TAXONOMIC AND ECOLOGICAL CHARACTERISTICS OF ROSEMARY-LEAVED WILLOW (*SALIX ROSMARINIFOLIA* L.) IN VOJVODINA REGION IN SERBIA

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Abstract. Rosemary-leaved willow (*Salix rosmarinofolia* L.) is a rare and protected species in Serbia. The research was based on ecological characteristics of this species (climatic, vegetational and edaphic) as well as its taxonomical characteristics in Vojvodina region - the northern part of Serbia, where two rosemary-leaved willow sites occur (Subotica-Horgos sand and Deliblato sand). The climate is temperate continental. This willow is the dominant species in two ecologically very similar plant communities, *Holoschoeno-Salicetum rosmarinifoliae* Stjep. Vesel. 1953. in Deliblato sand and *Festucetum vaginatae mixtum* Gaj. 1986. *salicetosum rosmarinifoliae* (Mag 1953) Soo 1939 in Subotica-Horgos sand. These communities are strongly xerophilous, when it comes to moisture requirements. They are strongly intolerant to light and they prefer alkaline soils. In relation to warmth, they are mesothermal to thermophilous. Hemicryptophytes are the dominant life form in the spectrum of life forms, followed by phanerophytes and therophytes. Pontic-Central Asian group is the most frequent in the spectrum of floral elements. Two varieties of *Salix rosmarinifolia* L. are present-var. *rosmarinifolia*, which dominates in both localities and var. *argyotricha*. The geological bedrock on both localities is made of sand, and soils belong to Glaysol (Calcaric, Arenic). Fraction of fine sand absolutely dominates, humus content is relatively low, while soil reaction is mildly alkaline. Soils are poorly supplied with phosphorus, while the potassium supply is somewhat better. Occurrence of rusty-grayish zones in deeper soil layer indicates fluctuation in underground water level and reduction-oxidation processes.
Keywords: *Subotica sand, Deliblato sand, ecology, taxonomy, variability*

Introduction

The *Salix* L. genus is one of the genera richest with woody species in the northern Hemisphere. Flora of Serbia contains 18 native species of *Salix* L. (Cvjetićanin and Perović, ined.). Rosemary-leaved willow (*Salix rosmarinifolia* L.) taxonomically belongs to subgenus Vetrix, section Incubae. It is a small shrub, achieving heights of 0.5-2 m. It is distributed in northern, central and eastern Europe, and western Siberia (Cvjetićanin et al., 2016). To the west it integrates with *Salix repens* L. and hybridizes with that species (Bartha, 2014). In Serbia this species is on the southern limit of its distribution range, while in Bulgaria it is considered extinct (Plants of the World online, 2023). Rosemary-leaved willow is a rare species in Serbia and it is protected by law (Službeni glasnik Republike Srbije, 2010, 2016). It is registered only on a couple of localities: Subotica-Horgos sand, Deliblato sand, Kopaonik, Vlasina lake and Pešter plateau (Cvjetićanin and Perović, ined.). Its typical sites are swamps, margins of wet forests or meadows, but it also grows as a pioneer species of sandy areas, especially in deeper depressions between dunes. It likes soils which are rich in alkalis (Gajić, 1983).

Although there is no specific research on the abundance of this species in Serbia, it is noted that its frequency is declining. As an example, Stjepanović-Veseličić (1979), during investigation of vegetation of Deliblato sand, mentioned occurrence of this

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species on several localities, where this willow is not to be found anymore. Considering the rarity of this species in Serbia, its declining abundance, and that there has not been any detailed ecological investigation of this species in Serbia, the aim of this research was to increase the knowledge about its ecological characteristics, which include climate, vegetation and soil data. Research was done in Vojvodina region, which is located in northern part of Serbia, where the two known sites of rosemary-leaved willow occur (Subotica-Horgos sand and Deliblato send). Both localities represent inland dunes. Native grasslands and inland dunes of Vojvodina are considered to be among the most important centers of floristic diversity of Serbia, because they are rare ecosystem entities, mostly destroyed by anthropogenic factor, and they contain the last fragments of relic native grassland flora and vegetation (Stevanović et al., 1995).

