened at the European level and protected by the Decree of the Bern Convention, are present here. So far, Zasavica represents a habitat for two Balkan endemics – the Danube crested newt (*Triturus dobrogicus*) and eastern subspecies of the sand lizard (*Lacerta agilis bosnica*), as well as for two rare and threatened species, fire salamander (*Salamandra salamandra*) and common spadefoot (*Pelobates fuscus*).

#### Ornithofauna

A total of 182 species of birds were recorded in this area so far. The determined number of proved nesting species is 87, while another 10 species represent potential nesting species. For its generally known ornithological values, Zasavica is included in the registry of areas of international significance for birds, according to the IBA project. The ornithological value is primarily reflected in richness of rare and threatened nesting species, as well as for its significance for the emigration and wintering. Among the important species there are the bittern (*Botaurus stellaris*), night heron (*Nycticorax nycticorax*), little egret (*Egretta garzetta*), spoonbill (*Platalea leucorodia*), marsh heron (*Circus aeruginosus*), and lapwing (*Vanellus vanellus*).

The white stork (*Ciconia ciconia*) is nesting in the surrounding settlements and feeding on the terrains of Zasavica. With the purpose to improve the nesting conditions for this species, wooden platforms were placed in Zasavica and in the surroundings.

#### Theriofauna

So far, the presence of 45 species of mammals was determined. This area has sufficiently preserved diversity of natural conditions for the survival of many species of mammals, particularly those that are linked to aquatic and swamp habitats, reeds, and marsh forests, such as the otter (*Lutra lutra*), Miller's water shrew (*Neomys anomalus*), muskrat (*Ondatra zibethica*), wild cat (*Felis silvestris*), and ermine (*Mustela erminea*). Many present species – all species of bats (*Chiroptera*), harvest mouse (*Micromys minutus*), hazel dormouse (*Muscardinus avellanarius*), martens (*Martes martes*, *M. foina*), are on the list of natural rarities of Serbia.

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### Ecosystem services:

Social and cultural values:

The social and cultural life of the local inhabitants in the hinterland of Zasavica is related to the ecological character of this area, nowadays the same as it was before. The life style of the people is connected with the wet habitats, primarily through fishing and cattle breeding, and these activities go far into the past.

During the times of the Roman Empire, the nearby Sremska Mitrovica was called Sirmium, and it was one of the four capitals and the centre of the entire Pannonia. The Romans were the first to make an irrigation system in this area. From Sirmium to present Zasavica, the Artemis' bridge led across the Sava. The main road to Bosnia continued further from that bridge, along the ridges and dry terrains of Mačva. There was a pier in Banov Brod. In sporadic enclaves of arable land and pastures, surrounded by swamps and forests, the Romans built their rural houses, the *Vilae Rusticae Romanae*. In the recent history, the most important events in this region were the battles of Serbian rioters for the liberation from the Turkish rule at the beginning of the 19th century. The Turkish army from Bosnia was met at the ridges near the village of Ravnje, the only place where it could have passed through the wilderness of Mačva.

The old legends about dragons are associated with the origins of Zasavica, dating as far as to the Celtic times. The legend tells that the ponds and meanders were the dragon's dwelling, shiny castles each with seven rooms. Dragons were the curators and bearers of strength and fertility. The revival of these legends came in the image of the haiduk Stojan Čupić, called Zmaj od Noćaja (Dragon from Noćaj), and his heroic deeds in the struggle against the Turkish rule.

Although the areas under pastures and mown meadows are today significantly reduced in comparison to their previous state, the traditional cattle breeding in the form of freely roaming cattle is still present on the pasture Valjevac. The cattle is here put to graze by the villagers from surrounding villages, as well as by the Manager of the Reserve, who started to breed Podolian cows in spring of 1998. Around fifty Podolian cows are freely grazing on the pasture Valjevac, comprising the area of 300 hectares. Furthermore, the nature conservation club "Pokret Gorana" started to breed Mangalitsa pigs in 1998. During time, the herd increased and today it counts four hundreds heads of this race. The Mangalitsa pigs are bred in old traditional way, freely roaming on the enclosed pasture Valjevac. It is important to mention that the autochthonous dog race, the pulin, and the Balkan donkey are also bred on this pasture.

Several shepherds' stories are preserved until today. Among them, the one that in the most beautiful manner describes the bond between the people and the Zasavica, is the love story of Dostana and Stanko, who fell in love while guarding cattle, playing shepherds' games, and picking water lilies in Zasavica.

Current scientific research and facilities:

The multidisciplinary studies of Zasavica are the most comprehensive in comparison to all other protected natural areas in Serbia, including a wide spectrum of scientific and expert fields (water quality, macromycetes, flora, vegetation, snails, crustaceans, dragonflies and damselflies, butterflies, ants, longhorn beetles, fishes, amphibians, reptiles, birds, mammals). The results of these studies were published in the form of two Proceedings from expert conferences dedicated to Zasavica, held in 2001 and 2007. Since the proclamation of the Reserve until nowadays, sixteen new species for Serbia were recorded here, from the groups Hydracarina, Ostracoda, Rotatoria, and Curculionidae.

