

Original Research

**CONTRIBUTION OF THE DISTRIBUTION OF THE SPECIES
Ricciocarpos natans (L.) CORDA 1829 IN THE SNR ZASAVICA AND MACVI WITH
THE ANALYSIS OF THE HABITAT**

DOI: 10.5937/EcoTER26394S

Mihajlo Stanković^{1*}

¹ Pokret gorana, Svetog Save 19, 22000 Sremska Mitrovica, SERBIA

Abstract

The species *Ricciocarpos natans* in Serbia was recorded in a small number of localities, mostly north of the Danube and Sava rivers. Through our research in Mačva, the species was found in a total of 38 localities, 20 of which are within the boundaries of the reserve and 18 outside the boundaries of the protected area, with a total of 63 findings within the boundaries of the protected area and outside it. The species is found in canals, swamps, lowland peatlands, mudflats, etc., most often in coastal vegetation *Scirpo-Phragmitetum* W. Koch 26 subass. *typhaetosum* (*angustifoliae-latifoliae*) Soó 73, or in floating *Lemno-Salvinion natans* Slavnić 56 and *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954.

Keywords: *Ricciocarpos natans*, Mačva, Zasavica, habitat.

INTRODUCTION

Ricciocarpos natans (L.) Corda 1829 belongs to the genus *Ricciocarpos* Corda 1829, family *Ricciaceae* [1]. The species has a heart-shaped to kidney-shaped green thallus with fewer branches and its main character is the long purple sword-shaped scales that hang from the lower surface of the floating plants [2]. This is a rare swimming thalloid liverwort, which is found in shaded shallow warm nutrient-enriched waters and has a terrestrial form in mudflats when the water recedes. The species *Ricciocarpos natans* is a cosmopolitan, aquatic moss that inhabits eutrophic waters on most continents except the polar ones [2] and often forms dense, floating colonies [3]. It inhabits a variety of aquatic habitats with different water parameters and periods of occurrence and despite its wide ecological amplitude, the species is locally rare and of low diversity. The species is globally distributed, but it is rare in southern Europe. The population trend in Europe is considered stable and therefore the assessment is of least concern (Lc) [4], but many subpopulations at the national and regional level are threatened, *i.e.* declining or unstable and therefore listed as Critically Endangered (CR) (Slovenia), Endangered (EN) (Austria, Germany, Spain); vulnerable (VU) (eg Great Britain, Slovakia), etc. [5]. Occurs from sea level in the Mediterranean to 600 m.a.s.l. in Switzerland, or up to 1000 m.a.s.l. in France [4]. In Serbia, it was recorded in a small number of localities, mostly north of the Danube and Sava rivers [6], unfortunately new field visits to some known localities did not confirm its presence, and that is why the species is a candidate for the new

* trogloxen@gmail.com

Red List of bryophytes of Serbia. The dynamics of appearance is irregular over the years, due to the requirements of its habitat. In some parts of Europe, gametangia and sporophytes are rarely seen, and the spread is believed to be clonal [4]. Since this semi-aquatic moss in Serbia has been recorded in a small number of localities, mostly north of the Danube and Sava rivers, our data contribute to a better knowledge of its overall distribution in Serbia.

MATERIAL AND WORK METHODS

Floristic research involves the application of standard botanical methods of habitat survey. At the location, the number of specimens on the surface (if it is a small area) or the coverage of the surface (if it is a larger or large area) is determined, in addition to data on the species itself, data on other plants in the area, type of habitat, water depth, etc. are recorded. For each locality, GPS coordinates were determined using Google Earth Pro and the UTM field. We divided the sites into two groups. The first group consists of localities within the boundaries of SRP Zasavica, and the second group consists of localities outside the boundaries of the reserve, whose overview we now give:

✓ **Localities within the SNR Zasavica: Crna bara:** canal Jovača (44°54'18.06"N-19°25'03.61"E), CQ77; Ribnjača bara (44°54'35.91"N-19°24'30.49"E), CQ77; **Radenković:** Batar (44°55'39.15"N-19°28'25.47"E), CQ77; Zelene bare (44°54'47.78"N-19°30'45.61"E), CQ87; Pačija bara (44°56'22.26"N-19°29'50.53"E), CQ87; Gajića ćuprija (44°56'05.91"N-19°29'02.65"E), CQ87; **Ravnje:** Čuturina kafana (44°57'17.18"N-19°27'38.96"E), CQ77; Batve (44°56'02.63"N-19°27'45.61"E), CQ77; Ravnjanska ćuprija downstream (44°56'20.53"N-19°25'57.22"E), CQ77; Ravnjanska ćuprija upstream (44°56'16.03"N-19°25'51.77"E), CQ77; Zovik (44°56'31.46"N-19°28'42.97"E), CQ77; **Prekopac** (44°55'15.81"N-19°25'20.43"E; 44°55'39.40"N-19°25'03.92"E), CQ77; **Banovo Polje:** Batar (44°55'41.94"N-19°28'27.75"E), CQ77; Ljubinkovića ćuprija (44°55'09.81"N-19°26'45.36"E), CQ77; Poljansko (44°56'24.49"N-19°26'03.30"E), CQ77; Ribnjača bara (44°54'50.97"N-19°24'39.30"E), CQ77; **Zasavica II:** Valjevac flood zone, (44°57'19.30"N-19°31'33.88"E), CQ87; Valjevac canal (44°57'15.77"N-19°31'30.02"E), CQ87; Turske livade (44°57'31.01"N-19°31'40.28"E), CQ87, Vrbovac (44°57'23.98"N-19°27'49.96"E), CQ77.

✓ **Localities outside the boundaries of the protected area: Glušci:** Bitva (44°54'01.29"N-19°33'00.78"E), CQ87; Duga bara (44°53'08.29"N-19°30'30.66"E), CQ87; Kaluže (44°52'25.91"N-19°30'34.57"E), CQ87; Lanište (44°54'03.47"N-19°33'08.82"E), CQ87; Kupusina greda (44°54'16.17"N-19°37'07.90"E), CQ87; Crna bara (44°53'53.10"N-19°35'55.31"E), CQ87; Češljuška bara (44°57'23.98"N-19°27'49.96"E), CQ77; **Salaš Noćajski:** Skenovača (44°55'50.24"N-19°37'46.09"E), CQ97; **Noćaj:** Kojšanski kanal 1, (44°57'31.85"N-19°32'57.43"E), CQ87; Kojšanski kanal 2 (44°57'27.25"N-19°32'28.18"E), CQ87; **Metković:** Jabukovac (44°52'05.41"N-19°31'36.16"E), CQ86; Klenić (44°51'06.08"N-19°31'39.11"E), CQ86; **Šabac:** Veliki cerski kanal (confluence with the Sava River) (44°44'37.35"N-19°43'39.84"E), CQ95; Šabac (Major): Veliki cerski kanal (44°44'37.35"N-19°43'39.84"E), CQ95; **Lipolist:** Veliki cerski kanal (44°43'08.69"N-19°32'11.27"E), CQ85; **Bogatić:** Panjevine (44°52'28.47"N-19°29'38.21"E), CQ87; **Crna bara:** Šobatovac (44°52'43.01"N-19°26'06.12"E), CQ77; Neškovine (44°53'24.13"N-19°25'36.34"E), CQ77.

The type of vegetation was determined according to Kitnaes *et al.* [7] and Plavac *et al.* [8]. The determination of the gorse *Ricciocarpos natans* was made according to Pavletić [9], and the other plants present according to the relevant literature sources [10–12].

RESULTS WITH DISCUSSION

During the work on the flora of the reserve and northern Mačva, the presence of the rare aquatic moss *Ricciocarpos natans* was noted. The paper processed data for the period from 2004 to March 2026. Now we will give an overview of the localities where the species *Ricciocarpos natans* was found with accompanying data.