Since within-species variation can have consequences for community dynamics and structure (Simović and Ocokoljić, 2022), taxonomic variability of this species on researched localities was also investigated with the aim to get detailed coenological knowledge. Ecosystems not only provide the necessary raw materials for life and production, but the products and services they provide are also important assets that humans rely on for survival and development (Pan et al., 2022), so the results of this research will provide more efficient *in situ* conservation of gene poll of this species, and facilitate protection of its plant communities.

Material and methods

The research was done in the year 2021. in two rosemary-leaved willow sites in Vojvodina region (Subotica-Horgos sand and Deliblato sand), which are the only two sites of this species in Vojvodina. Two sample plots from each site were taken into research (*Table 1*). Each sample plot had an area of 400 m^2 and covers the area of abundant occurrence of the species. Both researched objects are protected by law, Subotica-Horgos sand is in a category “Terrain of extraordinary features”, and Deliblato sand is a “UNESCO Special Nature Reserve”. On both researched localities the terrain is flat, without inclination, and elevations are around 80 m a.s.l. (Deliblato sand) or 120 m a.s.l. (Subotica-Horgos sand) (*Fig. 1*).

Table 1. *Researched localities with coordinates*

Locality	Latitude	Longitude	Elevation (m a.s.l.)
Deliblato sand			
1	44°50’06”N	21°16’06”E	80
2	44°50’16”N	21°16’31”E	80
Subotica-Horgos sand			
1	46°10’22”N	19°39’50”E	120
2	46°09’29”N	19°42’17”E	120

The research of taxonomic variability was done on the basis of leaf characteristics, while ecological research included climatic, vegetation and soil research.

Climate investigation was done using the data from the nearest synoptic climate stations - Sombor (45°46’N; 19°09’E; elevation 88 m a.s.l.) for Subotica-Horgos sand and Veliko Gradište (44°45’N; 21°31’E; elevation 82 m a.s.l.) for Deliblato sand. The

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analyzed data covered period from 1991. to 2020. years (https://www.hidmet.gov.rs; visited July 24th, 2021).

Intraspecific taxonomy of rosemary-leaved willow is based on leaf properties (Jovanović and Tucović, 1972; Cvjetićanin and Perović, ined.). For that reason, 20 *Salix rosmarinifolia* L. individuals were selected in each sample plot, and 20 leaves from each individual were taken into research (totally 400 leaves per locality), with the aim of ascertaining morphological leaf characteristics and taxonomical affiliation of populations.

Figure 1. *Map of protected areas of region Vojvodina with marked research localities: 1. Deliblato sand; 2. Subotica-Horgos sand (http://www.ekourbapv.vojvodina.gov.rs/rs/) visited July 24th, 2021*

Four phytocoenological relevés were collected (one relevé for each sample plot), using standard Braun-Blanquet method (Braun-Blanquet, 1964). On the basis of phytocoenological relevés, phytocoenological tables were produced. Determination of species was done using "Flora of Serbia" I-X (Josifović et al., 1972-1977; Sarić et al., 1986, 1992; Stevanović et al., 2012, 2022), "Flora Deliblatske peščare" (Gajić et al., 1983) and "Flora i Vegetacija Subotičko-Horgoške peščare" (Gajić, 1986).

Names of plant communities were given according to "Codex of Phytocoenological Nomenclature" (Weber et al., 2006) and "Forest phytocenoses of Serbia (Tomić and Rakonjac, 2013). Based on produced phytocoenological tables, ecological spectra were determined (relation of plant species towards moisture, soil reaction, light and heat), as well as the spectrum of life forms and the spectrum of floral elements. Ecological spectra and spectrum of life forms were produced according to Kojić et al. (1997) and Ellenberg and Leuschner (2010), while the spectra of floral elements were done according to Gajić (1980, 1984).

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Four soil profiles (one per each sample plot) were prepared and analyzed for investigation of soil characteristics. The type of geological bedrock and soil were determined, as well as physical and chemical soil properties. The laboratory soil analysis was done in the laboratories of University of Belgrade-Faculty of Forestry. WRB system was used for soil type determination (Knežević et al., 2011). Laboratory investigation was done according to the methods of Yugoslav Soil Research Society (1966, 1997).

