DOI 10.5644/Herb.15.1.05

TALL CONE FLOWER (RUDBECKIA LACINIATA L.) – NEW INVASIVE SPECIES IN THE FLORA OF BOSNIA AND HERZEGOVINA*

Sead Vojniković
Faculty of Forestry, University of Sarajevo, Zagrebačka 20,
71000 Sarajevo, Bosna i Hercegovina
e-mail: svojnikovic70@gmail.com

Abstract

This paper deals with the occurrence of Rudbeckia laciniata L. (Asteraceae), a new invasive species in the flora of Bosnia and Herzegovina (B&H). This species was introduced into European horticulture from North America during the seventeenth century. Since then it has spread on the appropriate habitats on the European continent. Thus in 1868, its spread was recorded across Slovenia. According to the EPPO Alert list, this species is in the group of invasive plant species. In October 2014 this species was first registered on the territory of B&H. The paper gives a brief morphological description of this species and observed sites of its occurrence. So far this species has been registered at ten localities in B&H. In the broader sense it is located along the rivers: Lim, Drina, Uvac, Bosna, Željeznica, and the Neretva. These habitats are typical for the occurrence of this species.

Keywords: Rudbeckia laciniata L., Bosnia and Herzegovina, invasive species, morphology

Introduction

The spread of invasive allochthonous (foreign, alien) species of plants and animals and the creation of new occupied (infested) areas at scrambling habitat balance, is a global problem (Rejmanek et al., 2006). The emergence of invasive plants and animals due to climate change, pollution and the destruction of natural habitats is the most dangerous factor to biodiversity and ecosystem stability but also the economy of some countries, and even the health of the human population (Pyšek et Richardson, 2010). The process of conquering new habitats is especially with the expansion of trade at a global scale, starting in the seventeenth century, and especially the growing global connectivity during the last decade of the twentieth and early twenty-first century.

Invasive alien species are alien species that spread and pose a threat to biodiversity (CBD, 2002). These are species that are rapidly expanding and achieving a large number of ground cover in a relatively short period of time or which threaten domestic so "native" species and pushes with their natural habitats. The reasons for the successful conquest of new habitats by invasive plants lies in the disruption of habitats, the abundance of nutrients, the slow return of natural vegetation, and fragmentation succession stages that help invading plants (Pyšek et Richardson, 2008).

Bosnia and Herzegovina (B&H) is not immune to these processes either. Part of invasive species represent and plant organisms. The most frequently mentioned invasive plant species in Bosnia and Herzegovina is the ambrosia or ragweed (Ambrosia artemisiifolia L.), a species whose pollen causes breathing problems in hypersensitive people. The first record of the occurrence of ragweed in B&H as invasive species was provided by Kovačević (1957). After these first notes of the occurrence, there was a spectrum of invasive plant species that have been registered by various authors: Slavnić (1960, 1964); Bjeličić et Stefanović, (1986); Abadžić (1986/87); Šumatić, (1990); Šarić et al, (2000); Šilić et Abadžić, (2000); Šoljan et al. (2003); Topalić-Trivunović et Šumatić, (2004); Šoljan et Muratović, (2000, 2002, 2004); Pehar, (2005); Redžić et al. (2008); Vojniković (2009); Maslo (2010, 2012, 2014). Until 2009 B&H 40 invasive plant species have been registered in B&H (Vojniković, 2009).

To deal with the increasing problem need are: international bodies, instruments, principles and guidelines that are used to prevent and reverse the spread of invasive species, e.g.: CBD, Berne Conference, GISP (Global Invasive Species Programme), IUCN Species Survival Commission (SSC) – ISSG (Invasive species specialist Group), the EU Biodiversity Strategy, European strategy on invasive alien species.

This paper describes an invasive species Rudbeckia laciniata L., that is new in the flora of Bosnia and Herzegovina, and presented its findings as well as the proposal of the struggle for its suppression.

Material and methods

During the field research and excursion visits to various locations at B&H in the fall of 2014, the occurrence of the species of the family Asteraceae has been observed. A review of regional flora and keys to identify flora of different countries in Europe (Lauber et Wagner, 2001); Blamey et Grey-Wilson, 2008); Frajman (2008)) was determined species of Rudbeckia laciniata L., further analysis of available literature: Francirkova

(2001), Muller (2004), Wittenberg, R. (ed.) (2005), and examining the EPPO (European and Mediterranean Plant Protection Organization) Alert list[1] has been established that the aforementioned species of in the list of invasive plant species. The analysis of the above literature has shown that there are no data regarding the occurrence of this species in our country.