Localities within the boundaries of the protected area (SNR Zasavica): **Crna bara:** Jovača canal: 01.08.2004, P=1x3 m, $\Sigma=17$ individuals (indiv.); 28.04.2007, P=3x2 m, covered 20% of the surface; **Ribnjača bara:** 22.07.2010., forbidden ground, P=10x2 m, covered 40% of the surface; 04.08.2023, mudflat, P=10x4 m, covered 20% of the surface; **Radenković:** Batar: 10.12.2005, coastal part, P=2x10 m, covered 70% of the surface; 06.11.2014, coastal part, P=1x2 m, covered 20% of the surface; 30.03.2005, coastal part, P=3x7 m, covered 40% of the surface; **Zelene bare:** 08.06.2010, forbidden ground, P=1x1 m, $\Sigma=20$ indiv.; **Pačija bara:** 29.07.2010, peatland, P=50x10 m, covered 60% of the surface; 14.12.2011, peatland, P=20x7 m, covered 20% of the surface; 14.12.2014, peatland, P=4x7 m, covered 20% of the surface; 14.11.2014, peatland, P=50x10 m, covered 70% of the surface; 05.11.2014, peatland, P=8x5 m, covered 30% of the surface; 06.03.2016, peatland, P=5x1 m, $\Sigma=9$ indiv.; 06.08.2019, peatland, P=20x4 m, covered 30% of the surface; 22.04.2023, peatland, P=7x5 m, covered 40% of the surface; 16.03.2024, peatland, P=10x7 m, covered 50% of the surface; **Gajica ćuprija:** 31.01.2013, coastal part, P=1x1 m, $\Sigma=7$ indiv.; 05.02.2013, coastal part, P=2x3 m, $\Sigma=2$ indiv.; **Vrbovac:** 16.03.2024, coastal part, P=1x1 m, $\Sigma=22$ indiv.; **Banovo Polje:** Batar: 30.05.2005, coastal part, P=2x5 m, $\Sigma=12$ indiv.; 18.02.2026, coastal part, P=1x2 m, $\Sigma=7$ indiv.; 27.02.2026, coastal part, P=4x2 m, $\Sigma=8$ indiv.; **Ljubinkovića ćuprija:** 28.04.2007, coastal part, P=3x3 m, $\Sigma=20$ indiv.; 21.06.2018, coastal part, P=1x1 m, $\Sigma=13$ indiv.; **Poljansko:** 05.02.2013, coastal part, P=3x1 m, $\Sigma=15$ indiv.; **Ribnjača bara:** 05.03.2016, forbidden ground, P=1x1 m, $\Sigma=23$ indiv.; 02.08.2016, forbidden ground, P=3x2 m, covered 20% of the surface; 09.08.2021, forbidden ground, P=30x5 m, covered 60% of the surface; 03.08.2022, forbidden ground, P=15x4 m, covered 20% of the surface; **Ravnje:** **Čaturina kafana:** 07.05.2006, coastal part, P=1x1 m, $\Sigma=16$ indiv.; **Batve canal:** 04.08.2010, P=20x2 m, covered 80% of the surface; 03.01.2022, P=10x2 m, covered 30% of the surface; **Prekopac:** 05.08.2010, mudflat, P=10x1 m, covered 20% of the surface; 09.09.2022, dry trough, P=30x20 m, covered 30% of the surface; **Ravnjanska ćuprija:** 17.04.2018, downstream 100 m, coastal part, P=100x2 m, covered 60% of the surface; 17.04.2018, upstream 200–300 m, coastal part, P=200x2 m, covered 30% of the surface; **Zovik,** canal: 02.08.2019, P=20x3 m, covered 80% of the surface; **Zasavica II:** **Valjevac flood zone,** 11.11.2019, dry mud flat, P=50x10 m, covered 30% of the surface; **Valjevac canal,** 16.11.2019, P=1x4 m, $\Sigma=20$ indiv.; **Turske livade,** canal, 19.03.2023, P=5x2 m, covered 30% of the surface.

Localities outside the boundaries of the protected area: **Glušci:** **Bitva canal:** 30.03.2005, P=3x4 m, covered 50% of the surface; 07.08.2021, P=2x1 m, $\Sigma=9$ indiv.; 07.07.2023, P=3x5 m, covered 20% of the surface; **Duga bara:** canal, 07.09.2009, P=2x2 m,