Results

Climate characteristics

Climate characteristics on both localities are almost the same. The climate is temperate continental, with maximal temperatures in July and minimal in January. Mean temperature in July is 22.5°C in Sombor, and 22.6°C in Veliko Gradište. During January, mean temperatures are 0.5°C in veliko Gradište, and 0.6°C in Sombor. Mean yearly temperature is 11.9°C in Veliko Gradište, and 11.7°C in Sombor. Mean yearly precipitation is 636.0 mm in Sombor, and 669.8 mm in Veliko Gradište, which is below average level for Serbia (896 mm). Precipitation is relatively evenly distributed throughout the year, with maximal values in summer months (Sombor-79.8 in June, Veliko Gradište-76.3 mm in July), and minimal in March (Sombor-35.4 mm, Veliko Gradište-41.5 mm).

Vegetation characteristics

The total number of 59 vascular plant species was recorded on phytocoenological relevés. Rosemary-leaved willow is the dominant species in the shrub layer in all relevés. Individual specimens of native white poplar (*Populus alba* L.), as well as introduced black locust (*Robinia pseudoacacia* L.) and black pine (*Pinus nigra* Arn.) occur in tree layer. Most frequent species in the ground layer are: *Scabiosa ochroleuca* L., *Galium verum* L., *Euphorbia cyparissias* L., *Achillea millefolium* L., *Centaurea arenaria* Bieb. & Willd., *Verbascum lychnitis* L., *Polygala comosa* Schkur, *Silene otites* (L.) Wibel and *Asclepias syriaca* L.

According to Jovanović (1997), *Salix rosmarinifolia* L. is the dominant species in plant community *Holoschoeno-Salicetum rosmarinifoliae* Stjep. Vesel. 1953 in Deliblato sand, while in Subotica-Horgoš sand it builds a very similar ecological community *Festucetum vaginatae mixtum* Gaj. 1986. *salicetosum rosmarinifoliae* (Mag 1953) Soo 1939 (*Table 2; Figs. 2* and *3*).

Figure 2. *Rosemary-leaved willow community on Subotica-Horgos sand*

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Figure 3. *Rosemary-leaved willow community on Deliblato sand*

Table 2. *Phytocoenological table for rosemary-leaved willow communities on Deliblato and Subotica-Horgos sands*

Plant community	***Holoschoeno–Salicetum rosmarinifoliae*** Stjep. 53		***Festucetum vaginatae mixtum salicetosum rosmarinifoliae*** **(**Mag. 53) Soo 39		
Locality	**Deliblato sand**		**Subotica-Horgos sand**		
No. of phytocoenological relévе	1	2	3	4	**Presence level**
Forest compartment	426	428	41	58	
Elevation (m a.s.l.)	80	80	120	120	
Aspect	-	-	-	-	
Inclination (°)	-	-	-	-	
Area of relevé (m²)	400	400	400	400	
TREE LAYER					
Canopy	0.1	0.2	0.1	0.1	
Average height (m)	6	6	10	6	
Average diameter (cm)	15	15	20	15	
Average distance (m)	8	6	8	7	
Pinus nigra Arn.	+	+			**III**
Populus alba L.		1.2	1.1		**III**
Robinia pseudoacacia L.		+		1.1	**III**
Juniperus communis L.	1.1				**II**
SHRUB LAYER					
Canopy	0.2	0.4	0.5	0.5	
Average height (m)	1.2	1.5	1.5	1.5	
Salix rosmarinifolia L.	2.3	2.3	3.3	3.3	**V**
Populus alba L.		2.3	+		**III**
Robinia pseudoacacia L.		+		+	**III**
Juniperus communis L.	+				**II**
Genista tinctoria L.	+				**II**
Berberis vulgaris L.		1.1			**II**
Pinus nigra Arn.		+			**II**
Crataegus monogyna Jacq.			1.1		**II**
Celtis occidentalis L.			1.2		**II**
GROUND LAYER					
Coverage	0.9	1.0	1.0	1.0	
Scabiosa ochroleuca L.	1.1	+	1.1	1.2	**V**
Galium verum L.	2.3	2.3	1.1	1.1	**V**
Euphorbia cyparissias L.	2.3	3.4	2.2		**IV**

