Short commentary

Mapping and monitoring invasive plant species to protect endangered flora in Eco Centre „Jezera“ Bijeljina

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Abstract

Eko Centre „Jezera“ is located in the northeastern lowland part of Bosnia and Herzegovina, entity Republika Srpska, near the town of Bijeljina with an average altitude of 70 m. The predominant part of the centre is represented with marsh ecosystems, hydrophilic forests, few mesophilic and hydrophilic meadows as well as anthropogenic habitats. An increasing number of visitors and currently existing invasive alien species (IAS) pose a threat to endangered and vulnerable plant populations. The main goal of the research was to identify and map both invasive and endangered flora of the „Jezera“ and develop a plan for continuous monitoring and habitat conservation. The original research was conducted in the late spring of 2021. The exact location of each invasive plant population was mapped using Garmin GPS and geological maps. As a reference database, the preliminary list of invasive plant species in Bosnia and Herzegovina was used. Important plants found in the centre are listed in the vascular flora Red list of the Republika Srpska entity. The nomenclature follows the Euro+Med PlantBase and The International Organization for Plant Information database. All identified IAS and important species are accompanied with Raunkier life forms: Ph-phanerophyte, Ch-chamaephyte, H-hemicryptophyte, G-geophyte, Hy-hydrophyte, T-therophyte. Out of 78 plants identified in „Jezera“ at the time of research, 5 (6.41%) were IAS: *Ailanthus altissima* (Mill.) Swingle. (Ph), *Amorpha fruticosa* L. (Ch), *Asclepias syriaca* L. (H), *Fallopia japonica* Hout. (G), *Robinia pseudoacacia* L. (Ph). The abundance and cover in the phytocoenological recordings varied from <5% (*A. syriaca*) to 50% (*F. japonica*). Three identified species from the vascular flora Red list, *Orchis militaris* L. (G), *Nymphea alba* L. (Hy), *Nuphar lutea* L. (Hy) were found on the separated locations. In order to complete data, we intend to repeat the observations throughout the whole vegetational season and install the plot monitoring.

keywords: invasive flora, endangered plants, monitoring, Jezera Bijeljina,

Introduction

Invasive alien species (IAS) represent animals or plants introduced deliberately or by an accident into a natural environment, outside their native habitat. Due to their fast spread and reproduction, they are dangerous for native species. An alarming problem are invasive plant species that cause serious damage to local ecosystems and economical loss worth billions of dollars around the world (Diagne, C. et al., 2021).

Eco Centre „Jezera“ is located in the northeastern part of the Bosnia and Herzegovina, the entity Republic of Srpska in the lowland plain Semberija positioned on the edge of the Pannonian Basin. This meso-region plain was reshaped mainly by the deposition of various materials from Drina and Sava rivers as well as the fluvial erosion processes. (Lepirica, et al., 2019). The average altitude is 70m with the trend of rising from north to south. Geological base originate from peroid of Devon and Lower Devon dominantly presented by limestone (Čičić, 2002). The prevalent typee of soil is semigley (Brulica and Vukorep, 1980). Once landfill site, Eco Centre „Jezera“ today resembles many visitors from the region who enjoy relaxation and recreational activities. It represents series of anthropogenic swamps and small lakes that originated over the years of gravel exploitation on Drina river. Other parts of the Centre consists of mesophilic and hydrophilic meadows as well as the fragments of hydrophilic forest. According to the city Bijeljina development strategy for the next decade enacted by the government, the third goal regarding the environment is to establish an integrated approach to environmental protection with responsible usage of natural resources originated from renewable sources and improve energy efficiency (Grad Bijeljina, 2013). In this light, „Jezera“ are an important site both for the city and the Semberija region and the main task of the conducted research was to map and establish a preliminary list of invasive and endangered flora.

Materials and methods

The fieldwork investigations were conducted in the late spring of 2021. We recorded all the necessary data (habitat, elevation, date of investigation, percentage cover) as well as all the site coordinates, bedrock and soil type using Garmin (eTrex® 10), geological (Čičić, 2002) and pedological maps (Brulica and Vukorep, 1980). To identify plant species on site we used identification keys: Domac (1979), Javorka and Csapody (1991), Šarić (1991), Šilić (2005), Nikolić et al. (2014). As a reference database, we used a preliminary list of invasive plant flora in Bosnia and Herzegovina (Maslo, 2016). For the endangered plant species found in the Eco Centre, Red List of the vascular flora in Republic of Srpska entity was used. Plant nomenclature follows the Euro+Med PlantBase (2006) and The International Organization for Plant Information database (2017). Both invasive and important plant species are assigned with Raunkier life forms: Ph-phanerophyte, Ch-chamaephyte, H-hemicryptophyte, G-geophyte, Hy-hydrophyte, T-therophyte (Raunkier, 1934).