A research camp is organised each July and August in the Special Nature Reserve Zasavica, by the Scientific Research Society of Biology Students "Josif Pančić". Ten to fifteen biology students participate in the research of the biodiversity of the reserve.

A master's thesis on aquatic macrophytes of Zasavica, analysed after the method of Köhler, was successfully defended in December 2003.

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

With the support of the Institute for Nature Conservation of Serbia, the Manager participates in permanent education of the public, local community, all interested parties, and the beneficiary of the natural asset, on values and significance of the natural values of "Zasavica", through numerous contributions in electronic and written media. Informative boards, signposts, and billboards were placed near all major traffic directions. The visitors' centre at the edge of the pasture Valjevac is the focal point in education on nature protection, with the guides, lecturers, adequate educational material, and souvenirs. A lot of educational-informative material, such as prospectuses, calendars, and books, was printed, including the richly illustrated "Guide through the nature in the Special Nature Reserve Zasavica".

For the third consecutive year, in the period July-August, the Management of the Reserve organizes an international working camp in the nature reserve Zasavica. Up to 10 young people, older than 18 years, participate in this camp. In the first year, the participants worked on removal of waste and macrophyte (flotant) vegetation, which has completely grown over the waterway in a part of the reserve (the village Zasavica 2, the pasture Valjevac) where the route for the tourist boat "Umbra" was planned. In the second year, the volunteers made souvenirs of the reserve from natural materials.

On February 2<sup>nd</sup>, 2002, the Special Nature Reserve Zasavica was the host of the celebration organised on the occasion of the World Wetland Day.

A draft study of the tourism management plan for the protected area of the SNR "Zasavica" was also realised. Three training seminars and lectures were held during its realisation, where, through the workshops, the principal directions were

determined and the data were gathered. Another study was also realised in scope of the international project "Development of methodology and management plan for tourism in SNR Zasavica". A seminary dedicated to the raising of public awareness on the reduction of the pollution and the protection of the ecosystems in SNR Zasavica was also organised.

In addition to the good relations with local elementary schools, and the pool on the significance of Zasavica carried out in surrounding villages, all regular and occasional workers are the inhabitants of the nearby villages. The international project "*Zasavica, the support to the local economy through the sustainable tourism – A feasibility study*", financed by the European Union, and realised by the European Agency for Reconstruction is also carried out within the reserve.

#### Current recreation and tourism:

The visitors centre represents a central tourist point of the reserve. It is a wooden building with a turret 18 m tall, from which the view spreads over the pasture and the widest and the most beautiful part of the rivulet Zasavica. This object hosts the souvenir shop and has two rooms with seven beds, as well as two auxiliary rooms. In front of it is a wooden quay that leads to the boats and a tourist vessel "Umbra" on which tourists make tours around the reserve. Zasavica has up to 6,000 visitors per year, among which the largest number are schoolchildren. Near the wooden object, there is a waterwheel as a tourist attraction. Of other objects, there are the "Beaver's Tavern" and the ethnic room with an eave, representing an ethnographic-historic exhibition of the old household and agricultural objects and tools from the end of the 19<sup>th</sup> and the beginning of the 20<sup>th</sup> century. There is also a toilet with indoor and outdoor showers to be used in the summer. In the "Beaver's Tavern" there is a barbecue, a "talandara" (plough disk), and a kettle for food preparation. Recently, a parking place for cars and busses was arranged in front of the visitors' centre, but outside of the reserve. This whole area is at disposal for visitors 24 hours daily and 365 days yearly, since there is always one of the workers, who guards the objects and the area, and greets the guests. This is a place where tourists can obtain the necessary information on the reserve by lectures or by informative billboards (maps of the reserve, the greatest values of the reserve – photos of the flora and fauna, a board with a small entomological exhibition, and other supplementary elements). For the purpose of tourism developing, the tourist vessel "Umbra" with 60 seats is available for tourists since 2002. Since 2003, the vessel's route goes through the most beautiful part of the reserve, from Valjevac to the forester's bridge, along 7 km. The guests can view the widest part of the Zasavica, behind which is the pasture, followed by the complex of floodable forests, so that in a glance one can observe both the waterfowl and the various forest birds. Sport anglers, with a little luck, can fish nice specimens of the wild carp, pike, or goldfish, at special locations and fishing blinds. Boat tours along the Zasavica are a true enjoyment for the fans of photo safaris, and the eco-bread and a speciality of Mačva - fish grilled on the plough disk, are offered as a special attraction. Traditionally, the spring and autumn pike hunt, a competition in pike fishing in

Zasavica, is organised twice a year. So far, five of these pike hunts were organised, gathering around 50-60 anglers from different parts of Serbia.