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Achillea millefolium L.	1.2	1.1	1.1		**IV**
Centaurea arenaria Bieb. & Willd.	+	+		+	**IV**
Verbascum lychnitis L.	+		+	1.1	**IV**
Polygala comosa Schkur	+	+ .1	+		**IV**
Silene otites (L.) Wibel		1.2	1.1	+	**IV**
Asclepias syriaca L.		+	1.1	+	**IV**
Teucryum chamaedrys L.	1.2	1.1			**III**
Euphorbia seguierana Necker	1.1			+	**III**
Hieracium umbellatum L.	+	+			**III**
Lotus corniculatus L.	+ .1	1.1			**III**
Phleum phleoides (L.) Karst.	+			+	**III**
Scirpus holoschoenus L.	1.2	1.1			**III**
Carduus nutans L.	+	+			**III**
Veronica spicata L.	+			+	**III**
Calamagrostis epigejos (L.) Roth.	+			1.1	**III**
Potentilla arenaria Borkh.	+ .1	1.2			**III**
Festuca vallesiaca Schleich & Gaudin	2.3	2.3			**III**
Poa pratensis L.		3.4	+		**III**
Festuca vaginata Wald. et Kit.			2.3	1.2	**III**
Consolida regalis Gray			1.1	1.1	**III**
Tragopogon floccosus Wald. et Kit.			+	+	**III**
Inula salicina L.	+				**II**
Poa compressa L.	+				**II**
Alyssum tortuosum Wald. et Kit.	+				**II**
Lithospermum officinale L	+				**II**
Arthemisia campestris L.	3.3				**II**
Dianthus giganteiformis Borbas	+				**II**
Chrysopogon gryllus (L.) Trin.		2.2			**II**
Coronilla varia L.		1.1			**II**
Stipa joannis Cel.			3.3		**II**
Dactylis glomerata L.			+		**II**
Succisa pratensis Moench			1.1		**II**
Erigeron canadensis L.			1.2		**II**
Alopecurus pratensis L.			+		**II**
Setaria glauca (L.) R. Br.			+		**II**
Hordeum murinum L.			1.1		**II**
Marrubium peregrinum L.			+		**II**
Podospermum canum Mey			+		**II**
Andropogon ischaeum L.			+		**II**
Stipa capillata L.				3.3	**II**
Calamintha acinos (L.) Claivr.				+	**II**
Polygonum arenarium Wald. et Kit.				1.1	**II**
Asperula cynanchica L.				+	**II**
Eryngium campestre L.				+	**II**
Thymus glabrescens Willd.				1.2	**II**
Arabis hirsuta (L.) Scop.				+	**II**
Crepis fetida L.				+	**II**

According to moisture requirements, rosemary-leaved willow plant communities are very xerophilous, since predominantly xerophilous species (xerophytes and subxerophytes) make 76% of all species, while mesophilous make 14%, and mostly hygrophilous species 10% (*Table 3*).

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Table 3. *Relation of plants toward soil moisture (vascular plant species number and their percentage share)*

Xerophytes	Subxerophytes	Mesophytes	Subhygrophytes
11 (19%)	33 (57%)	8 (14%)	6 (10%)

Decisive factor for survival of rosemary-leaved willow communities is a relatively high level of underground water. The withdrawal of underground water through aridization of the area lead to an increased share of xerophytes and fragmentation of the rosemary-leaved willow sites (Stjepanović-Veseličić, 1979). Contrastingly, moisture requirements of different species are caused by their various root depths, which use different levels of underground water (Jovanović, 1997).

Analysis of relation of plant species to soil reaction shows that the communities are mostly alkaliphilous, since alkaliphilous vascular plant species make 55% of total number, neutrophilous 28%, acidophilous only 3%, while 14% of plant species are indifferent towards soil reaction (*Table 4*).