Results and Discussion

Out of 78 plants identified at the time of research, 5 (6.41%) were invasive plants and 3 (3.85%) were recognized as endangered/important according to Red list vascular flora of entity Republic of Srpska (Vlada Republike Srpske, Crvena lista zaštićenih vrsta flore i faune Republike Srpske, 2012) (Table 1) (Figure 1.)

Table 1. Recorded invasive and important flora in Eco Centre „Jezera“

Taxon	Family	Origin	Life form	Status
Fallopia japonica Houtt.	Polygonaceae	East Asia	G	*Invasive*
Ailanthus altissima (Mill.) Swingle	Simaroubaceae	East Asia	Ph	*Invasive*
Asclepias syriaca L.	Apocynaceae	North America	H	*Invasive*
Amorpha fruticosa L.	Fabaceae	North America	Ch	*Invasive*
Robinia pseudoacacia L.	Fabaceae	North America	Ph	*Invasive*
Orchis militaris L.	Orchidaceae	Native (Europe)	G	**Endangered/ Important*
Nymphea alba L.	Nymphaeaceae	Native (Europe)	Hy	**Endangered/ Important*
Nuphar lutea L.	Nymphaeaceae	Native (Europe)	Hy	**Endangered/ Important*

*Red list vascular flora of entity Republic of Srpska

All detected invasive plants have established their populations with the cover-abundance in the phytocoenological recordings between 5% (*Asclepias syriaca* L.)-50% (*Fallopia japonica* Houtt.).

Fallopia japonica builds on the meadow with fairly large populations in the proximity of the road. Similarly, VanWallendael et al. (2020) collected samples on the roadside. Also, In Kozara National Park, Bosnia and Herzegovina, *F.japonica* builds two large populations on Mrakovica site (Hasanović et al., 2020). This species is well known for its invasiveness using rhizomes which can be spreading 5-7 m laterally (Pridham, 1966) and a large number of viable seeds (Forman and Keseli, 2003). Scientists are trying to eliminate this invasive plant using different approaches. For example in National Park Una, as a part of the project SAVA TIES - Preserving Sava River Basin Habitats through Transnational Management of Invasive Alien Species, researchers were involved in the pilot project of eradication *Fallopia x bohemica* using both chemical (Glyphosate and Garlon 3A injections) and mechanical methods (digging and smothering – nylon cover) (Tratnik et al., 2020).

Between mesophilic meadow and pathway, we detected the presence of *Ailanthus altissima.* The location of this species and a large number of shoots spreading down the meadow could potentially endanger *Orchis militaris.* In addition, *A. altissima* seeds have a high germination rate (64%-98%) and their dissemination is almost impossible to control (Sladonja et al., 2015). *O. militaris* is listed on the Red List of Vascular Flora in the Republic of Srpska and represents important species for this entity in Bosnia and Herzegovina. In the central region of Bosnia and Herzegovina, Šabanović et al. (2019) reported that *O. militars*, *O. pallens* and *O. spitzelii* were the most endangered populations. (Šabanović et al., 2020). Furthermore, *O. militars* is mentioned in two international agreements: Convention of International Trade in Endangered Species of Wild Fauna and Flora, Annex II (CITES) (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2010) and Commission Regulation

(EU) No 1320/2014, of 1 December 2014, amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulation trade therein, Annex B (EU regulation of trade of fauna and flora, 2014). Even though *O. militars* has a status of Least Concern species according to IUCN Red List status of threatened species, this could change unless we protect mentioned area from invasive species and uncontrolled resource exploitation.

Populations of *Amorpha fruticosa* were dominant and well established along the western bank of the large lake. Approximately 10-15m from the bank, we detected a mixed community of *Robinia pseudoacacia* and *A. fruticosa* which are prevalent regarding tree population. Doroftei et al. (2005) reported the emergence of new sprouts and roots of *R. pseudoacacia* and *A. fruticosa* after cutting, burning or pulling. Especially *A. fruticosa* showed high adaptation where all individuals produced new roots and spindles after pulling (Doroftei et al., 2005). Besides that, we detected *Populus alba*, *Populus nigra* and *Salix alba*, species which are often found on the banks of rivers and lakes mostly on the alluvial soils. Because of habitat degradation and low genetic diversity (Storme et al., 2004), black poplar is one of the most endangered species in Western Europe and it is close to extinction (Cagelli and Lefevre, 1995).

