

## CHAROPHYTES (CHAROPHYTA) IN THE ZASAVICA SPECIAL NATURE RESERVE

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**Abstract** – Floristic and taxonomic diversity, as well as studies of ecological characteristic of Charophyta algae were carried out within the complex biodiversity researches, in the Zasavica Special Nature Reserve. Nine species were recorded: *Chara globularis*, *C. contraria*, *C. vulgaris*, *Nitella mucronata*, *N. capillaris*, *N. syncarpa*, *N. confervacea*, *Tolypella intricata* and *T. prolifera*. The most common charophyte habitats are shallow, often ephemeral, ponds and puddles in diluvial forests and marshy meadow depressions. Charophytes were also found in riparian areas of water flows, springs and channels, in shallow water (0.1 to 1.2 m), neutral to alkaline (pH 7.4-8.8), and on different substrates (silt, peat, bogland mold).

**Key words:** Charophyta, diversity, ecology, Zasavica Special Nature Reserve

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### INTRODUCTION

Since 1997, when Zasavica was proclaimed a Special Nature Reserve of the first category, the complex and continuous biodiversity research in this area has been intensified, especially after 2008 when it was included in the Ramsar List of Wetlands of International Importance.

The area of the Zasavica SNR is characterized by numerous aquatic and wetland habitats where diverse and often specific flora and fauna can be found. There have been studies from different research fields carried out in this region but data about algae, especially charophytes, are rare (Simić et al., 2007; Blaženčić and Stanković, 2008).

This study is a synthesis of a twelve-year charophyte research in the Zasavica SNR. Our aim was to establish the presence, floristic composition, taxonomic diversity, ecological characteristics and distribution of charophytes in this area.

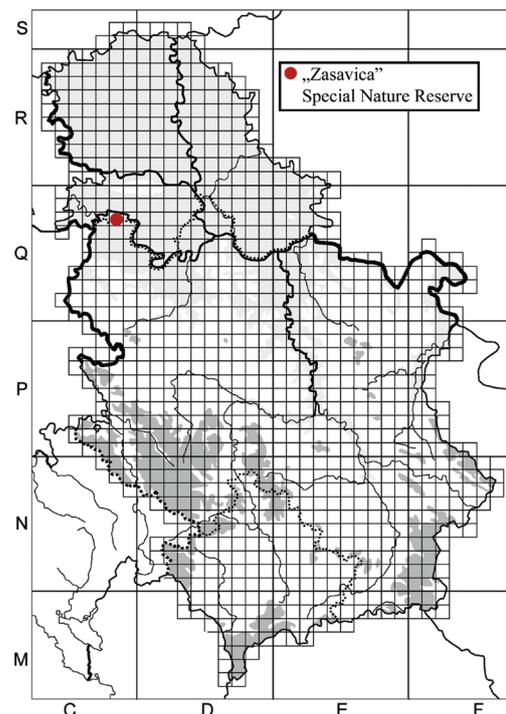


Fig.1. Map of Serbia with geographic position of Zasavica SNR.

The Zasavica SNP is located in northeastern Serbia, or more precisely, in the south of the Autonomous Province of Vojvodina, east of the river Drina and south of the river Sava (Fig. 1). It has a surface area of 1821 ha and is situated within the municipalities of Sremska Mitrovica and Bogatić.

Its hydrological and hydrobiological characteristics, terrain configuration, groundwater proximity and mosaic of streams, channels and ponds make this area very rich in aquatic and wetland habitats that are populated by various biological communities and a great number of rare and threatened species, among which a high level of Charophyta diversity has been observed.

Regarding climate conditions, the Zasavica SNR belongs to the subcontinental-semiarid continental climate which is the transitional zone between temperate continental climate and continental climates (Stevanović and Stevanović, 1995).

## MATERIALS AND METHODS

Charophyte sampling in the Zasavica SNR was performed in the period between 1998 and 2010 in the following localities: Ostrovac, Gradina, Sadžak, Lug, Turske livade, Preseka, Valjevac, Šumareva ćuprija, Pačja bara, Zovik, Batve, Batar, Bostanište, Trebljevine, Panjevine, Prekopac, Jovača, Široka bara and Bara Ribnjača (Fig. 2).

