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***HERACLEUM SOSNOWSKYI* MANDEN. (APIACEAE) – A NEW INVASIVE SPECIES IN THE FLORA OF SERBIA**

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Abstract: As invasive species are some of the most important drivers of global change in biodiversity and ecosystem services, early detection of invasive species and the ability to track their spreading are of crucial importance. One of the most dangerous invasive plant species in Europe, *Heracleum sosnowskyi* Manden. *H. sosnowskyi*, is recorded as a new species in the flora of Serbia. It was found in June 2016 in the area of Belgrade on the left bank of the Danube, near Kovilovo. Data concerning its morphology, habitat characteristics, flowering period and population size in Serbia are presented in this paper.

Key words: *Heracleum sosnowskyi*, invasive plant species, a new invasive species, Belgrade

INTRODUCTION

The introduction and spread of invasive non-native species (INNS) constitutes one of the most important drivers of global change in biodiversity and ecosystem services in today's world (Sala et al., 2000). Invasive plants also cause serious economic losses related to these changes. That is why early detection of invasive alien species and the ability to track their spreading is critical for undertaking appropriate management decisions (Maistrello et al., 2016).

The most dangerous invasive plant species in Europe belong to the genus *Heracleum* and they include the species: *H. mantegazzianum*, *H. sosnowskyi* and *H. persicum* (EPP0, 2009). According to Baležentienė (2012) *H. sosnowskyi* (Sosnowsky's hogweed) is among the six most dangerous invasive species, which successfully spreads along roads and has become naturalized in habitats and plant communities in European countries.

H. sosnowskyi originates from the central and eastern Caucasus and western, central, eastern and southwestern Transcaucasia and northeastern Turkey (Gavrilova, 2003; Jahodová et al., 2007; Jahodová et al., 2007a). It was first introduced into Russia from its natural habitats (in 1947) than in Latvia, Estonia, Lithuania, Belarus, Ukraine and the former German Democratic Republic (Nielsen et al., 2005). Before the 1970s *H. sosnowskyi* was rare, but since 1970s it was recorded to have spread in many European countries (Игнатов et al., 1990) (Fig. 1). *H. sosnowskyi* was introduced as an agricultural crop to Europe, where its large biomass was ensiled to provide fodder for livestock (Nielsen et al., 2005). It was also cultivated in many botanical gardens and sometimes as ornamental plant in gardens (Бялт, 1999; Григорьевская et al., 2004).



Figure 1. Distribution map of *H. sosnowskyi* in Europe

(Downloaded from DAISIE web site: <http://www.europe-aliens.org>)

The species is mostly found at ruderal habitats (roadsides, disturbed habitats, abandoned agricultural fields, yards and gardens).

H. sosnowskyi is morphologically very similar to the species *H. mantegazzianum* (Jakub-ska-Busse et al., 2013). Some botanists do not consider *H. sosnowskyi* a distinct species, but a subspecies of *H. mantegazzianum* or *H. pubescens*. *H. sosnowskyi* was discovered in 1772, but due to confusion in determination, it was described as distinct species in 1944 by Mandenova (Jakubowicz et al., 2012).

The generated confusion is the reason why this species has not been included in the European lists of invasive plants until now. There are six naturally occurring species from the genus *Hera-cleum* in Serbia (Nikolić, 1973; Budak, 1986). The most common species is *H. sphondilium* L. (common hogweed). The other five species are: *H. pollinianum* Bertol, *H. sibiricum* L., *H. ternatum* Vel., *H. verticillatum* Panč. and *H. orphanidis* Boiss. The last two taxa are Balkan endemics (Tomović, 2007) and they are listed at The Ordinance on proclamation and protection of strictly protected and protected wild species of plants, animals and fungi (Official Gazette of RS, 2010; Official Gazette of RS, 2011; Official Gazette of RS, 2016). Until now the species *H. sosnowskyi* has not be found in Serbia.

This paper reports on the first finding of *H. sosnowskyi* in Serbia. The main aims of the study

were to determine its habitat preferences and to estimate its population size in the Grbavica Canal (Široka bara, Kovilovo) habitat.

MATERIALS AND METHODS

H. sosnowskyi was found on the left bank of the Danube, near Kovilovo (GPS coordinates: 44°55'32.31"N, 20°20'52.54"E), during the floristic investigation in June 2016. The collected specimens of this species were herbarized and deposited in the Herbarium of the Institute for Nature Conservation of Serbia (Belgarde). Determination of plant species was carried out by standard floristic methods. Relevant literature was used for olant determination (Javorka, Csapody, 1934; Josifović, 1970-1977; Tutin et al., 1964-1980; Jakub-ska-Busse et al., 2013; Flora Europaea).

RESULTS

The invasive plant species *H. sosnowskyi* was found for the first time in Serbia in Belgrade area on the left bank of the Danube, near Kovilovo in June 2016.



Figure 2. The stem of *H. sosnowskyi* (foto by S. Petrović)



Figure 3. The leaf of *H. sosnowskyi* (foto by N. Sekulić)

H. sosnowskyi is biennial or perennial plant. Its height is usually 100-300 cm. The stem is ridged and sparsely hairy with purple blotches (Fig. 2). On the upper surface the leaves are hairless with a slight hair below. Lower leaves are divided into three segments that are non-deeply divided into oval shortly sharply pointed parts (Fig. 3). The leaf margins have short rounded teeth. The flowers are white, sometimes pinkish. Outer petals radiate, and are 9-10 mm long. Slightly convex compound umbels, 30-50 cm across have 30-75 rays with only short hairs. Flowering typically lasts from June to August. The fruits are egg-shaped or oval; 8-10 mm (–15 mm) long, and when uripe, they are densely hairy.



