

Management of continental saline ecosystems in the Republic of Serbia – Are these ecosystems suitable for nature-based tourism?

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Abstract: Continental saline habitats represent unique, authentic and rare ecosystems. These ecosystems are typically distributed in arid and semi-arid regions; however, they are also found in inland areas in temperate climate zones. Usually, the general public is not familiar with this particular type of ecosystem. In order to present saline habitats to tourists, a broadly applied method of ecosystem suitability assessment (ESI – ecosystem suitability index) was used and adjusted to the purposes of this research. The research aims to estimate the nature-based tourism potentials of selected sites. Thus, six representative halophytic habitats distributed along the geographic gradient, from the Pannonian Plain to the south of Serbia, were chosen. In terms of each site, seven indicators (e.g., flora and vegetation, bird fauna, landscape, protection status, accessibility, and ecotourism facilities), important for nature-based tourism, were analyzed. The results show that the Pannonian saline habitats have greater opportunities for development of this type of tourism in almost all categories compared to southern sites.

Keywords: saline habitats, nature-based tourism, ecosystem suitability index

JEL classification: Q57

Upravljanje slatinskim ekosistemima u Republici Srbiji – Da li su pogodni za turizam zasnovan na prirodnim resursima?

Sažetak: Kontinentalna slatinska područja predstavljaju jedinstvene, autentične i retke ekosisteme. Ova područja su svojstvena aridnim i semiaridnim klimatskim zonama, ali se sporadično pojavljuju duboko u kontinentu umerene zone. Često je ova vrsta ekosistema nepoznata široj populaciji. U svrhu približavanja slatinskih staništa turistima korišćen je široko primenljivan metod procene podobnosti ekosistema za turizam zasnovan na prirodnim resursima. Cilj ovog istraživanja je procena ekoturističkih potencijala odabranih područja. Za

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potrebe istraživanja izdvojeno je šest reprezentativnih slatinskih lokaliteta duž geografskog gradijenta, od Panonske nizije do juga Srbije. Za svaki lokalitet je analizirano sedam kriterijuma (flora i vegetacija, fauna ptica, predeo, status zaštite, pristup i ekoturistička infrastruktura) koji su značajni za ekoturizam. Rezultati su pokazali da panonske slatine imaju veći ekoturistički potencijal po gotovo svim analiziranim kriterijumima u poređenju sa južnim slatinama.

ključne reči: slatinska područja, ekoturizam, indeks podobnosti ekosistema
JEL klasifikacija: Q57

1. Introduction

Saline ecosystems are primarily distributed in arid and semi-arid regions, but they could be found in all climate zones as a type of intrazonal vegetation. Generally, around the globe, naturally occurring saline areas, salt affected soils include salt marshes, salt coastal wetlands or salt sandy shores, as well as continental salt marshes and meadows/pastures. Flora and vegetation growing in salt-affected areas is referred to as halophytic flora and vegetation. Halophytes are remarkable group of plants that have developed special abilities and mechanisms to cope with extremely high salt concentrations (Rančić et al., 2019). The fact is that only a small number of plants can grow in conditions of increased salinity. The habitats with halophytic flora and vegetation are indeed captivating landscapes, bearing no resemblance to any other attractive ecosystem. Saline habitats, as rare and specific ecosystems, have an important role and are valuable for preserving the natural habitats of halophytic species and communities, including the regulatory and supporting functions, as well as a great potential for tourism development. Because of their authenticity, representativeness and rarity, saline habitats can be ranked as an ecotourism attraction.

