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Contribution to the knowledge of invasive flora in Kozara National Park

Short Communication

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Abstract:

Kozara National Park is exposed to different anthropogenic influences even though it is categorized as IUCN Category II. In this study, we investigated, identified and mapped invasive flora and their impact on the native plant communities. During summer 2018, the fieldwork was conducted at 6 locations using the Braun-Blanquet method for the investigation of plant communities. The total of 13 invasive alien species (IAS) have been detected. Most of the IAS belong to the Asteraceae family, originating from North America (76.92%). The most abundant life forms were therophytes and geophytes found in *Artemisietalia* communities. Conclusively, the IAS are widespread in the examined area, particularly in the parts of the park designated for tourist recreational activities.

Key words:
alien flora, Bosnia and Herzegovina, vegetation

Apstract:

Prilog poznavanju invazivne flore Nacionalnog parka Kozara

Nacionalni park Kozara izložen je različitim antropogenim uticajima, iako prema IUCN spada u kategoriju II. U istraživanju smo identifikovali i mapirali invazivnu floru i njihov uticaj na autohtone biljne zajednice. Tokom leta 2018. terenski rad je sproveden na 6 lokacija primenom Braun-Blankuet-ove metode za ispitivanje biljnih zajednica. Otkriveno je ukupno 13 invazivnih stranih vrsta (IAS). Većina IAS pripada porodici Asteraceae, poreklom iz Severne Amerike (76,92%). Najzastupljenije životne forme su terofite i geofite, pronađene u zajednicama reda *Artemisietalia*. Zaključno, IAS su široko rasprostranjeni u ispitivanom području, posebno u delovima parka predviđenim za turističke rekreativne aktivnosti.

Ključne reči:
strana flora, Bosna i Hercegovina, vegetacija

The invasive alien species (IAS) in Bosnia and Herzegovina were observed in research in the previous century (Slavnić, 1960; Slavnić 1964; Bjelčić & Stefanović, 1986; Abadžić, 1986/87). However, only since the verification of CBD (Convention on Biological Diversity) in 2002, monitoring IAS has become mandatory. According to the national CBD report (Strategija i akcioni plan za zaštitu biološke raznolikosti Bosne i Hercegovine 2015-2020. Podrška Bosni i Hercegovini za revidiranje Strategije i akcionog plana za zaštitu biološke raznolikosti i izradu Petog nacionalnog izvještaja prema Konvenciji o biološkoj raznolikosti, 2016), the plan was to observe all IAS and identify pathways of spreading by 2020. So far, no official list of invasive flora and fauna exists. In that light, every investigation which goes into the direction of study the IAS is of great importance. Every year, high biodiversity and ecological value of Kozara National Park attract many visitors, who can potentially endanger certain eco-

Table 1. General locality information

No.	Locality	Coordinates	Altitude (m)	Slope (°)	Exposition	Bedrock	Soil type
1	Zečiji kamen - Viewpoint	N 45° 1'3.13" E 16°52'16.15"	655	45	SW	Limestone	Calcome-lanosol
2	Ski plateau - Mrakovica	N 45° 0'50.75" E 16°54'13.38"	785	5	W	Eocene flysch	Deposol
3	Gumline - Viewpoint	N 44°59'43.29" E 16°54'43.37"	520	10	SW	Limestone	Calcome-lanosol
4	Road for Kotlovača	N 45° 00'23.9" E 16°52'42.5"	655	0	W	Gabbro	Deposol
5	Sledding site - Mrakovica	N 45° 0'56.59" E 16°54'18.73"	790	5	SE	Eocene flysch	Deposol
6	Mountain hut - Mrakovica	N 45° 00'50.8" E 16°54'20.6"	650	50	SE	Eocene flysch	Deposol

systems. It is worth noting that Bucalo et al. (2007) detected 657 vascular plants in a relatively small area of the Park (3910 ha). With this in mind, the main purpose of the study was to contribute to better understanding of distribution of invasive flora in the Kozara National Park.