Figure 4. The Grbavica river canal – the habitat of *H. sosnowskyi* (foto by S. Petrović)



Figure 5. *H. sosnowskyi* individuals (foto by S. Petrović)

H. sosnowskyi population extends in the form of a narrow belt along both sides of the Grbavica river canal (Fig. 4). The Grbavica canal is located along a forest edge at 73 m altitude. This habitat is wet and occupied by dense populations of aggressive invasive species: *Amorpha fruticosa* L. and *Aster sp.* In addition, the species *H. sosnowskyi* forms a dense and stabile population in the studied habitat. A total of 10 individuals are recorded per 10 m². During the flowering period the individuals in the population are very tall, cca. 2 m (Fig. 5). The total area covered by *H. sosnowskyi* population is 150 m².

During research, one case of phytophotodermatitis was recorded on an agricultural worker caused by the sap of *H. sosnowskyi* (Fig. 6).

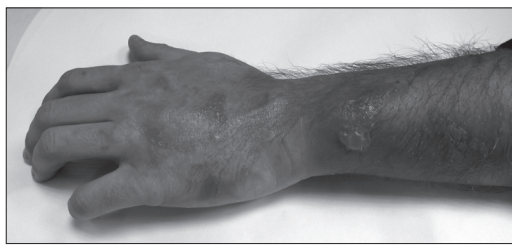


Figure 6. The phytophotodermatitis caused by the sap of *H. sosnowskyi* (foto by S. Petrović)

DISSCUSION

H. sosnowskyi is included in several European databases relating to invasive flora and fauna which indicates the importance of the species as the invasive plant (NOBANIS; DAISIE; EPPO). The latest European Commission document (Official Journal of the European Union, 2014) relating to the control of the spread of invasive species, classified *H. sosnowskyi* as one of the 14 species of importance for the European Union.

Accordingly, the species *H. sosnowskyi* is identified as an aggressive invasive plant in many European countries (Kabuce, Priede, 2010). It is known that these plants cause serious economic losses and have adverse environmental impacts. Considering the aforementioned data, there is no doubt of the importance of early detection of the invasive plant *H. sosnowskyi* and the monitoring of its populations.

Individuals of average size produce about 20.000 seeds. The seeds easily disperse via water and wind. Long-distance dispersal events that transport the seeds far from the source population are important mechanisms of plant dispersal, e.g. during extreme events such as floods. Wind is an important vector of local dispersal, especially in winter when seeds are blown over the frozen or snow-covered soil surface (Kabuce, Priede, 2010). In addition to that, human activities are one of the vectors of its spreading seeds.

According to current data for Serbia (Lazarević et al., 2012), *H. sosnowskyi* was for the first time found in a studied locality (the left bank of the Danube, near Kovilovo). It can be assumed that this species arrived in Serbia during the big floods that occurred in previous years. There is high probability that *H. sosnowskyi* individuals occur sporadically or else, establish populations along watercourses in other Serbian localities, considering the large amount of seeds that plants produce and their effective dispersion by water and wind in Serbia.

H. sosnowskyi has a negative impact, not only on the native flora and economy, but also on human health. Namely, the species of the *Heracleum* genus produce furanocoumarins. Many furanocoumarins are toxic and are produced by plants as a defense mechanism against various types of predators, ranging from insects to mam-

mals (Berenbaum, 1981). This class of phytochemical is responsible for phytophotodermatitis. Namely, the sap of *H. sosnowskyi* is phototoxic. When the contacted skin is exposed to sunlight or ultraviolet rays, it can cause phytophotodermatitis (severe skin inflammations). Initially, the skin colours red and starts itching. Blisters form as it burns within 48 hours, and sometimes even hospitalisation may be necessary (Jakubská-Busse et al., 2013; Jakubowicz et al., 2012).

With regard to the serious problems caused by invasive species, the establishment of a national legislation is of crucial importance. The introduction of alien species into natural areas is prohibited by the Law on Nature Protection of the Republic of Serbia (Official Gazette of RS, 2010; 2016.) and the appropriate prohibition and permission of the competent Ministry are prescribed. In addition, this law defines the control measures for invasive species. One problem lies in the implementation of the Law. The second problem is the necessity of adoption of by-laws that would regulate introduction control, monitoring and invasive species suppression.

In accordance with the international and national recommendations, it is chiefly necessary to permanently monitor the recorded *H. sosnowskyi* populations. Also, it is important to investigate the localities in Serbia that are potential habitats for this species. Public education in recognising the species and the dangers it poses is necessary. Public enterprise "Srbijašume" is responsible for the studied locality in the territory of Belgrade. They have already begun the process of suppression of *H. sosnowskyi* (mowing and spraying by herbicides). In order to inform the public about the problems this species can cause, the Institute for Nature Conservation of Serbia posted the basic information on *H. sosnowskyi* on its website. This institution will also undertake activities that they are in charge of.

In the locality where this species was recorded for the first time, the individuals in populations, are very tall (cca. 3 m) at the time of flowering. Because of the height of individual plants during flowering time, it is recommended to remove individuals in early spring, before flowering. During the moving, it is necessary the use gloves and eye protection. When a plant is to be moved with the root, the plant should be cut 10 cm un-

der soil surface. Depending on the population abundance and size of the individuals, the moving can also be done by land use change, plowing, grazing and spraying (in accordance with the law on herbicides usage).

CONCLUSION

The finding of *H. sosnowskyi* on the left bank of the Danube, near Kovilovo (Belgrade) represents the first recording of this species in the territory of Serbia. *H. sosnowskyi* is considered one of the most dangerous and aggressive invasive plant species in Europe, not only because of its negative impact on biodiversity, but also due to the serious human health problem (phytophotodermatitis) it can cause. Further investigation on the spreading and distribution of *H. sosnowskyi* should be urgently performed.

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