$\Sigma=22$ indiv.; Kaluže: canal and spillway, 07.09.2009, $P=10 \times 4$ m, covered 30% of the surface; Lanište: canal, 10.10.2009, $P=2 \times 3$ m, covered 40% of the surface; Kupusina greda: forbidden ground, 25.07.2009, $P=1 \times 2$ m, $\Sigma=28$ indiv.; Crna bara: forbidden ground, 17.07.2014, $P=1 \times 1$ m, $\Sigma=11$ indiv.; Češljuška bara: 05.08.2023, forbidden ground, $P=2 \times 7$ m, covered 30% of the surface; 26.10.2023, forbidden ground, $P=3 \times 7$ m, covered f 40% of the surface; Salaš Noćajski: Skenovača canal, 19.09.2006, $P=1 \times 1$ m, $\Sigma=20$ indiv.; Noćaj: Kojšanski canal 1, 15.06.2006, $P=50 \times 2$ m, covered 60% of the surface; Kojšanski canal 2, 30.04.2006, $P=100 \times 2$ m, covered 40% of the surface; Metković: Jabukovac canal, 15.11.2006, $P=1 \times 1$ m, $\Sigma=9$ indiv.; Klenić, canal, 01.11.2015., $P=1 \times 1$ m, $\Sigma=6$ indiv.; Šabac: Veliki cerski canal (confluence with the Sava River), 29.09.2008, $P=20 \times 2$ m, covered 40% of the surface; Šabac (Major): Veliki cerski canal, 28.10.2015, $P=2 \times 1$ m, $\Sigma=7$ indiv.; Lipolist: Veliki cerski canal, 31.10.2009, $P=1 \times 1$ m, $\Sigma=18$ indiv.; Bogatić: Panjevine, canal, 13.07.2009, $P=3 \times 2$ m, covered 20% of the surface; Crna bara: Šobatovac, forbidden ground, 09.07.2010, $P=2 \times 1$ m, $\Sigma=36$ indiv.; Neškovine, riverbed Batar, 20.07.2011, $P=5 \times 2$ m, covered 30% of the surface; Radenković: Virovlje, canal, 24.05.2020, $P=1 \times 1$ m, $\Sigma=5$ indiv.;

For the species *R. natans*, we have a total of 63 findings both within the SNR Zasavica and outside it in North Mačva, in a total of 38 localities, of which 20 are within the boundaries of the reserve and 18 within the protected area.

Analysis of localities within the boundaries of SNR Zasavica: Within the protected area, we have the largest number of finds (9) at the Pačija bara site, which represents a lowland peatland, followed by the Batar locality with 6 finds and the Ribnjača bar with 5 finds. At 15 locations, we counted individuals because it was about areas of a few square meters, and for areas larger than 10 m^2 , an assessment of the coverage of the area was made and given in percentage (%). The most common surface coverage was 20–30%, in two cases we have coverage of 70–80% in the localities of Batar (2005), Batve (2010), Pačija bara (2014) and Zovik (2019). In 2018, we mention the site Ravnjanska ćuprija where 100 m upstream and about 200 m downstream from the bridge there was coverage of 60 and 30% in the shafts between the rushes. According to the type of habitat, the largest number of findings (15) is in the coastal zone of the watercourse, which is partially overgrown with vegetation. In six cases, the ephemeral type of terrain was forbidden, and in such habitats the species occurs only when the water is deeper than 30 cm, such is the case at Ribnjača pond, where this moss was recorded five times. In nine cases, the findings were in the lowland peatland at the Pačija bara site, while in two cases, the findings were in the mud (when the water recedes suddenly and quickly) or in the cracked mud itself after a slow withdrawal of water and percolation. Canals in the reserve are present in the protection zone and there were seven findings in the canals that are reclamation facilities. The emergent vegetation is *Scirpo-Phragmitetum* W. Koch 26 *subass. typhaetosum (angustifoliae-latifoliae)* Soó 73 developed along the canal banks and the species was found in water pockets between rushes. As the water depth increases in the canal, both floating and submerged plants appear, the most common vegetation being *Lemno-Salvinion natans* Slavnić 56, *Lemno minoris-Spirodeletum polyrhizae* W. Koch 1954, *Ceratophylletum demersi* (Soó27) Hild.1956, *Lemnetum trisulcae* Knapp et Stoffers 1962, and *Ceratophyllo-Hydrocharidetum morsus-ranae*. Pop. 1962. In the reserve zone, the species *Ricciocarpos natans* occurs in the following priority Natura 2000