In the Republic of Serbia, these rare saline habitats are primarily distributed in the Pannonian plane, where different salt-affected soil types occupy the surface of 15,000 to 25,000 ha. Most of them are located in Bačka, then in Banat and fewer in Srem. The highest percentage of solonetz type of soil is found in Banat (68,000 ha), less in Bačka (4000 ha) and even less in Srem (3,000 ha) (Đorđević & Radmanović, 2016). Saline habitats appear as small mosaically distributed patches in the southern part of Serbia, near the Prokuplje, Vranje and Bujanovac. Natural saline ecosystems are among the most endangered and fragile habitats in Serbia, due to high anthropogenic pressure, including the formation of reclamation canals, changes in the water regime, conversion of salt-affected soils into arable land or garbage dumps, intensive grazing, invasion of weeds and ruderal flora, burning, construction etc. According to (Zlatković et al., 2005), to this day, rare saline habitats have survived in the area of Vojvodina and few of them in the south of Serbia. Besides well-affirmed ecotourism attractions, saline habitats could be seen as captivating multifunctional additions in tourism offer, contributing to nature conservation and education, as well as boosting the economy and diversification of economic activities in local communities.

In general, saline habitats, especially coastal and continental salt marshes, have similar characteristics to wetlands that are recognized as an ecotourism attraction. Wetlands, as well as salt marshes, are ranked as productive ecosystems for their biodiversity richness, especially in plant and bird species, and very attractive landscapes. According to biodiversity and ecosystem features, these types of habitats could be considered as a place of nature-based tourism and recreation. Coping and replicating a well-established model of wetland ecotourism supports development of saline habitats as ecotourism sites that provide advantages and potentials for local communities through the diversification of the local economy, as well as ensures ecological benefits for these sites.

The aim of this study is to review and assess suitability of selected saline habitats in the Republic of Serbia for nature-based tourism. The research was based on the hypothesis that the remaining natural and autochthonous saline habitats possess a variety of natural values (original flora, fauna, landscapes, etc.) suitable to be considered as nature-based tourism objects providing a range of ecological and economic benefits.

2. Theoretical background

Throughout the world, saline habitats refer to coastal salt marshes called lagoons, mangrove habitats, sand dunes, continental halophytic ecosystems with specific halophytic flora and vegetation adapted to survive in the range of environmental conditions – edaphic rather than climatic, as well as wet saline habitats, deserts and salt meadows in the temperate climate zone (González, 2020; O’Leary & Glenn 1994). Saline habitats are characterized by a range of roles in terms of ecosystem functions and services. Besides maintaining ecosystem balance, they have a variety of commercial values (Nikalje et al., 2019). Saline meadows are traditionally used for livestock grazing as well as hay supply for winter feed. It is known that many halophytes are suitable for pharmaceuticals or industrial chemicals production, as well as for raw materials such as fiber, biomass, biofuel, etc. (Dagar, 2005). Halophytes support human well-being through food, fodder, non-timber forest products (Zhao et al., 2011). They are also a source of medicinal and aromatic plants, spices, construction materials, energy, and ecosystem support. Their role in CO₂ sequestration, landscaping, natural purification, environmental protection and wildlife support is very important (Luković et al., 2021). In addition, a number of recent studies examined chemical suitability of halophytes for human nutrition (Barreira et al., 2017). The demand for halophytic products on the European market is growing. Some halophytic species, e.g., *Salicornia europaea*, *Salicornia frutescens*, *Suaeda maritima*, *Aster* sp. genus *Atriplex* have already become a part of the new and attractive cuisine. In some tourist centers they are included in the gastronomic offer and often used in salads, as spices, side dishes and etc., due to their health benefits for the consumers (Petrooulos et al., 2018; Srivarathan et al., 2020).