Table 4. *Relation of plant species toward soil reaction (vascular plant species number and their percentage share)*

Acidophiles /neutrophiles	Neutrophiles	Neutrophiles /alkaliphiles	Alkaliphiles	Indifferent species
2 (3%)	16 (28%)	30 (52%)	2 (3%)	8 (14%)

Regarding the light requirements, the plant communities with dominance of rosemary-leaved willow are very intolerant, since mostly intolerant species comprise 78%, semitolerant - 22%, while tolerant species were not recorded at all (*Table 5*).

Table 5. *Relation of plant species toward light (vascular plant species number and their percentage share)*

Semitolerant	Semitolerant/intolerant	Intolerant
13 (22%)	41 (71%)	4 (7%)

According to warmth requirements, both communities have thermophilous-mesothermic character, since thermophilous species make 51%, and mesothermic 48% of the total number. Microthermic species are not present (*Table 6*).

Table 6. *Relation of plant species toward warmth (vascular plant species number and their percentage share)*

Mesothermic	Mesothermic/thermophilous	Thermophilous
28 (48%)	24 (41%)	6 (10%)

Analysis of life forms spectrum shows the dominance of hemicryptophytes (herbaceous perennial plants) with 59%, which are globally the most frequent life form in sites with temperate continental climate. After them come the phanerophytes with

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14%, and therophytes with 10%. Chamaephytes (8%) and geophytes (3%) are scarcely represented. The share of geophytes in these communities is significantly lower compared to the normal life form spectrum of Serbia, where the participation of this life form is 9% (Jovanović, 2007). That is caused by the intolerant character of these communities to light, which need intensive illumination for its development. Because of that, there is no significant development of ephemerophytes, plants which finish their life cycle in a very short period, and which are characterized by the geophyte life form (Allaby et al., 2015) (*Table 7*).

Table 7. *Spectrum of life forms (vascular plant species number and their percentage share)*

Phanerophytes	Hemicryptophytes	Chamaephytes	Geophytes	Therophytes
8 (14%)	35 (59%)	5 (8%)	2 (3%)	6 (10%)

The most frequent group in the spectrum of floral elements is Pontic-Central Asian (41%), connected to steppes of Pannonian basin, and it confirms the mostly steppe character of investigated area. Floral elements of wide ecological amplitude (Eurasian and Circumpolar and cosmopolitan group), also have a significant participation of 37%. Significantly scarcer are members of Central European (10%), and Submediterranean groups (4%). Four adventive vascular plant species were recorded on researched area - *Robinia pseudoacacia* L., *Celtis occidentalis* L., *Asclepias syriaca* L. and *Erigeron canadensis* L., which at the same time belong to invasive species in Serbia (Stojanović et al., 2021). That means that researched communities suffer from moderate level of weeding processes, which will require removal of invasive species (*Table 8*).

Table 8. *Spectrum of floral elements*

Group of floral elements	Number of plant species	Percentage share
Pontic-Central Asian	24	41%
Eurasian	17	29%
Central European	6	10%
Circumpolar and cosmopolitan	5	8%
Submediterranean	3	5%
Adventive	4	7%

Taxonomical characteristics

According to leaf characteristics, two varieties were set apart: *Salix rosmarinifolia* var. *rosmarinifolia*, which has glabrous mature leaves, and *Salix rosmarinifolia* var. *agryotricha*, which has silvery silky pubescent mature leaves. Within var. *rosmarinifolia*, three forms were determined, depending on leaf dimensions (relation of length to width) and shape:

1. *Salix rosmarinifolia* var. *rosmarinifolia* f. *rosmarinifolia*, has leaves around 5 times longer than wide, with typical leaf shape
2. *Salix rosmarinifolia* var. *rosmarinifolia* f. *latifolia*, with elongated lanceolate leaves, 2 to 4 times longer than wide

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3. *Salix rosmarinifolia* var. *rosmarinifolia* f. *angustifolia*, with linear or linear-lanceolate leaves, 6 to 10 times longer than wide

The highest relation of leaf length to width (7.34) was recorded at the tree No. 10 on first site on Deliblato sand, while the lowest value (3.78) was recorded on tree No. 3 on the second site of Subotica-Horgos sand.