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**Potential threats:**

a) within the Ramsar site:

According to various sources (written documents, topographic charts, pools), the main hydro-ameliorative activities in the area of Zasavica were not carried out until the middle of the 20<sup>th</sup> century. Dense channel networks in the area of Bitva, Batar, and western part of Zasavica were dug mostly during 1950-1970. The colony of herons, being an excellent bioindicator of such changes, emerged in that period, when the activities were most intensive. The process of regulation of the water regime is now mostly completed, and the only swampy area that remains is the area of Sadžak in the eastern part of Zasavica, along with small pond complexes in the western part.

The construction of a pumping station on the channel near Mačvanska Mitrovica, in 1953, did not have drastic effects on the decrease of the ground and surface waters in Zasavica for the next 20 years, until the dense channel network was completed in 1970's.

The spring floods (spills from the riverbed) of Zasavica are minimal, and they primarily depend on the regime of the pumping station. In April 1996, the flood intensity was only 5- 6% in comparison to the situation 100 years ago, which was even worse further in the past, when the riverbed of Zasavica was semi-dry. It is obvious that current water regime and floodable zone primarily depend on the pumping station near M. Mitrovica. According to the inhabitants, the pastures of Valjevac were regularly flooded in spring with water deeper than 1 meter.

DOMBROVSKI (1895) emphasizes that to reach the "pond of Zasavica" in spring, when the herons are nesting, is life threatening. He talks about wandering peat islands with bushes of sallows and willows, and older current residents remember that these peat bogs were still present 40-50 years ago.

There were several large and more compact forest complexes on elevated terrains along Zasavica some 100 years ago. Today, only several enclosed areas remained, and somewhat more compact areas with woody vegetation can be found northwards to Sadžak, in the area of western Valjevac, in Vrbovac, as well as westwards from Batar in Poljanski. The human influence caused separation of compact forest communities and, by favouring the exploitation of certain species, it contributed to their uniformity.

Today, the forest clearing as a negative factor in conservation of pristine areas and species richness is slowed down, since there are no more large forest complexes, and only small enclosures remain. However, clearing of some complexes with old trees of oak, ash, and poplar is still present. Many natural forests are replaced with plantations of European- American poplars.

The area surrounding the waterway is an alternated natural environment with arable fields, and the natural vegetation is characterised with rare remains of forests and small surfaces of wet and moderately wet meadows where cattle actively graze, which are therefore degraded to a large extent.

The waterway is overgrown with a large biomass of plant material, followed with high organic production that permanently provokes siltation of the riverbed, stops the water flow, and further deteriorates the water regime conditions within the waterway, so it is necessary to implement active measures of protection by removing the vegetation in order to sanitise the conditions in this waterway.

Hydromechanic and ameliorative activities carried out in Mačva alternated the image of this area. However, the rivulet Zasavica succeeded to retain its former image to a certain extent.

Recently, Zasavica have been exposed to a great human influence, which, along with the natural processes, led to fast eutrophication and degradation of some parts of this aquatic ecosystem.

The value of the saprobity index, the total number of algae, and the presence of certain species, indicate that the water is relatively clear with the low organic content, and with less intense eutrophication processes than in other similar aquatic ecosystems. However, values of saprobity index as large as 2.5 were estimated at certain localities, corresponding to the intermediate category between the 2<sup>nd</sup> and 3<sup>rd</sup> water quality class. Usually, these are places where the human impact is the most prominent.

Some of the potential negative factors are the inadequate regulation of the water regime through the dam and the state of neglect of the channels that supply Zasavica with water.

Aquatic ecosystems are exposed to pollution by the runoff of insecticides and fertilizers from the surrounding cultivated areas and, to a lesser extent, by spills of faecal waters.

Sporadic cases of disposal of mechanical waste and opening of wild depots, both in dry habitats and along the waterway, were observed.

Spontaneous introduction of American predatory fishes *Ameiurus nebulosus* and *Lepomis gibossus* into the river Zasavica has also triggered negative effects.

b) in the surrounding area:

In the 19<sup>th</sup> century, northern Mačva was much more covered with forests and swamps than with arable land. Since the last decade of the 19<sup>th</sup> century these forest are decreasing, but ponds and marshes still occupy a large part of Mačva. Compact forests units were cleared mainly between 1860 and 1880, and during the 20<sup>th</sup> century they have even more been chopped up, which led to the present existence of sporadic enclosures.

Large swamp complexes in the western part of Zasavica (from Crna Bara to Ravnje), in the central part from Vrbovac to Sadžak, and to the south in, at that time still not ameliorated, watershed of Bitva around Noćaj and Glušac, can be seen on topographic maps from the beginning of the 20<sup>th</sup> century. Regular spring floods in



this area comprised more than 2,500 ha, with particularly good habitat conditions for the development of many types of communities linked to water.

The expansion of the urban and weekend zones and of the infrastructure, intensification of the agriculture, and disturbance of natural features of the Drina and Sava and their riparian areas, also have a significant impact.

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