During material sampling, notes were taken of the habitat type, the substrate characteristics, the water temperature, chemical reaction (pH) and depth of the plants charophytes grow with. Specimens were fixed with 4% formaldehyde or 50% alcohol.

Charophyte species were identified using the keys proposed by Corillion (1957, 1975), Wood and Imahori (1964, 1965), Голлербах and Красавина (1983), Krause (1997), Schubert and Blindow (2003)

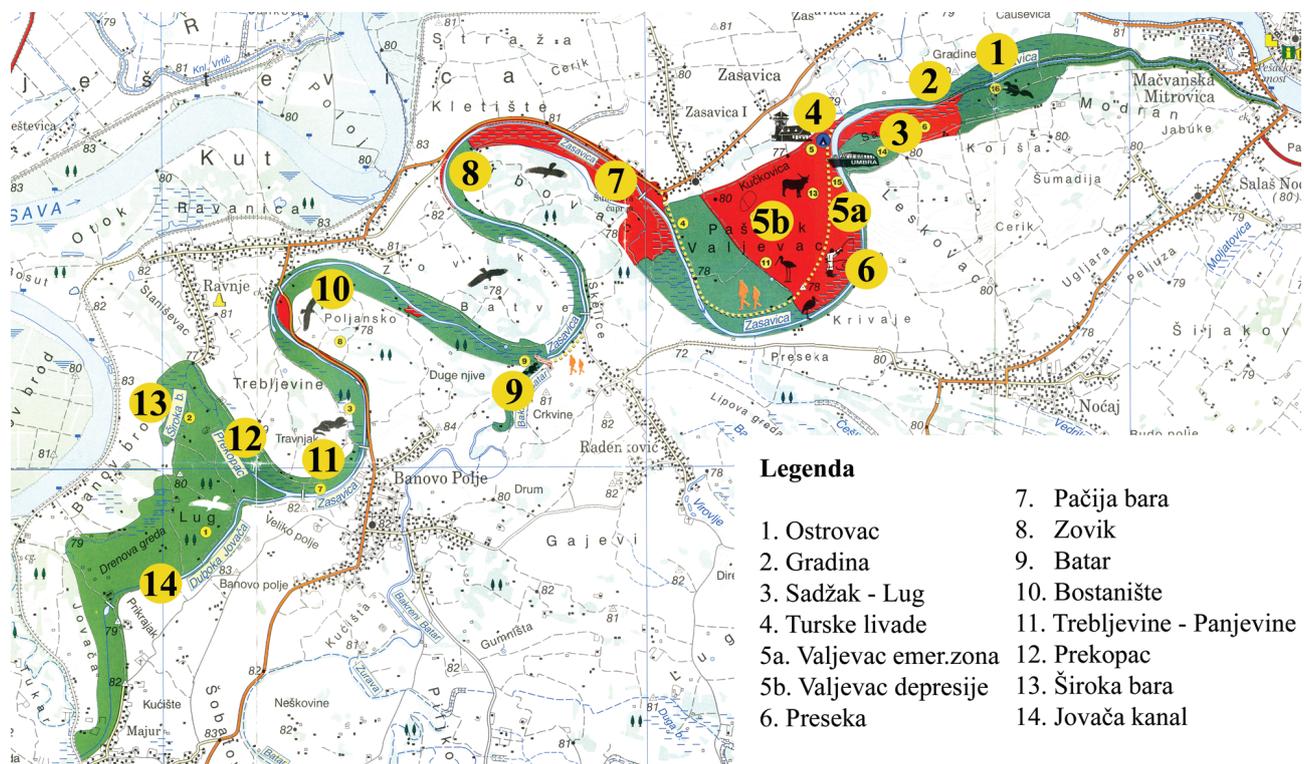


Fig.2. Map of Zasavica SNR with position of studied localities.

and vascular plants according to the keys proposed by Josifović (1970-1977) and Sarić (1992).

The samples are deposited in the collection of wet specimens of the Herbarium of the Institute of Botany and Botanical Garden "Jevremovac" (BEOU), University of Belgrade.