habitats: 7230, 3260 and 3150 [4]. Within the boundaries of the reserve, we have 15 localities where the species has been found. We will develop six localities where we will analyze the type of habitat and vegetation. **Pačija bara**: is a specific habitat that belongs to the type of lowland peatlands (Natura 2000 code 7230) [13]. It is a depression in GJ "Vrbovac" surrounded by 110 ha of arboriculture of hybrid poplar and willow on α/β - β clay soil. The total area is 1,07 ha. In the pond itself, there are single trees of *Salix alba* and bushy *Salix cinerea*, which in some parts create an almost impassable terrain. The community of *Thelyptero-Phragmitio-Salicetum cinereae* M. Jank. 1984 is sporadically developed, where in the herbaceous floor there are characteristic lumpy sods of species from the genus *Carex* (*Carex riparia*, *C. pseudocyperus*, *C. hirta*, *C. otrubae*, *C. vulpina*) that dominate the terrain. Pačija bara is a periodic water body, which in its deepest part has up to 0.7–0.8 m of water. *Thelypteris palustris* Schott and *Urtica kioviensis* Rogow. appear in the parts where the peat is more pronounced, and *Hottonia palustris* L. occasionally appears. In addition to species from the genus *Carex*, which dominate as the most common species, the following are present: *Mentha aquatica* L., *M. longifolia* (L.) Huds., *Sparganium erectum* L., *Lemna trisulca* L., *Spirodela polyrrhiza* (L.) Schleid., *Riccia fluitans* L. **Bara Ribnjača** represents the rest of the wetlands in the inundation level of the rivers and dries up every year in the period from June to September. Vegetation consists of a wide emergent zone *Scirpo-Phragmitetum* V. Koch 26 *subass. typhaetosum (angustifoliae-latifoliae)* Soó 73 and depending on the water level of the *Lemno-Salvinion natans* Slavnić 56, *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954 and *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962, *Ceratophylletum demersi* (Soó 27) Hild. 1956, *Lemnetum trisulcae* Knapp et Stoffers appear. 1962 and *Potameto-Ceratophylletum demersi* Jank. 74. **Batar** is a tributary of Zasavica, 15 km long, rises near Sovljak. The protected part includes upstream from the mouth in a length of 5 km. Since the settlement of beavers in 2005, the habitat has changed drastically, siltiness has increased (mud depth over 1 m) and the water depth does not exceed 1 m. Coastal part of *Scirpo-Phragmitetum communities* W. Koch 26 *subass. typhaetosum (angustifoliae-latifoliae)* Soó 73, *Lemno-Salvinion natans* Slavnić 56, *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954, *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962 and *Ceratophylletum demersi* (Soó 27) Hild. 1956 appear in the riverbed (closer to the mouth) and *Lemnetum trisulcae* Knapp et Stoffers 1962 further upstream, depending on the water level [14]. The structure of the forest almost completely overlaps the watercourse, and part of the forest has entered the riverbed. The forest along the coast is a community of *Populeo-Salicetum* Raj. 1950. *subass. Ruboetosum* (Gajić 1954, Tóth 1958). em. Erdeši 1971. and further from the watercourse, depending on the configuration of the terrain and the level of groundwater, there are forests of *Genisto elatae-quercetum* Horv. 1938. *subass. Leucojo-fraxinetum* Glav. 1959, *Brachypodio silvaticae palustris-Quercetum* Erdeši. 1955 and *Genisto elatae-Quercetum* Horv. 1938. *subass. alno-carpinetosum* [15]. **Prekopac**: represents an ephemeral water area surrounded by forest. Until 2010, the water was in the trough all year round, after that the water appears in the spring and disappears in June. The bed of the Prekopac is overgrown with vegetation, *Scirpo-Phragmitetum* W. Koch 26 *subass. typhaetosum (angustifoliae-latifoliae)* Soó 73 or *subass. phragmitetosum* Schmalle 39. There is a narrow forest belt along the coast, and arable land continues to it. The forests belong ass. *Brachypodio silvaticae palustris-Quercetum* Erdeši. 1955 and *Genisto elatae-Quercetum* Horv. 1938 *subass. alneto-carpinetosum betuli*