Figure 1. Image of *Rudbeckia laciniata* L. – inflorescence in the late autumn aspect.

Figure 2. Population of Rudbeckia laciniata L. in the Otes-Ilidža area.

[1] http://www.eppo.int/INVASIVE_PLANTS/ias_lists.htm (datum pristupa URL: 25. 12. 2014) www.eppo.int/QUARANTINE/plants/mini_datasheets/Rudbeckia_laciniata.doc&rct=j&frm=1&q=&esrc=s&sa=U&ei=qPebVP2iMOfnywPSvYGQCw&ved=0CCUQFjAD&usg=AFQjCNGXO6V7CTFfDax6rqVVWW2HOFFEyg (datum pristupa: 25.12.2014.)

Results and discussion

Tall cone flower (*Rudbeckia laciniata* L., Asteraceae = common Bosnian name - dijeljenolisna rudbekija) is a perennial herbaceous plant, with erect (rarely) branched stems and rhizomes, high from 0.5 to 2 - 3 m. The stems and leaves are usually gray-green, bare or with sparse hairs. Its lower leaves are opposite; its upper leaves are more oval and can be composed of three lobes. All leaves may be serrated to a flat rim. Inflorescence resembles the inflorescence of sunflower, in addition to being smaller in diameter that ranges from 6 to 12 cm. Larger tongued flowers around the perimeter of the head of a flower are golden yellow, tubular flowers on the lower convex perianth closer to the centre of the flower heads are greenish to brown. Gills involocrum heads are golden yellow colour, there are 6-10 of them. It blooms from June to October. The fruit is ahenia, 4-5 mm long, of yellow, brown or beige colour, with short four dental papus.

In B&H *Rudbeckia laciniata* L. was observed at the following locations:

- Uvac (a smaller population at approximately 385 masl);
- The bridge on Lim in Rudo (a smaller population at approximately 360 masl);
- Međeđa (a smaller population at approximately 360 masl);
- Ustiprača (a large group at approximately 350 masl);
- Village Kukavice near Rogatica (a smaller population at approximately 510 masl);
- Rogatica (three larger populations at approximately 530 masl);
- Sarajevo - Otes (one larger population at approximately 495 masl).
- By the river Bosna from Sarajevo to Žepče, to assume and continue along the river Bosna (frequent and dense population of 480-330 masl)
- Jablanica (around the dam of the Jablanica Lake, one population - approximately 200 masl).

The natural range of this species is North America (east and west of Canada and the US). The infested areas in Europe are almost the whole of Europe, with the exception of the Iberian Peninsula, and the south-southeast of the Balkan Peninsula (Wittenberg, 2005). Except in Europe this species is registered in China and New Zealand.

Typical habitats of this species are the rivers, streams and wetlands, dams, escarpment roads, waste dumps along roadsides, edges of forests, and thickets. It requires a temperate climate and mainly colonizes the lower altitude, usually below 700 m. It prefers moist soil in shade.

Its tall cone flower creates mono dominant colonies with absence of other species, which has a large impact on biodiversity. Also, it has a negative impact on the process of progressive succession of forest trees in the alluvial areas. This species is toxic, even possibly fatal for animals (horses, sheep and pigs) if eaten.