Table 9 shows that both varieties and all forms of rosemary-leaved willow occur on both sites in similar abundance so there is no significant oscillation considering leaf dimensions and prevalence of different taxa within the researched localities (*Table 9; Fig. 4*).

Table 9. *Distribution of varieties and forms of rosemary-leaved willow on researched localities (number of individua and percentage share)*

	S. rosmarinifolia* var. *argyotricha	***S. rosmarinifolia* var. *rosmarinifolia***	***var. rosmarinifolia* f. *rosmarinifolia***	***var. rosmarinifolia* f. *latifolia***	***var. rosmarinifolia* f. *angustifolia***
Deliblato sand	3 (8%)	37 (92%)	28 (70%)	4 (10%)	5 (12%)
Subotica-Horgos sand	4 (10%)	36 (90%)	25 (62%)	8 (20%)	3 (8%)

Salix rosmarinifolia var. *argyrotricha* occurs much more scarcely than *Salix rosmarinifolia* var. *rosmarinifolia*. Most frequent form is *Salix rosmarinifolia* var. *rosmarinifolia* f. *rosmarinifolia* which dominates on both localities.

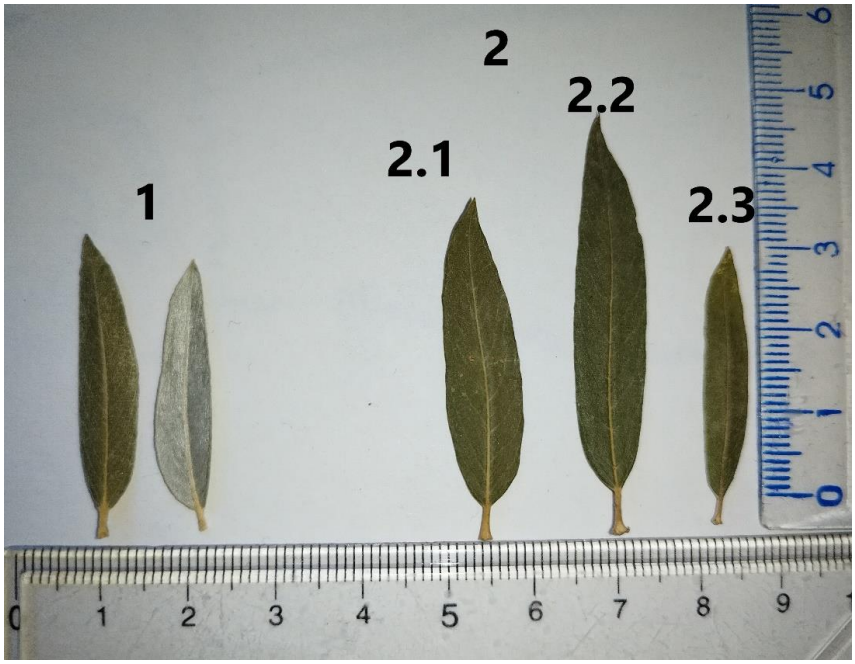

Figure 4. *Display of varieties and forms of rosemary-leaved willow on researched localities. 1. S. rosmarinifolia var. argyrotricha. 2. Salix rosmarinifolia var. rosmarinifolia (2.1 f. latifolia; 2.2 f. rosmarinifolia; 2.3 f. angustifolia)*

Soil characteristics

Soil analysis revealed that on both localities, on all four analyzed soil profiles the same parent rock type occurs (sand) as well as the same soil type - Glaysol (Calcaric, Arenic),

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according to WRB soil classification (Knežević et al., 2011). Such soils form under the influence of microrelief and underground water in the profile which never reaches the surface, but oscillates at the depth of 0.5-1.5 meters. Water reaches the zone of rhizosphere by capillary ascending process, thus enabling lush vegetation development.