The investigated area included the central and south part of Kozara massif. The fieldwork was performed on 6 locations through original phyto-coenological research during the summer 2018. The analysis of the floristic composition was executed with the standard method Zurich-Montpellier school Braun-Blanquet (1964). Description of each site was made using Garmin GPS and topographic, geological and pedological maps (**Tab. 1**.) Preliminary list of invasive plant flora for B&H (Maslo, 2016) was used as a primary database. For the plant identification, we used following identification keys: Domac (1979), Javorka and Csapody (1991), Šarić (1991), Šilić (2005), Nikolić et al. (2014). The nomenclature

Table 2. Recorded invasive flora in Kozara National Park

Taxon	Family	Detected in community	Origin	Life
Ambrosia artemisiifolia L.	*Asteraceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950; *Querco-Ostryetum carpinifolie* Ht. 1938	North America	T
Erigeron canadensis (L.) Cronquist	*Asteraceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	North America	H
Erigeron annus (L.) Pers.	*Asteraceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950; *Querco-Ostryetum carpinifolie* Ht. 1938	North America	H
Galinsoga parviflora Cav.	*Asteraceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	North and South America	T
Juncus tenuis Willd.	*Juncaceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	North America	H
Parthenocissus quinquefolia (L.) Planch.	*Vitaceae*	*Fagetalia sylvaticae* Pawlowski in Pawlowski *et al.* 1928	North America	Ph
Phytolacca americana L.	*Phytolaccaceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	North America	G
Reynoutria japonica Houtt.	*Polygonaceae*	*Adenostyletalia* Br.-Bl. 1931	East Asia	G
Robinia pseudoacacia L.	*Fabaceae*	*Fagetalia sylvaticae* Pawlowski in Pawlowski *et al.* 1928	North America	Ph
Solidago gigantea Aiton	*Asteraceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	Northen America	G
Sorghum halepense (L.) Pers.	*Poaceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	Middle East	G
Veronica persica Poir.		*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	South-Western Asia	T
Xanthium strumarium L. subsp. *italicum* (Moretti) D. Love	*Asteraceae*	*Artemisietalia* Lohm. Prsg. *et* Tx. in Tx. 1950	North America	T