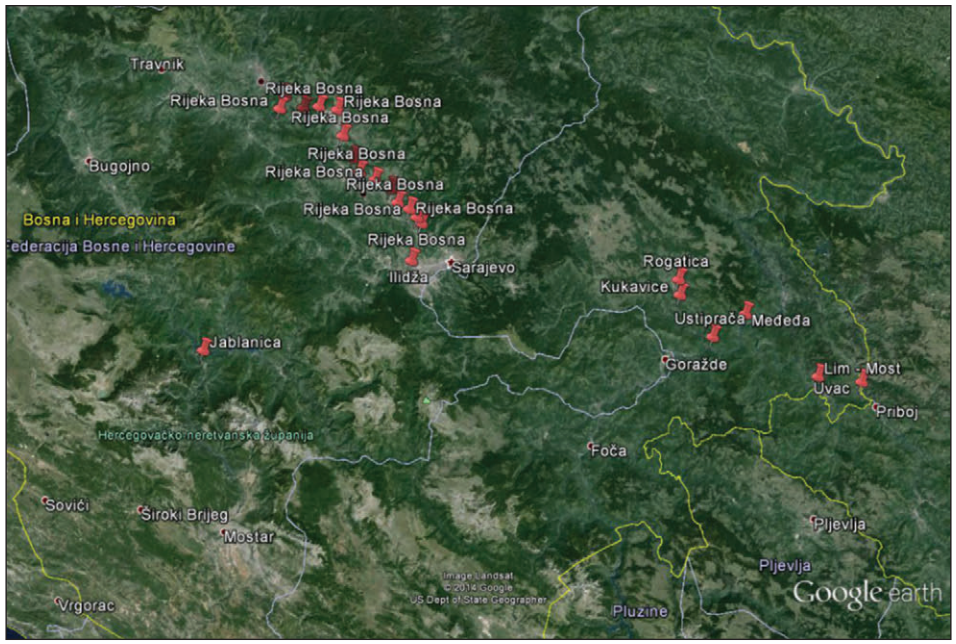

Figure 3 - Identified sites of the species *Rudbeckia laciniata* L. in B&H (marked with a red pin)

All observed locations are typical features of habitats that are characteristic of the occurrence of the species. These are mostly sites along the roads that are anthropogenized ruderal habitats in humid soils. In a broader sense, these habitats are found along the rivers Lim, Drina, Uvac or Željeznica, Bosna, and one site by the Neretva River.

The species Rudbeckia laciniata L. reproduces the fragmentation of rhizomes quickly and effectively. Also it easily spreads with the help of fruit species but its seeds can germinate only in open, unoccupied and disturbed habitats. Removing the rhizomes species Rudbeckia laciniata L. from the land can be very effective in the fight against this kind of species, but only in small areas. However, this method of control can mean "preparation" of land for seed, if the plants are in the phase of fruiting. Cutting this species several times a year results in the weakening of the plant, and

can help in its control. This method of control is generally quite expensive because it involves an intense manual work that is repeated throughout the year. Planting pioneer tree species that follow the alluvial habitats of particular species of the genus Alnus sp. and Salix sp. by overshadowing slow down the acquiring this type of habitat. In this case it is necessary to assist the measures of care and cultivation of fruit trees. It is also possible to use the appropriate herbicide, which can affect the success of this type of loss. A proximity to water courses, limiting the use of herbicides due to potential contamination of water courses (EPPO RS 2009/040)[2].

In addition to physical combat of invasive species, B&H should also develop legal instruments to combat invasive plant species. So far our legislation has not provided answers to these threats. The nature protection law in Federation of B&H (FB&H) and the Republic of Srpska (RS) neither directly treats the issue of invasive species nor combat them in any way. This law prohibits the introduction of alien species.

In view of this problem, as well as the growing importance of the problem of invasive species, it will be necessary to amend these laws in terms of the special treatment of this issue in future perspective. In order to monitor the situation and prevent the consequences caused by this species, it is necessary to include it into the document Black list of invasive species of flora and fauna and the Observation list at the entity or state level (something similar to the current Red List of flora of FB&H and RS). The Black list of flora should contain a list of invasive alien plant species that can cause damage in the field of biodiversity, health and economy. The observation of flora list should include invasive alien species that potentially can cause damage. The species from this list have already caused damage in the neighbouring countries. Plant species from the observation list must be registered and their expansion prevented.

In B&H, we should pay greater attention on the education for the manager of nature in the way of combating against invasive plant species, both in the field of recognition and monitoring of these species, as well as in the domain of various forms of struggle against them.

In addition, B&H must partake in these activities at the global and regional levels. At the operational level it should pursue activities that include monitoring the situation on the ground and an active fight to prevent the spreading of these species, particularly in forest ecosystems. Otherwise, due to the lag and lack of care in monitoring these activities, we can realistically anticipate a loss of biodiversity and reduction of stability of

[2] https://archives.eppo.int/EPPOReporting/2009/Rse-0902.pdf

ecosystems, but also effects that can significantly affect the economy, as well as the health of the human population.