Several studies (e.g., Lasabuda et al., 2019) investigated ecotourism suitability of mangrove habitats (as one of the saline types). Mangrove ecosystems are becoming, in recent times, a subject of interest as tourism destinations. The growing popularity of mangroves and the findings of the mentioned studies are used to promote a sustainable approach, nature, and wildlife conservation (Nelly et al., 2019). In addition, certain studies were conducted to determine marine ecotourism suitability (Johana et al., 2017; Tanto et al., 2018). By examining the studies, practice, knowledge, and experience in wetlands ecotourism, as well as a new approach in mangrove ecosystems as an ecotourism destination, the authors came up with the idea to analyze potentials and suitability of continental saline habitats in this respect. Salt marches and salt meadows (steppe) are inconsistently distributed in the territory of the Republic of Serbia (the Pannonian plane and southern Serbia). Salt marches represent one of the floristic centers in the Republic of Serbia. The landscape of saline habitats complements several shallow alkaline lakes. These rare inland habitats have existed in the Carpathian Basin since the last Ice Age (Šefferová Stanová et al., 2008). The unusual plant species characteristic for marine areas rather than the country which has no access to the sea, together with sparkly-crystal surfaces formed due to the increased salt concentration in the soil and high evaporation of groundwater during summer, make these areas unique and very attractive. Alkaline lakes are habitats of many different bird species that could be the subject of interest of a wider group of ecotourists (Ecsedi et al., 2004). Due to limited geographical distribution and anthropogenic factors, they belong to the group of the most threatened habitats in Europe. Only several sites are under protection, while the rest of them are competing with agriculture or human impact. In recent time there has been some progress

towards protecting such rare ecosystems. Nature-based tourism could be the solution for the promotion of educational aspects including gaining practical experience, getting opportunities to work with scientists, involvement in data collection and active participation in nature conservation. Ecotourism activities offer travel opportunities to tourists who are fond of nature and willing to contribute to conservation, as well as open to learning about rare habitats, country and culture (Lowman, 2004). As responsible tourism branch, nature-based tourism is a driving force and a safeguard of the ecosystem integrity and producer of economic benefits for local communities that can encourage conservation (Nash, 2001). Such rare ecosystems are always attractive for eco-tourists, and their “placing on the market” must be strictly regulated by conservation strategies and sustainable use of natural resources, even though nature-based tourism has less harmful impacts (Sánchez-Prieto et al., 2021). To avoid any kind of negative impact of tourism, it is necessary to apply sustainable development models, which imply using natural resources “that meet[s] all economic, social, and aesthetic needs while respecting cultural integrity, basic ecological processes, biological diversity, and lifestyles” (Raičević & Marjanović, 2021, p. 92). Saline ecosystems as a part of rural ambient include numerous additional activities arranged by rural hosts such as hunting, fishing, horse-riding, walking, even wellness (Tomić et al., 2020).

3. Materials and methods

3.1. Study area

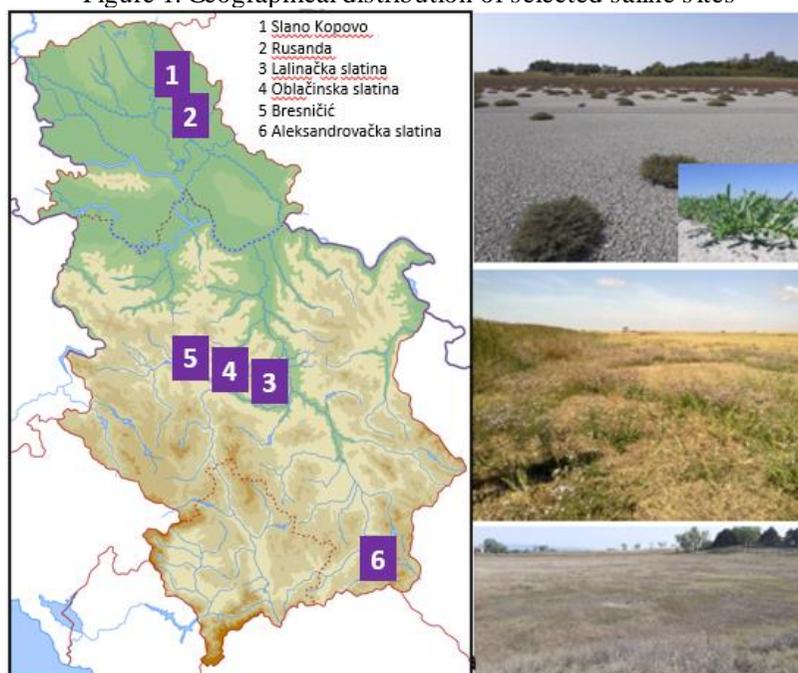
The study area includes two representative continental saline habitats located in the Pannonian plane (Slano Kopovo and Rusanda) and four habitats geographically distributed in southern Serbia (Lalinačka slatina, Oblačinska slatina, Bresničič and Aleksandrovačka slatina) (Figure 1).