Asclepias syriaca was detected along the pathways to larger lakes where the anthropogenic impact is more pronounced. Although we detected only 6-10 individuals, a disturbed ecosystem could potentially allow further spreading of *A. syriaca*. Habitat conversion and changes in soil characteristics can allow an explosive increase in the population size of this invasive plant (Szilassi et al., 2019). Upon finding this species harmful to the native ecosystems and economy, EU listed *A. syriaca* as an invasive plant according to EU Regulation 1143/2014 (Council of the European Union, European Parliament, 2014).

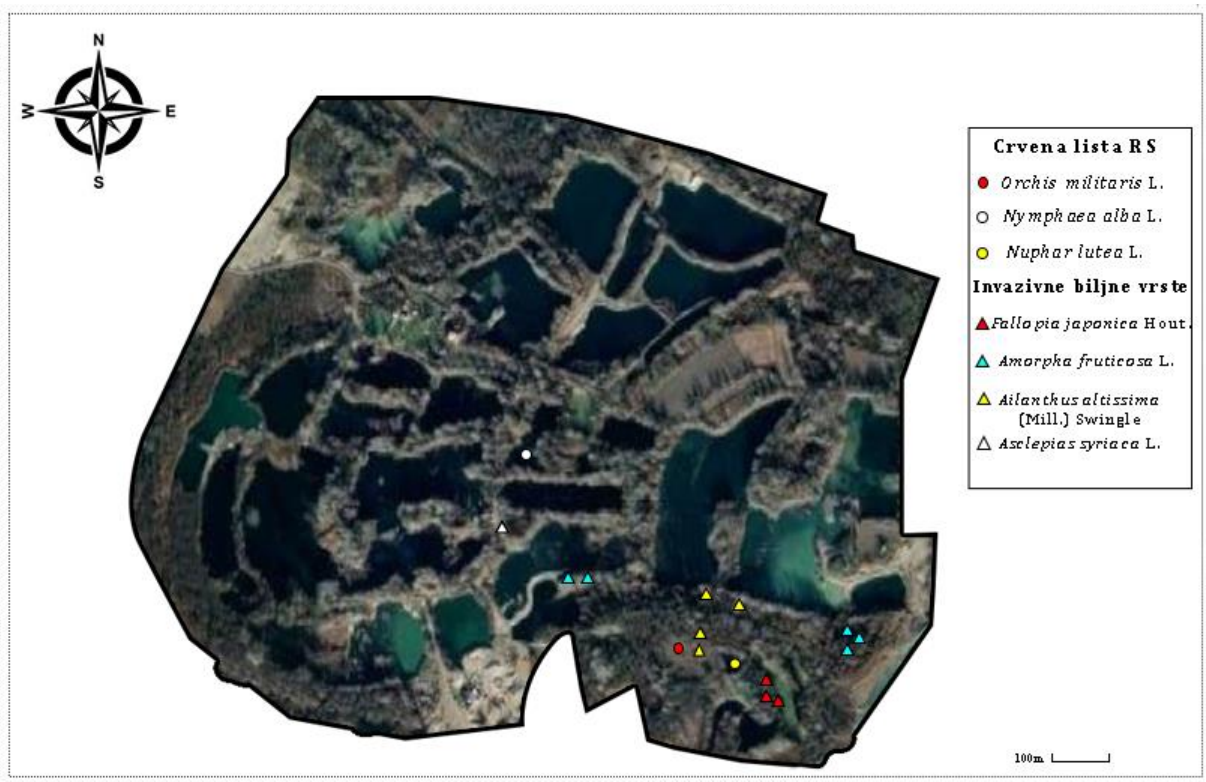

Figure 1. Map of invasive and endangered flora

Two aquatic macrophytes *Nymphaea alba* and *Nuphar luteum* are identified in separate lakes. Their populations are presented with only a few individuals. Even though they are the Least Concern species

according to IUCN Red List status of threatened species, they are added to the Red List of Vascular Flora in the Republic of Srpska (Vlada Republike Srpske, Crvena lista zaštićenih vrsta flore i faune Republike Srpske, 2012) and recognized as an important. Furthermore, aquatic macrophytes can be used as bioindicators of water quality in rivers and lakes (Onaindia et al., 2005; Pereira et al., 2012) and certainly represent useful indicators regarding water pollution and eutrophication (Bytyqi et al., 2020).

Invasive plant species pose a major risk to the diversity of indigenous flora. To prevent their spreading, local community, government and activists have to engage together in the eradication or monitoring these populations. Further research on this site will include repeated observations throughout the whole vegetational season and establishing invasive flora plot monitoring.

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