## RESULTS

In the area of Zasavica SNR we have established the presence of nine species of the Charophyta division. The most common species are *Nitella mucronata* (A. Braun) Miq. in H. C. Hall 1840 emend. Wallman 1853 and *Chara globularis* Thuill. 1799, while others, *Chara vulgaris* L. 1753, *C. contraria* A. Braun ex Kütz. 1845, *Nitella capillaris* (Krocker) J. Groves et Bullock-Webster 1920, *N. syncarpa* (Truill.) Chevall. 1827, *N. confervacea* (Bréb.) A. Braun ex Leonh. 1863, *Tolypella intricata* (Trentepohl ex Roth) Leonhardi 1863 and *T. prolifera* (Ziz ex A. Braun) Leonhardi 1863, are much less frequent.

*Chara globularis* was found in the localities: Ostrovac, Preseka Turske livade, Valjevac, Šumareva ćuprija, Pačja bara, Zovik, Batar, Prekopac and Jovača. Its habitats are ephemeral ponds and puddles, channels and streams where the water is often shallow, 0.2 to 0.3 m, sometimes up to 1.2 m. During the spring the recorded water temperature was 15 to 16°C, while in the summer it varied between 16 and 22°C. It inhabits slightly alkaline to alkaline waters (pH 7.8-8.8). The substrate is silt, silt with clay or bogland mold.

*C. globularis* usually grows with other stoneworth species: *Chara contraria*, *C. vulgaris*, *Nitella mucronata*, *N. syncarpa*, *N. confervacea*, *Tolypella prolifera*, as well as with filamentous algae and mosses and vascular plants: *Alisma plantago-aquatica* L., *Ceratophyllum demersum* L., *Potamogeton crispus* L., *Heleocharis palustris* L., *Utricularia vulgaris* L.

The presence of *C. globularis* was recorded from spring (April) to late autumn (November). Fertile plants were already recorded in April, while

gametangia were developing until late autumn.

*Chara contraria* samples were collected during spring and summer in these localities: Ostrovac, Turske livade, Valjevac, Jovača, Široka bara and Bara Ribnjača. It populates the shallow waters of channels and ephemeral ponds, 0.2 to 0.4 m deep. The water is slightly alkaline (pH 7.8). In summer time the water temperature was about 20°C. The substrate is silt or clay.

*Chara contraria* mostly grows together with other charophyte species: *Chara globularis*, *C. vulgaris*, *Nitella syncarpa*, *N. confervacea*, *Tolypella prolifera* and with vascular plants: *Alisma lanceolatum* With., *Schoenoplectus lacustris* (L.) Palla, *Bulboschoenus maritimus* (L.) Palla, *Utricularia vulgaris*.

*Chara vulgaris* was found in the following localities: Valjevac, Batve, Široka bara and Bara Ribnjača. It mostly inhabits slightly alkaline waters (pH 7.8) in flooded meadow depressions or shallow ephemeral ponds and puddles, or even in ruts (depth between 0.3 and 0.5 m).

This species forms mixed communities with other charophyte species: *C. globularis* and *C. contraria*, as well as with mosses and vascular plants: *Alisma lanceolatum*, *Alisma plantago-aquatica*, *Schoenoplectus lacustris*, *Bulboschoenus maritimus*, *Butomus umbellatus* L., *Heleocharis palustris*, *Sparganium erectum* L., *Lemna trisulca* L.

*Nitella mucronata* was found in the localities: Ostrovac, Gradina, Lug, Sadžak, Valjevac, Preseka, Šumareva ćuprija, Pačja bara, Bostanište, Trebljevine and Panjevine. Its presence was observed from April to December, most frequently in ephemeral puddles in flooded zones of forests. The water is shallow, 0.2 to 0.5 m deep, slightly alkaline (pH 7.4-8.2) and the substrate varies from mold to peat. *N. mucronata* has been found growing together with *C. globularis* and among sods of *Carex vulpina* L.

*Nitella capillaris* was recorded during springtime in Valjevac. Both male and female plants were

collected from shallow ephemeral puddles, 0.1 to 0.3 m deep, which were formed in meadow depressions. The water is slightly alkaline (pH 7.8) and the substrate is mold.