Slano Kopovo represents one of the most important saline habitats in the Republic of Serbia according to the level of preservation of authenticity and nature. Slano Kopovo is located in northwestern Banat (Province of Vojvodina) near the city of Novi Bečej. This saline habitat is also important for its saline lake. The lake (together with its surrounding area) was declared a natural asset of exceptional importance and classified in the first category of protection at the end of 2001, while according to the classification of the International Union for Conservation of Nature (IUCN) it belongs to category IV - habitats and other managed areas. In addition, Slano Kopovo was listed under the Ramsar Convention in 2004 as a wetland of international importance. It is characterized by a steppe-continental climate, as well as all other areas in Vojvodina. During the summer months, the lake usually dries up and a salt crust forms on the floor of the lake. This site is a typical example of extreme saline habitats which are characterized by a mixture of salt marches and salt steppe vegetation. Many plant species characteristic of this type of vegetation are rare or endemic species and are protected by the law (*saltwort-Salsola soda*, *sea-blites-Suaeda maritima*, *glasswort-Salicornia europaea*, *Schwartzerbergian's plantain-Plantago schwartzerbergiana* etc.). In addition, Slano Kopovo is one of the most important bird habitats in Serbia.

Lake Rusanda is one of the saline habitats in Banat region. This lake is part of the Rusanda Nature Park and is surrounded by meadows and anthropogenically altered habitats. The Rusanda Spa and its Special Hospital for Rehabilitation, located in the centre of the Nature Park, use mineral peloid in different medical and spa treatments. This lake represents one of the last remaining alkaline lakes in Serbia. Lake Rusanda is located near the town of Melenci and resembles the shape of the letter C. It is inhabited by numerous bird species, and it is a migratory stopover. The shore of Rusanda lake is overgrown with the Pannonian endemic seashore *aster - Aster tripolium ssp. panonicus* and succulent halophytes.

Saline habitats of central and southern Serbia include limited number of sites distributed around Prokuplje and along the valley of the South Morava, near Vranje and Bujanovac. These complex salt habitats include several sites: Lalinačka slatina, Oblačinska slatina, Bresničić and Aleksandrovačka slatina, that are the subject of the research in this study. These saline habitats are mosaically distributed in the shape of small patches around the source of salt waters. A few saline sites in this region belong to vulnerable and threatened habitats. Flora and vegetation in this region differ from those in the Pannonian region in a biogeographical sense. The impact of sub-mediterranean climate has produced specific conditions. Floristic differences are reflected in the presence of rare and endemic species such as *Camphorosma monspeliaca*, *Sachys milanii*, *Puccinellia festuciformis* ssp. *Convolute* etc., but also in the absence of succulent halophytic flora.

Figure 1: Geographical distribution of selected saline sites



Source: Author's research (author's photographs: 1. Slano Kopovo, 2020; 2. Rusanda, 2015; 3. Oblačinska slatina, 2020)

3.2. Data collecting method

Necessary datasets were collected during the comprehensive research of saline habitats in the Republic of Serbia (2012-2015) and these include: vegetation patterns (communities, density, cover), floristic data, data on protection or endangerment, geospatial information, as well as community information such as accessibility to main roads or ecotourism facilities. Data on flora and vegetation were collected using the standard Braun-Blaquet method (Braun-Blaquet, 1932) widely used in the science of phytocoenology. The data on more than 300 *relevés* were collected on the whole territory and stored in vegetation databases (GIVD, Dajić-Stevanović et al., 2012). For the purpose of this research, 16 *relevés* were examined for each of the selected sites. Data on fauna were collected from secondary literature sources. Geospatial and communities' data were collected using GPS, fieldwork observation and national infrastructure of geospatial data (National Spatial Data Infrastructure, 2021).