Conclusion

The emergence of the species Rudbeckia laciniata L. as a new invasive species has brought an additional problem in terms of biodiversity and stability of ecosystems in Bosnia and Herzegovina. Given the size and severity of the problem and the constant appearance of new invasive plant species, it is necessary to work on the Black list and the Observation list of flora at the state or at the entity level. Since the tall cone flower recently observed, and the area which is occupied in B&H is limited, it is necessary to take adequate measures that will prevent its spread. It is therefore essential inclusion many actors which are in the process of managing nature. Immediate action must be taken in order to control and prevent the spread of these species.

As fighting measures. we recommend devising legal instruments for monitoring and applying international instruments, principles and guidelines in the fight against invasive (plant) species.

Literature

ABADŽIĆ, S. 1986/87: Prilog poznavanju horologije i ekologije dviju adventivnih vrsta – Echinocystis lobata (Michx) Torrey et Gray i Bidens bipinnata L. u Flori Bosne i Hercegovine: GZM B&H, Sarajevo, NS 25-26, str.: 71-77.

BJELČIĆ, Z., STEFANOVIĆ, V. 1986: Phytolacca americana L. u flori i vegetaciji Bosne i Hercegovine. Godišnjak Biol. inst. Sarajevo, Vol. 39, str.: 5-11.

BLAMEY, M., GREY-WILSON, C. 2008: Die Kosmos Enzyklopädie der Blütenpflanzen, Fracnch-Kosmos Verlags-GmbH & Co. KG, Stuttgart.

FRANCIRKOVA, T. 2001: Contribution of the invasive ecology of Rudbeckia laciniata in the Czech Republic. In: Brundu, G., Brock, J., Camarda, I., Child, L., Wade, M. (eds.) Plant Invasions: Species Ecology and Ecosystem Management, Backhuys Publishers, Leiden: 89-98.

FRAJMAN, B. 2008: Deljenolistna rudbekija Rudbeckia laciniata, Informativni list 7, Spletna stran tujerodne-vrste.info/informativni-listi/INF7-deljenolistna-rudbekija.pdf, Projekt Thuja. (http://www.tujerodne-vrste.info/informativni-listi/INF7-deljenolistna-rudbekija.pdf, datum pristupa: 13.11.2014.)

KOVAČEVIĆ, J. 1957: Rasprostranjenost sjevenoameričkog korova limundžika (Ambrosia artemisiifolia L.) u korovskim fitocenozama Srednje Posavine. Godišnjak Biol. inst. Sarajevo, God. X, Fasc. 1-2, str.:173-176.

LAUBER, K., WAGNER, G. 2001: Flora Helvetica 2.0, CD – ROM, Ein interaktiv Führer durch die Pflanzwelt der Schweiz, Haupt digital.

MASLO, S. 2010: Giant hogweed Heracleum mantegazzianum Sovier & Levier – a new non-indigenous species in the flora of Bosnia and Hercegovina. Herbologia 11 (2): 17-24.