*Nitella syncarpa* was found in Valjevac (male and female plants) and in Sadžak (only male plants). It grows on a silty substrate in ephemeral puddles, 0.1 to 0.2 m deep, together with other charophytes: *Chara globularis*, *C. contraria*, *Nitella confervacea* and *Tolypella prolifera* and vascular plants: *Batrachium aquatile* (L.) Dum, *Utricularia vulgaris*.

*Nitella confervacea* (Fig. 3) samples were collected in May and July in Valjevac. Its habitats are an ephemeral pond in a flooded zone and an ephemeral puddle in a rut, 0.1 to 0.2 m deep. *Utricularia vulgaris*, *Chara globularis*, *C. contraria*, *Nitella syncarpa* and *Tolypella prolifera* were also identified in the ephemeral pond, in May. *Utricularia vulgaris* was a dominant species.

The occurrence of *N. confervacea* in Zasavica SNR is reported for the first time in Serbia. The species is dioecious, and both male and female plants were found.

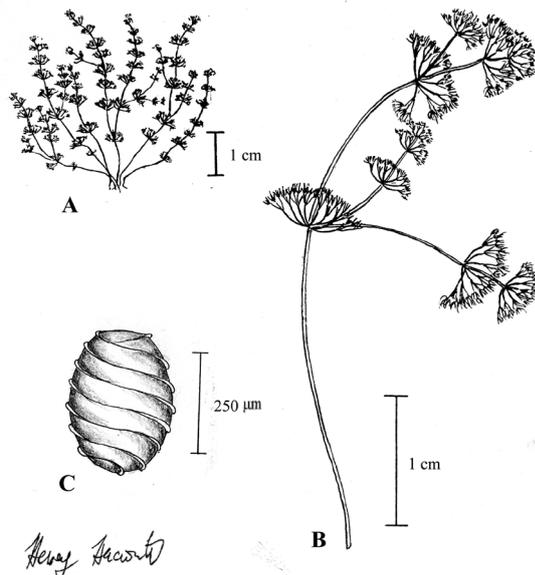


Fig.3. *Nitella confervacea* – scheme: A – habitus, B – branchlet, C – oospore.

*Tolypella intricata* (Fig. 4) was found only in springtime in the localities Valjevac and Pačja bara. The habitat is ephemeral pond, 0.2 to 0.3 m deep. The water is slightly alkaline (pH 7.8) and the substrate is bogland mold. It grows with vascular plants *Batrachium aquatile* and *Mentha aquatica* L.

The findings in the Zasavica SNR are the first records of *Tolypella intricata* for Serbia. Moreover, it is the only reliable data for the entire region of West and Central Balkans (Blaženčić and Stanković, 2008).

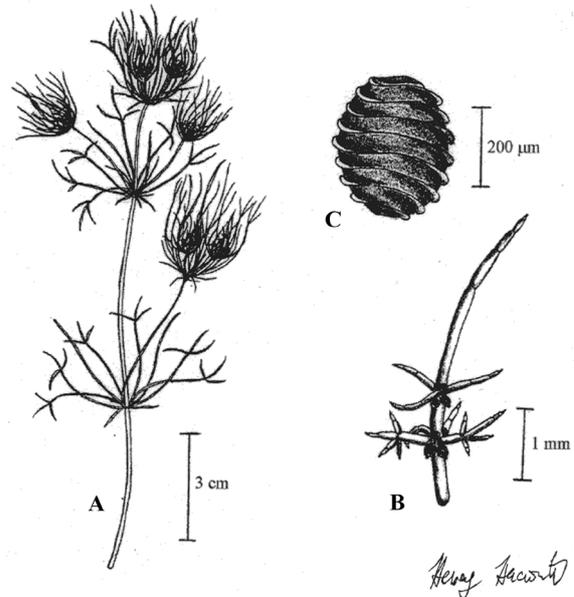


Fig.4. *Tolypella intricata* – scheme: A – habitus, B – part of fertile branchlet, C – oospore.