3.3. Data analysis

Data analysis was conducted based on similar studies (e.g., Nelly et al., 2020; Pin et al., 2021) with adjustment of selected parameters to this research. The final set of parameters/variables include vegetation cover, percentage of endemic, rare or attractive plant species per *relevé*, bird diversity, percentage of modified landscapes, category of the protected area, accessibility in terms of main roads vicinity and ecotourism infrastructure such as info tables, viewpoints, bridges, towers etc. Ecotourism suitability assessment was carried out using ESI (ecosystem suitability index for continental saline habitats).

$$ESI = \sum (N_i / N_{max}) \times 100\% \quad (1)$$

N_i = The value of parameter “ i ” (weight x score),

N_{max} = Maximum value of continental saline habitat tourism category.

The suitability index was classified into three categories consisting of N = Not suitable, with a value of <50%, S2 = Quite suitable, with a value of 50-75% and S1 = Suitable, with a value of 75-100% for parameters that could be estimated using percentage share.

Table 1: Matrix of continental saline habitats ecotourism suitability

Env. Parameters/category	Weight	Score		
		1 N	3 S2	5 S1
Vegetation cover (VC)	5	<50%	50-75%	>75%
Endemic/rare/attractive species (NSp)	5	<50%	50-75%	>75
Birds diversity (BD)	3	<30%	30-50%	>50%
Protection status (PS)	3	NOP	NM, FOB, SNR,	NtP, NP
Modified landscape (ML)	3	>70%	30-70%	<30%
Accessability (A)	1	ND/NR	ND/HR	D/HR
Ecotourism facilities (EF)	1	NEF	IT	IT, VP, etc.

Note: Abbreviations: NOP – Not protected, NM – Natural monument, FOB – Features of outstanding beauty, NtP – National park, SNR – Special nature reserve, NP – Nature park, ND – Not designed, NR – Not road, D – designed, HR – Have road, NEF – Not ecotourism facilities, IT – Info tables, VP – Viewpoints)

Source: Author's research

4. Results and discussion

The main parameters that were considered for the nature-based tourism suitability of continental saline habitats were selected according to similar studies that deal with the main factors of ecotourism attractiveness. The following 7 categories were assessed: vegetation cover, participation of endemic, rare and attractive flora, bird diversity as an important ecotourism attraction, the status of protection, level of anthropogenic modification of original landscape, a factor of accessibility and existing ecotourism facilities or infrastructure. The weights and score values were given according to the importance of ecotourism activities (Table 1). The values of each category were given based on fieldwork research described in

Methods and represented in Table 2. Based on observation results, out of all criteria parameters related to suitability of saline habitats for nature-based tourism, Oblačinska slatina had the lowest ESI value of 45.3, while Rusanda had the highest ESI value of 87.4. The matrix of nature-based tourism suitability indicates that sites Slano Kopovo and Rusanda are suitable (S1), while Lalinac is quite suitable (S2) and Oblačina, Bresničić and Alekdandrovac are not suitable (N); The possible reasons for such results lie in the fact that they are not protected, there are no information signs or boards which would inform the people about their location and significance and are considerably modified by anthropogenic impact.