Vuk 1959. When the canal with water is over 0.5 m deep, the community *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962 and *Hydrocharo-Nymphoidetum peltatae* Slavnić 56 appears, and when is water depth and up to 1.5 m there are communities of *Nymphaeetum albo-lutea* Nowinski 28 subass. *nupharetosum* (Timar) Kórpáti and *Potameto-Ceratophylletum demersi* Jank.74 [14]. **Kanal Jovača:** A narrow strip of occasionally flooded forests ass. *Genisto elatace-Quercetum* Horv 1938 subass. *Leucoio-Fraxinetum angustifolia* Glav. 1959 appears in the canal bed itself. In the canal, when there is water, communities of *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954 and *Lemnetum trisulcae* Knapp et Stoffers 1962 are developed, while the emersion zone consists of a community of *Scirpo-Phragmitetum* W. Koch 26 subass. *typhaetosum (angustifoliae-latifoliae)* Soó 73 and subass. *Schoenoplectetum lacustris* Soó 73 [14]. The Valjevac pasture covers an area of 300 ha. The pedological base is characterized by mineral-marsh soil with a large influence of underground and flood waters, and the soil is characterized as scaly rite cherts. The terrain is slightly undulating, interspersed with beams and depressions. A semi-aquatic community *Scirpo-Phragmitetum* W. Koch 26 with three sub-associations was developed on the coast: *phragmitetosum* Schmale 39, subass. *typhetosum (angustifoliae-latifoliae)* Soó 73 and subass. *Schoenoplectetum lacustris* Soó 57, which occur in the form of larger or smaller areas and is dominated by the subass. *typhaetosum (angustifoliae-latifoliae)* [14]. This community is followed by the belt ass. *Acoro-Glyceretum maximae* and the presence of this association is conditioned by the high level of groundwater and frequent flooding, and as a special element of this community is the presence of the species *Utricularia australis* as an Atlantic-Mediterranean species whose presence indicates a mesophilic and weakly acidic type of water [16]. In that flood zone, the moss *Ricciocarpos natans* was found in the community of *Scirpo-Phragmitetum* W. Koch 26 and *Acoro-Glyceretum maximae*.

Analysis of localities outside the boundaries of the protected area: Outside the boundaries of the reserve, the species was found in a total of 16 localities with a total of 22 findings. We have the largest number of finds, three each, in two localities (Bitva and Veliki Cerski kanal), followed by Kojšanski kanal 1 and 2 and Česljuška bar with two finds each. At 11 locations, individuals were counted on areas of a few square meters, while for areas larger than 10 m², an assessment of the surface coverage was made, and the values are given in percentages (%). The highest number of individuals counted was 36 in Šobatovac in 2010, followed by Kupusina greda with 28 and Duga bara with 22 individuals. In most cases the surface coverage was 30–40%, in two cases we had coverage over 50% and in one case the coverage was 60% at the Kojšanski kanal 1 locality in 2006 and Bitva in 2005. Among the sites, the site Kojšanski kanal 1 and 2 stands out with the largest area covered by individuals on an area of 50–100 m long and 2 m wide, where the surface coverage was 40–60% and the species was in the shafts between the rushes. According to the type of habitat, the largest number of finds (16) is in canals, in five cases the terrain was a slightly sunken depression with water over 30 cm deep. In one case, the species was found in dry cracked mud covered by tall vegetation in the Neškovine locality. In the majority of cases, the canals are on average 2–3 m wide where the emergent vegetation of the community *Scirpo-Phragmitetum* W. Koch 26 subass. *typhaetosum (angustifoliae-latifoliae)* Soó 73 is developed, which partly and completely covers the width of the canal and the individuals are found in water pockets