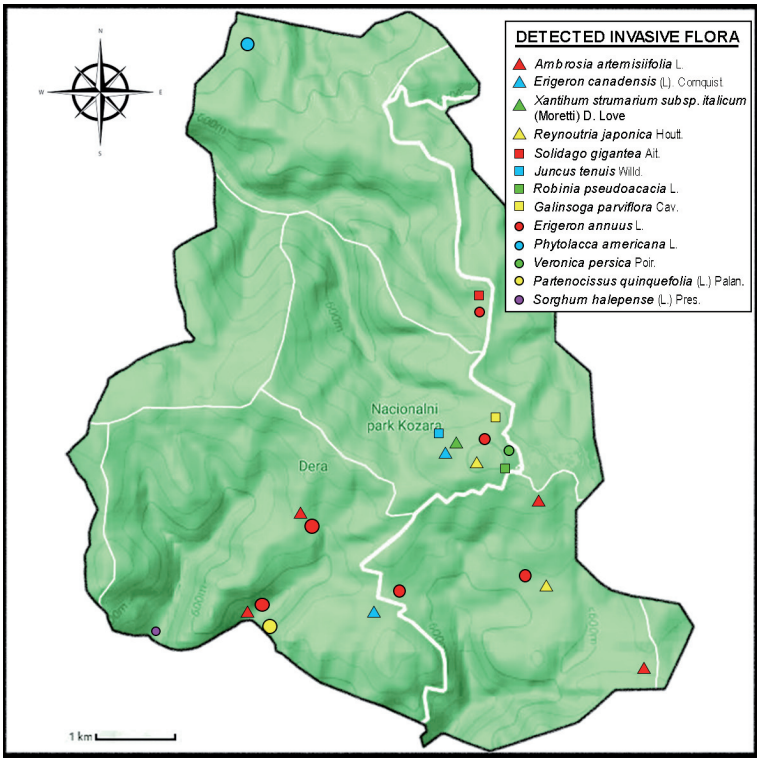

Fig. 1. Map of detected invasive flora in the Kozara National Park

follows the Euro+Med PlantBase (2006) and The International Organization for Plant Information (IOPI) database (2017). Syntaxonomic position of the analyzed communities was determined based on the list of plant communities in Bosnia and Herzegovina (Prodromus) (Lakušić 1978, Barudanović et al., 2015) and International Code of Phytosociological Nomenclature (Weber et al., 2000). The taxa are listed alphabetically and accompanied by life form data (Ph-phanerophyte, Ch-chamaephyte, H-hemicryptophyte, G-geophyte, Hy-hydrophyte, T-therophyte) (Raunkiaer, 1934).

Out of the 119 identified plant species in the Kozara National Park, 13 (10.9%) were IAS (**Tab. 2**). Maslo (2016) listed 50 IAS in the preliminary list of IAS in Bosnia and Herzegovina. It is important to state that the overall number of IAS in the Park may not be definitive due to the scope of research. All identified plants are neophytes, originated from North America (76.92%) and Asia (23.08%). The majority of IAS belong to Asteraceae (46%) which is, regarding invasiveness, one of the most abounding in the world (Pyšek, 1998).

The most abundant life forms in the examined flora of the investigated area are therophytes (30.76%) and geophytes (30.76%) followed by hemicryptophytes (23.1%) and phanerophytes (15.38%). Even though the studied area is characterized by mesophilic and hydrophilic habitats with the larger portion of phanerophytes and hemicryptophytes (Lakušić et al., 1991; Bucalo et al., 2007), continuous anthropogenic impacts in the form of degradation resulted in expansion of nitrified, xerophytic and stomped habitats. Hard and compact soil, high insolation and temperature, along with weak soil transparency enabled the development and domination of therophytes and geophytes (Jovanović, 1993). The relatively high percentage of hemicryptophytes (23.1%) is not surprising because these plant species have extraordinary regenerative potential and can endure stomping and breaking (Topalić-Trivunović, 2006). Continuous construction projects and expansion of tourist offer allow undisturbed spreading of invasive flora, both alien and native. With five marked recreational trails and the accompanying infrastructure, invasive flora is spreading on the ski and trim tracks near Mrakovica where we detected nine IAS: *Ambrosia artemisiifolia, Erigeron canadensis, Erigeron annuus, Galinsoga parviflora, Juncus tenuis, Reynoutria japonica, Robinia pseudoacacia, Veronica persica* and *Xanthium strumarium* subsp. *italicum*. Along the roads from Mrakovica to Gola Planina, three IAS were found, *Ambrosia artemisiifolia*, *Reynoutria japonica* and *Erigeron annuus*. By the trails from Mrakovica to Kozarački kamen, Benkovac and Zečiji kamen we identified *Ambrosia artemisiifolia, Erigeron canadensis, Erigeron annuus, Robinia pseudoacacia, Solidago gigantea, Galinsoga parviflora* and *Veronica persica*.

Phytolacca americana was detected in the northwestern and *Sorghum halepense* in the southern part of the park. The gathered data suggest that all IAS continuously spread alongside the roads and trails. Many studies confirm that IAS spread near roads (Hansen & Clevenger, 2005; Meunier & Lavoie, 2012; Brisson et al., 2017).

Of the detected invasive flora, the most important is the spreading of *Ambrosia artemisiifolia* and *Reynoutria japonica* given their negative impact on human health (Leru et al., 2015) and biodiversity (Aguilera et al., 2010). The high abundance of *A. artemisiifolia* on the Mrakovica plateau is of special concern. Even though it was detected in only two localities near Mrakovica, *Reynoutria japonica* populations could possibly continue the spreading around the nearest pathways. Growing in high-density populations (Naiman et al., 2005), Japanese knotweed disables the development of any other plant species through strong allelopathic effect (Murrell et al.,

2011). The spreading of this species would be harmful particularly in the zone of Pašini konaci due to unique swamp habitats with communities *Glycerietum plicatae* Kulczynski 1928 and *Lemnetum minoris* (Oberd.1957) Th. Mull. Gors.1960.

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