Table 2: The suitability values of continental saline habitats categories for nature-based tourism

Research site	Sampling point	Parameter/category							Σ	ESI	SCg
		VC	NSp	BD	PS	ML	A	EF			
Slano Kopovo	Water, Costal Meadow	75.0	70.0	74.0	70.0	10.00	90.0	10.0	79	83.2	S1
Rusanda	Water, Costal Meadow	70.0	70.0	84.0	75.0	30.00	90.0	70.0	83	87.4	S1
Southern salines	Lalinac	70.0	30.0	70.0	60.0	50.00	75.0	1.00	53	50.8	S2
	Oblačina	60.0	40.0	70.0	1.00	75.00	75.0	51.0	43	45.3	N
	Bresničić	55.0	60.0	70.0	1.00	75.00	1.00	1.00	47	49.5	N
	Aleksandrovac	60.0	55.0	65.0	1.00	75.00	50.0	10.0	47	49.5	N

Note: SCg – Suitability category

Source: Author's research

4.1. Vegetation cover and floristic attractiveness of continental saline habitats

Natural resources are a very important component of the development of tourism in general. Knowledge and assessment of natural resources represent the basis for strategic planning and management of the potential tourism area. Flora and vegetation are components of natural biological resources. Vegetation cover with endemic, rare and attractive species has the highest weight because it represents the key factor of attractiveness. According to Reichel et al. (2008), nature and landscape play an important role in attractiveness, including the wild flora and fauna, as well as the tradition and culture. Rare, endemic flora is very competitive for tourism attractions (Henri et al., 2017). As reported in the assessment study (Asrianny et al., 2020) of main ecotourism attractiveness, flora was identified as a very important factor in addition to natural features. Some strictly protected plants, among which are succulents *Salicornia europaea*, *Suaeda pannonica*, *Suaeda maritima*, *Salsola soda*, etc., are found on the territory of a saline habitats of Vojvodina, to which Slano Kopovo and Rusanda belong (Luković & Dajić Stevanović, 2020). These plant species represent the main attraction and build a recognizable mosaic of the landscape together with evaporated salt crystals on the land surface. The second group of floristic attractions includes salt-steppe meadows populated with *Artemisia santocica* that smells like the seaside. Besides the mentioned plants, many other endemic, rare and attractive species grow in this region such as *Limonium gmelini*, *Plantago schwartzerbergiana*, *Plantago maritima*, which are all considered important ecotourism objects as confirmed by other studies in the field of ecotourism (Brankov & Žujović, 2008). A Ramsar site - Special Nature Reserve “Slano Kopovo” and the Nature Park “Rusanda” represent the last examples of the authentic Pannonian salt marshes with a wealth of flora and fauna (Čučulović et al., 2012). On the

other hand, southern saline habitats are fragmented and mosaically distributed like small patches in total surroundings. They give a unique visual effect to the landscape. All Panonian saline habitats do not contain the same number of different species, however this does not diminish the floristic value of sites. Several studies recognized and valorized salt marshes as a touristic potential based on the authenticity of a site, designation as a Ramsar site or the potential for local development (e.g., [Brankov & Žujović, 2012](#); [Stojanović et al., 2018](#)).

4.2. Bird diversity

Birdwatching is one of the acceptable recreational ecotourism activities since it seeks to observe wildlife ([Rajević et al., 2016](#)). It represents a very responsible and educational activity, and, as part of ecotourism, supports conservation of natural and cultural values of the local area, contributes to the development of the local community and brings important economic benefits ([Son et al., 2011](#)). Birdwatching is considered in numerous studies as a part of the ecotourism package (e.g., [Suana et al., 2020](#)). The most developed birdwatching market is in Great Britain and the Netherlands, while the most attractive destinations are exotic countries (Africa, Asia, Japan, India). Having in mind the fact that more than 70% of the bird fauna of Europe lives in Serbia, the country represents one of the potentially desirable locations for bird watching ([Škvareninová et al., 2013](#)). Centers of bird diversity in the Republic of Serbia are related to nature protected areas like NP Djerdap, NP Kopaonik, NP Golija etc., or Ramsar sites such as Peštersko polje, Vlasina, Gornje Podunavlje, Labudovo okno and Zasavica. Saline lakes Slano Kopovo and Rusanda, as subjects of this research, are home to more than 200 bird species and important migratory stations. Especially interesting bird species are thin-beaked mallard, blue-billed duck, black float, little cormorant, and cranes. Floristic and bird fauna characteristics of saline lakes make the core basis for suitability for nature-based tourism in these areas.