The fraction of fine sand absolutely dominates in the researched soil profiles, while clay and colloids content vary, but usually increase their share with increasing soil depths. Researched soils possess relatively low humus content. The humus is mostly represented up to 20 cm depth (1.18-2.74%), and it decreases with increasing soil depth (0.10-0.78%). Soils have mildly alkaline reaction (pH 8.20-8-80). They are poorly supplied with accessible phosphorus (1.1-2.3 mg/100 g of soil), while the supply with potassium is somewhat better (1.0-2.8 mg/100 g of soil).

The presence of underground water in profiles is essential for *Salix rosmarinifolia's* survival on these dry sites. The emergence of grayish-rusty zones in deeper parts of soil profiles points to fluctuation in underground water level and reduction-oxidation processes, so it can be concluded that it is in accordance with the requirements of the researched species. Its survival on such localities is conditioned mostly by edaphic factors, i.e. water presence in soil profile, which, in inland dunes, occurs sufficiently only in interdune depressions, where water retains for longer period (*Fig. 5*).

Figure 5. *Soil profiles Deliblato sand 2 and subotica-Horgos sand 2*

Conclusion

Rosemary-leaved willow (*Salix rosmarinifolia* L.) is a rare species in Serbia and it is protected by law (Službenik glasnik Republike Srbije, 2010, 2016). It is recorded only on a couple of sites: Subotica-Horgos sand, Deliblato sand, Kopaonik, Pešter tableland, Vlasina lake (Cvjetićanin, Perović, ined.). This research was based in Vojvodina region, which is the northern part of Serbia, where two of the rosemary-willow sites occur (Subotica-Horgos sand and Deliblato sand).

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The climate on researched localities is temperate continental, with maximal temperatures in July (around 22.5°C) and minimal in January (around 0.5°C). The precipitation is evenly distributed throughout the year and it is around 650-700 mm yearly. On researched localities, this species is the dominant species in two ecologically very similar plant communities, *Holoschoeno-Salicetum rosmarinifoliae* Stjep. Vesel. 1953. in Deliblato sand and *Festucetum vaginatae mixtum* Gaj. 1986. *salicetosum rosmarinifoliae* (Mag 1953) Soo 1939 in Subotica-Horgos sand. Researched communities are strongly xerophilous, when it comes to moisture requirements. They are strongly intolerant to light, and considering soil reaction, they are alkaliphilous. They have mesothermal to thermophilous character, when it comes to warmth. Hemicryptophytes are the dominant life form in this spectrum of life forms, followed by phanerophytes and therophytes. Pontic-Central Asian group is the most frequent in the spectrum of floral elements, connected to steppe areas of Pannonian lowland, which confirms mostly steppe character of researched localities. Significant distribution possesses also the floral elements of wide ecological amplitude (Eurasian and Circumpolar and cosmopolitan floral groups).

Two varieties of rosemary-leaved willow are present in researched localities - *Salix rosmarinifolia* var. *rosmarinifolia*, which dominates in both localities and comprises 73 out of 80 analyzed specimens and *Salix rosmarinifolia* var. *argyotricha*, which is represented by seven specimens. There is no difference in their occurrence on researched localities.

Analysis of soil profiles shows that geological bedrock on both localities is made of sand, and soils belong to Glaysol (Calcaric, Arenic). Fraction of fine sand absolutely dominates in these soils, while content of clay and colloids varies, but usually increases as soil layers deepen. Humus content is relatively low and decreases with increasing soil depth. Reaction of soils is mildly alkaline. They are poorly supplied with accessible phosphorus, while the supply with potassium is somewhat better. Occurrence of rusty-grayish zones in deeper soil layer indicates fluctuation in underground water level and reduction-oxidation processes. The presence of underground water in profile is essential for *Salix rosmarinifolia* L. survival on these dry sites.

Considering that *Salix rosmarinifolia* L. is a rare and protected species in Serbia, which is significantly endangered by aridification and the occurrence of intensive droughts, the results of this research in Vojvodina region will contribute to the increased knowledge of rosemary-leaved willow ecology and its taxonomy in the region. This will facilitate protection of this species on natural sites, adding that all activities which could contribute to reduced distribution or disappearing of this species should be restricted.

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