MASLO, S. 2012: Rescue grass Bromus catharticus Vahl.- a new alien species in the flora of Bosnia and Herzegovina. Herbologia 13 (2): 31-36.
MASLO, S. 2014: Alien flora of Hutovo blato Natural park (South Bosnia and Herzegovina). Herbologia 14 (1): 1-13.
MULLER, S. 2004: Rudbeckia laciniata In: (2004) Plantes invasives en France. (Ed. Muller S) pp. 114-115. 2004 Muséum national d'Histoire naturelle, Paris (FR), (Patrimoines naturels, 62).
PEHAR, J 2005: Vrtlarstvo II, Izdanje, Mostar.
PYŠEK, P., RICHARDSON, D. M. 2008: Invasive Plants. In Sven Erik Jørgensen and Brian D. Fath (Editor-in-Chief), Ecological Engineering. Vol. [3] of Encyclopedia of Ecology, 5 vols. pp. [2011-2020] Oxford: Elsevier.
PYŠEK, P., RICHARDSON, D. M. 2010: Invasive Species, Environmental Change and Management and Health; Annual Review of Environment and Resources, Vol. 35, pp.: 25-55
REDŽIĆ, S., BARUDANOVIĆ, S., RADEVIĆ, S. (eds.) 2008: Bosna i Hercegovina – Zemlja raznolikosti. Federalno ministarstvo okoliša i turizma, Sarajevo. Bemust. str.: 137-139.
REJMANEK, M., RICHRADSON, D. M., PYŠEK, P. 2006: Plant invasions and invasibility of plant communities; ed. van der Maarel, E. in: Vegetation Ecology, Blackwell Publishing.
SLAVNIĆ, Ž. 1960: O useljavanju, širenju i odomaćivanju nekih adventivnih biljaka u Bosni i Hercegovini. Godišnjak Biol. inst. Sarajevo, God.XIII, Fasc. 1-2, str.: 117-143.
SLAVNIĆ, Ž. 1964. Rod Bidens L. u flori Bosne i Hercegovine. Radovi naučnog društva SR Bosne i Hercegovine. Odjeljenje priv.-tehn. Nauka 25 (7): 155-162. Sarajevo.
ŠARIĆ, T., ĐIKIĆ, M., GADŽO, D., ELEZOVIĆ, Z. 2000: Promjene korovske flore u B&H pod uticajem agrotehnike. Herbologija, Sarajevo, Vol. I, br. 1, str.: 15-26.
ŠILIĆ, Č., ABADŽIĆ, S. 2000: Prilog poznavanju neofitske flore Bosne i Hercegovine. Herbologija, Sarajevo, Vol.I, br.1, str.: 29-39. Sarajevo.
ŠOLJAN, D., ABADŽIĆ, S., MURATOVIĆ, E. 2003: Neophytes in flora of Bosnia and Herzegovina. Third Balcan Botanical Congress, Abstracts; str. 197, Sarajevo.
ŠOLJAN, D., MURATOVIĆ, E. 2000: Rasprostranjenost vrste Ambrosia artemisiifolia L. Na području grada Sarajeva. Herbologia 1 (1): 41-47.
ŠOLJAN, D., MURATOVIĆ, E. 2002: Rasprostranjenost vrste Ambrosia artemisiifolia L. u Bosni i Hercegovini. Herbologija. 3 (1): 107-111.
ŠOLJAN, D., MURATOVIĆ, E. 2004: Rasprostranjenost vrste Ambrosia artemisiifolia L. u Bosni i Hercegovini (II). Herbologija. 5 (1): 1-5.
ŠUMATIĆ, N. 1990: Korovska vegetacija sjeveroistočne Bosne, Naučni skup: "Populacija, vrsta, biocenoza", Rezimei referata, str. 69, Sarajevo.
TOPALOVIĆ-TRIVUNOVIĆ, Lj., ŠUMATIĆ, N. 2004: Reynoutria japonica Houtt. – invasive species in ruderal flora of Banja Luka. Acta herbologica, Vol. 13, No. 1, str.: 13-18.
VOJNIKOVIĆ, S. (2009): Crna lista flore; Hrvatska misao, časopis za umjetnost i znanost. Matica hrvatska Sarajevo, god. XIII. br. 1/09 (50) nova serija sv. 36. str.86-95.
WITTENBERG, R. (ed.) 2005: An inventory of alien species and their threat to biodiversity and economy in Switzerland. CABI Bioscience Switzerland Centre report to the Swiss Agency for Environment, Forests and Landscape.
**** Konvencija o biološkome diverzitetu (2002): CBD (Convention on Biological Diversity) Guiding Principles for the prevention, introduction and mitigation of impacts of alien species that threaten ecosystems, habitats or species (annexed to Decision VI/23 adopted by the Conference of the Parties to the CBD, The Hague, April 2002).
**** Zakon o zaštiti prirode FB&H (2013): Službene novine FB&H br. 66/13.
**** Zakon o zaštiti prirode RS (2008): Službeni glasnik RS br. 113/08.

www.eppo.int/QUARANTINE/plants/mini_datasheets/Rudbeckia_laciniata.doc&rct=j&frm=1&q=&esrc=s&sa=U&ei=qPebVP2iMOfnywPSvYGQCw&ved=0CCUQFjAD&usg=AFQjCNGXO6V7CTFfDax6rqVVWW2HOFFEyg (datum pristupa: 25.12.2014.)
http://www.eppo.int/INVASIVE_PLANTS/ias_lists.htm (datum pristupa URL: 25.12.2014)
https://archives.eppo.int/EPPOReporting/2009/Rse-0902.pd