*Tolypella prolifera* was found only in one May sample in Valjevac. It grows in an ephemeral pond, 0.1 to 0.2 m deep, together with other charophytes, *Chara contraria*, *C. globularis*, *Nitella syncarpa* and *N. confervacea*, and with dominant vascular plant, *Utricularia vulgaris*.

## DISCUSSION

The presented results are based on charophyte research in the Zasavica SNR carried out during the last twelve years. The obtained results are significant

because Zasavica is the only region in Serbia where charophyte diversity, as well as the dynamics of their migrations (due to the ephemeral character of their habitats), are studied systematically over a longer period of time and in natural conditions.

The Zasavica SNR was selected for research for three reasons: (a) it is one of nine Ramsar sites in Serbia that needs to be comprehensively explored; (b) data on algal diversity and ecology are not numerous and there is hardly any data about charophytes in this area; (c) Zasavica SNR is a good model for charophyte study throughout Serbia owing to its hydrological, hydrographic, orographic and other characteristics.

So far, the occurrence of 22 species of the Charophyta division has been established in Serbia and, for the substantially smaller territory of Zasavica SNR, we have identified nine species. The specificity of charophyte diversity in Zasavica SNR is reflected in the fact that three out of four charophyte genera known for Serbia were recorded in this area, as well as a number of species belonging to family Nitellaceae – six out of nine. Moreover, *Nitella confervacea* is reported for the first time in Serbia, while *Tolypella prolifera* and *T. intricata* findings are the only reliable data for entire region of West and Central Balkans considering that their presence in formerly known habitats has not been confirmed (Filarszky, 1931; Degen, 1938).

*Tolypella intricata* findings in the area of Zasavica SNR are significant not just in terms of the occurrence of one more new species of algal flora for Serbia, but also for its importance for entire region of the Balkan peninsula, considering that all known data for this species were noted almost 40 to 100 years ago: for Bulgaria (Петковъ, 1913 and Вогеничаров et al., 1971), Croatia (Filarszky, 1931), Romania (Ionescu-Teculescu, 1970) and Greece (Wood and Imahori, 1965).

In the Zasavica SNR, charophytes preferably inhabit periodically flooded habitats in the surrounding meadows and forests, in shallow ponds and pud-

dles, and occasionally in channels, and the littoral part of streams and springs. The water is neutral to slightly alkaline. Regarding their ecological characteristics, our data are not any different from the literature data: Corillion (1957, 1975), Голлербах and Красавина (1983), Schubert and Blindow (2003), Langangen (2007), Pelechaty and Pukacz (2008).

The floristically richest habitats are those on the gently undulating locality of the Valjevac pasture where depressions are filled with water until mid-July. This locality, compared to the others, is the largest, occupying almost one half of the Zasavica SNR area (43.61%). At this locality, where we established the presence of all nine species found in the area of Zasavica, the soil is mineral-paludal and the water is shallow (up to 0.5 m) and slightly alkaline (pH 7.5-7.8). The most common species in Zasavica SNR is *Nitella mucronata* which was recorded at 11 localities. *Chara globularis* was found at 10, *C. contraria* at 6, while the other species were collected at a small number of localities (1 - 3).

By analyzing the places where charophytes were found, especially those of the species which were collected several times and for a longer period of time (*Chara globularis*, *C. contraria* and *Nitella mucronata*), it can be concluded that they can shift their position from one place to another depending on the transient local life conditions which are favorable for their development. This observation confirms the fact that their oospores are very resistant and can preserve vitality during longer periods of time and germinate when favorable conditions are fulfilled on a certain site.

The scientific interest in charophyte researches, as one of cenobionts of the vegetation of marshes and ponds, is important because it contributes to gaining more knowledge about the dynamics of changes in phytocenosis composition caused by fast and periodic changes in water regime.

The knowledge on charophyte features is also of great significance for water resource assessment and management. Charophytes have the ability to quick-

ly colonize habitats which makes them favorable for habitat revitalization (Van den Berg and Coops, 1999). Likewise, they are important as a habitat and food resource for fish, microinvertebrates, waterfowl and other organisms that are entirely or partly depended on water ecosystems during their life cycle. Regional researches, such as this one in the Zasavica SNR, also have a general importance because they contribute to acquiring knowledge about the biodiversity of Serbia.

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