between the rush trees. The vegetation depends on the depth of the water and the most common species are *Lemno-Salvinion natans* Slavnić 56, *Lemno minoris-Spirodeletum polirrhizae* V. Koch 1954, *Ceratophylletum demersi* (Soo 27) et al. 1962., *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962. and *Lemno-Utricularietum vulgaris* Soo 1928. Outside the boundaries of the reserve, we have 16 localities where this species has been found. We will single out five localities where we will analyze the type of habitat. **Bitva** is a river that rises near the village of Dublje near Bogatić, 31 km long and has a wide alluvial plain in the lower reaches. It flows north to Glušac, then turns east and flows into the Sava downstream from Mačvanska Mitrovica. The catchment area of Bitva is 85 km². Today, this area is criss-crossed by a network of canals whose sides are steep and deep, especially in the part between Bogatić, Radenković and Glušac, and is a key hydrotechnical facility for flood defense [17]. Most of the canal is under vegetation *Scirpo-Phragmitetum* W. Koch 26 subass *typhaetosum (angustifoliae-latifoliae)* Soó 73 or subass. *Phragmitetosum* Schmalle 39. Depending on the water level, communities of *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954, *Lemnetum trisulcae* Knapp et Stoffers 1962 and *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962 occur in the canal. The canals partly pass through the forest belonging to the ass. *Brachypodio silvaticae palustris-Quercetum* Erdeši. 1955 and *Genisto elatae-Quercetum* Horv. 1938 subass *alno-carpinetosum betuli* Vuk 1959 [15]. **The Kojšan canal** partly goes through the forest or arable land. The canal is overgrown with *Scirpo-Phragmitetum* W. Koch 26 subass *typhaetosum (angustifoliae-latifoliae)* Soó 73, and subass. *phragmitetosum* Schmalle 39. The forests belong to the ass. *Brachypodio silvaticae palustris-Quercetum* Erdeši. 1955. In the period when there is a canal with water, the community *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962 occurs, and when the canal is up to 1.5 m deep, the *Nymphaeto-Stratiotetum aloidii* Jank. 74 or *Hottonietum palustris* Tx. 37 occur [14]. **Veliki Cerski kanal** is the most important hydrotechnical, regulatory watercourse in the region. It includes drainage systems and surface flows. It stretches from the foot of Mount Cer to the Sava River where it flows into Šabac. The sides of the canal are very steep and deep, partly overgrown with thick bushy vegetation. In the largest part of the canal, a zone of emergent vegetation of *Scirpo-Phragmitetum* W. Koch 26 subass *typhaetosum (angustifoliae-latifoliae)* Soó 73, or subass. *Phragmitetosum* Schmalle 39. Depending on the water depth, communities of *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954, *Lemnetum trisulcae* Knapp et Stoffers 1962, *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962 occur in the canal. **Virovlje** the forbidden area is overgrown with *Scirpo-Phragmitetum* W. Koch 26 subass *typhaetosum (angustifoliae-latifoliae)* Soó 73, while communities of *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954 and *Ceratophyllo-Hydrocharidetum morsus-ranae* Pop. 1962, *Ceratophylletum demersi* (Soó 27) Hild. 1956 or *Lemnetum trisulcae* Knapp et Stoffers 1962 appear in the bed, depending on the water level [14]. **Češljuška bara** is the rest of the pistevina in the inundation plane, which dries up in the summer. The vegetation consists of the emergent zone *Scirpo-Phragmitetum* V. Koch 26 subass *typhaetosum (angustifoliae-latifoliae)* Soó 73, and in the water *Lemno minoris-Spirodeletum polirrhizae* V. Koch de 19S. 27) Hild. 1956 L. and *Lemnetum trisulcae* Knapp et Stoffers 1962. It is generally noted that its appearance largely depends on the water level. The largest number of findings (6) were in 2009, 2010, and 2023, when it was a favorable hydrological year with high water all year round. However, we must single out the year 2014, when there was a hydrological maximum

in Serbia with large floods throughout the country when there were hundred-year waters. And even though the hydrological situation was good to excellent in those years, the surface coverage under the *R. natans* species ranged from 20–30%, except at the Pačija bara site, where 70% of the 50x10 m surface was covered. The species *R. natans*, together with the species *L. trisulca*, *R. fluitans*, *Utricularia vulgaris* and *Wolffia arrhizal*, belongs to the type of species limited to oligotrophic and mesotrophic waters, with the fact that species typical for mesotrophic and eutrophic spore and stagnant waters (*Salvinia natans* and *S. polyrrhiza*) occur as sporadic specimens in the canals [18]. The species spreads primarily by vegetative propagation as the plants divide [19]. In addition to natural habitats such as ephemeral floodplains, low-lying peatlands and the shores of the Zasavice swamps, the species also inhabits semi-natural and anthropogenic habitats such as canals, excavations, etc. The species is also found in zones where the water recedes and muddy areas of varying density remain, and on dry parts of the coast with sods and cracks in the soil, where the moss was on the sides of the sods or in cracks. The most common plants that are present in the immediate vicinity of this moss are: *Berula erecta* (Hudson) Coville; *Lythrum salicaria* L.; *Mentha aquatica* L.; *M. longifolia* (L.) Hudson; *Polygonum amphibium* L.; *P. aviculare* L.; *P. hydropiper* L.; *P. mite* Schrank.; *Rumex hydrolapatum* Huds.; *Alisma plantago-aquatica* L.; *Scirpus lacustris* L.; *S. erectum* L.; *Juncus effusus* L.; *Lemna minor* L.; *L. trisulca* L., *U. vulgaris* L., *Ceratophyllum demesum* L. Threatening factors are habitat destruction, changes in natural seasonal water level fluctuations due to climate change and water quality problems. The species does not tolerate excessive competition from eutrophication and natural ecosystem succession [4].