4.3. Protected areas

Protected areas with their natural beauties are identified as a key expressive attribute of ecotourism satisfaction ([Carvache-Franco et al., 2020](#)). Three of the selected sites researched in this study were designated as protected areas: the Special Nature Reserve “Slano Kopovo”, Nature Park “Rusanda” and Natural Monument “Lalinačka slatina”. The rest of the studied sites are not under protection, notwithstanding their vulnerability and natural values. The status of protection determines the value/weight of the particular parameter and affects the final score; accordingly, the mentioned sites are considered suitable for nature-based tourism.

4.4. Authenticity of landscape

Some studies reported the importance of original eco-landscape for ecotourism suitability assessment ([Bunruamkaewa & Murayamaa, 2011](#); [Xiaolei et al., 2015](#)). The results show that protected sites (Slano Kopovo and Rusanda) have the highest values (between 10% and 30% are modified) of the preserved original landscape, while saline habitats in the south are over 50% modified and under the intensive anthropogenic impact. According to [Zlatković et al. \(2005\)](#), these southern saline habitats are suffering the negative impacts of agriculture, pollution, and degradation. These human factors disturb the original landscape and diminish the natural value important for tourism development.

4.5. Community factors (accessibility and ecotourism facilities)

Road network and infrastructure enable access to site points. Road accessibility was analyzed as one of the compulsory criteria for ecotourism suitability (Šiljeg et al., 2019). Developed road network and ecotourism infrastructure can largely affect the economic improvement of tourist destination (Chandio et al., 2014). Slano Kopovo has a good position in terms of traffic infrastructure, due to main roads which facilitate access from the direction of Novi Bečej. In the vicinity of Slano Kopovo, in the 30km to 50km radius, the town of Kikinda and the city of Novi Sad are located. The Rusanda site is located near a small town of Melenci and gravitates towards Zrenjanin and Novi Sad. Both sites are equipped with basic ecotourism facilities such as information desks or small tourism facilities. Researched sites in southern Serbia are less developed in terms of road infrastructure. These sites are situated in villages and some of them do not have direct access to major roads and are not marked by information or sign boards. Due to their geographical position, Lalinačka slatina, Oblačinska slatina and Bresničić gravitate towards the city of Niš and the town of Prokuplje, while Aleksandrovačka slatina gravitates towards the town of Vranje. The common characteristic of all these areas is that they are not marked by information boards and do not have any ecotourist facilities. Analyzed community factors indicate that the Pannonian saline habitats are more suitable for nature-based tourism development. Investments in infrastructure represent one of the crucial activities and strategic advantages for any type of tourism development (Đorđević-Milošević et al., 2021).

5. Conclusion

In this paper, the authors analyzed two Pannonian saline habitats (Slano Kopovo and Rusanda) and four saline habitats situated in southern Serbia (Lalinačka slatina, Oblačinska slatina, Bresničić and Aleksandrovačka slatina) according to their nature-based tourism suitability. Continental saline habitats represent exceptionally valuable biodiversity areas, however, the public is generally not aware of their existence. Tourism development in these areas must support protection, education, and promotion of natural values in order to preserve saline habitats. According to the results, the Pannonian continental saline habitats belong to the S1 suitability category. Lalinačka Slatina belongs to the S2 category in terms of its suitability, while the rest of the southern Serbian saline habitats are not considered suitable for nature-based tourism.

Although the Pannonian saline habitats are in the S1 category thanks to their exceptional flora and bird fauna and authenticity of landscape, investments in improvement and promotion of eco-tourism facilities are needed. The saline habitats in southern Serbia need to be further studied in the future period, as well as protected by the law and finally adequately promoted as potential nature-based sites.

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Conflict of interest

The authors declare no conflict of interest.

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