CONCLUSION

The species *Ricciocarpos natans* in Serbia has been recorded in a very small number of localities, which are mostly related to terrain north of the Danube and Sava rivers. Through our research in Mačva, the species was found in a total of 38 localities, of which 20 are within the reserve and 18 belong to the Northern Mačva region, with a total of 63 findings both within the protected area and outside it in Northern Mačva. The species is most often found in coastal vegetation *Scirpo-Phragmitetum* W. Koch 26 *subass. typhaetosum (angustifoliae-latifoliae)* Soó 73, *Lemno-Salvinion natans* Slavnić 56 and *Lemno minoris-Spirodeletum polyrrhizae* W. Koch 1954. For conservation purposes species, we need confirmation of the occurrence and distribution of the species in all parts of its known range, and that is why our data contribute to a better knowledge of its overall distribution in Serbia.

REFERENCES

- [1] Campbell DH. The Structure and Development of Mosses and Ferns (revised ed.). London: The Macmillan Co.; 1918. pp. 39–41.
- [2] Schuster RM. The Hepaticae and Anthocerotae of North America. Vol. VI. Chicago: Field Museum of Natural History; 1992. pp. 413–421.
- [3] Schofield WB. Introduction to Bryology. New York: Macmillan; 1985. p. 310.
- [4] Sergio C, Porley RD. *Ricciocarpos natans* (Europe assessment). The IUCN Red List of Threatened Species. 2019. Available from: www.iucnredlist.org/species/168892/87730535

- [5] Hodgetts NG, Lockhart N. Checklist and country status of European bryophytes –update 2020. Irish Wildlife Manuals. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 2020.
- [6] Pantović, J., Veljić, M., Grdović, S., *et al.* Cryptogamie, bryologie 2020, 41, 35–48.
- [7] Kitnaes KS, Plavac I, Vukelić VP, *et al.* Sites Important for Biodiversity along the Sava River in the frame of the LIFE 3rd project: “Protection of biodiversity of the Sava River Basin floodplains”. Project Report, 2010, 1–166.
- [8] Plavac I, Vukelić VP, Baranović PR, *et al.* Habitat Interpretation Sheets - Natura 2000 habitat types occurring along the Sava River in the frame of the LIFE 3rd project: “Protection of biodiversity of the Sava River Basin floodplains”. Technical Document, 2009, 1–129.
- [9] Pavletić Z. Flora mahovina Jugoslavije. Botanical Institute, University of Zagreb; 1968.
- [10] Gajić M, Karadžić D, Flora ravnog Srema sa posebnim osvrtom na Obedsku baru Šumarski fakultet Beograd i ŠG Sremska Mitrovica; 1991, pp. 77–357.
- [11] Javorka S, Magyar flóra (Flora Hungarica), Studium Budapest; 1924–1925, pp. 1307.
- [12] Josifović M, Flora SR Srbije I-X, SANU, odeljenje Prirodno-matematičkih nauka, Beograd; 1970–1986, pp. 197–198.
- [13] Dobretić V, Delić J, Perić R, *et al.* In: Zbornik radova „Zasavica 2012”, naučno-stručni skup sa međunarodnim učešćem o istraživanju biodiverziteta, Serbia. 2012. p. 17–57.
- [14] Dobretić V, Stojšić V, Delić J, *et al.* Specijalni rezervat prirode Zasavica-Predlog za stavljanje pod zaštitu kao zaštićeno područje I kategorije; Novi Sad, Serbia. 2012, p. 1–259.
- [15] Erdeši J, Janjatović G. In: Zbornik Naučnog skupa posvećenog istraživanjima vodenih ekosistema i plavnih zona; Sremska Mitrovica, Serbia. 2001. p. 57–64.
- [16] Stanković M. In: Zbornik radova VIII naučno-stručni skup o prirodnim vrednostima i zaštiti životne sredine, Zaječar, Serbia. 2000.
- [17] Marković JĐ. Enciklopedijski geografski leksikon Jugoslavije. Sarajevo: Svjetlos; 1990.
- [18] Cvijanović, Lj.D., Lakušić, V.D., Živković, M.M., *et al.* Tuexenia 2018, 38 269–286.
- [19] Allison KW, John C. The Liverworts of New Zealand. Dunedin: University of Otago Press; 1975. pp. 243–245.