

## The alien species of *Heracleum* (*Apiaceae*) in the Bulgarian flora revisited

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**Abstract.** The genus *Heracleum* (*Apiaceae*) is represented by four native species in the Bulgarian flora. In 2017, an alien species, *H. sosnowskyi*, was reported for the first time for Bulgaria in *Acta Zoologica Bulgarica*, Suppl. 9: 47–51, 2017. However, further studies have revealed that the species was misidentified and the reported plants from Sofia City in fact belong to *H. mantegazzianum*. In summer 2018, both *H. sosnowskyi* and *H. mantegazzianum* were found in the Rhodope Mts. The population of the former species comprised a few thousand specimens spread in grasslands, arable land and along three confluent local rivers, whereas the latter species was represented by only a few specimens. The specimens of both alien species outgrew any of the native herbaceous plants and reached a height of over three meters. The article presents the currently known distribution of the two species in the Bulgarian flora and the main distinguishing characters between *H. mantegazzianum*, *H. sosnowskyi* and the native *Heracleum* species. Some data about the populations, local spread and impact of the alien *Heracleum* species in Bulgaria are provided. The text is illustrated with photographs from the Bulgarian localities. Diploid chromosome number,  $2n = 2x = 22$ , is reported for *H. sosnowskyi* for the first time from a naturalised Bulgarian accession.

**Key words:** Alien plants, Giant hogweed, *Heracleum mantegazzianum*, *Heracleum sosnowskyi*, invasive species, Sosnowky's hogweed.

### Introduction

The genus *Heracleum* (*Apiaceae*) is represented by four native species in the Bulgarian flora: *H. angustisectum* (Stoj. & Acht.) Peev, *H. sibiricum* L., *H. ternatum* Velen. and *H. verticillatum* Pančić (Peev 1982). In 2017, an alien species, *H. sosnowskyi* Manden., was reported for the first time for Bulgaria (Vladimirov & al.

2017). However, further studies have revealed that the species was misidentified and the reported plants in fact belong to *H. mantegazzianum* Sommier & Levier. Therefore, until recently, of the alien *Heracleum* species only *H. mantegazzianum* has been recorded in the Bulgarian flora, especially in Sofia City, Sofia floristic region. Ironically, in summer 2018, *H. sosnowskyi* was found as well.

The aims of the present article are: 1) to report for the first time the occurrence of *H. sosnowskyi* in the Bulgarian flora; 2) to clarify the taxonomic identity and distribution of the alien *Heracleum* species in Bulgaria, and 3) to provide some data about the populations of the species and discuss their invasive status in the country.

## Material and methods

Field studies were carried out during summers of 2017–2019. Plant material was collected from Sofia city and from the Rhodopi Mts. Morphological characters were noted from the Bulgarian material and compared with the data from the literature (Mandenoova 1944; Brummit 1968; Nielsen & al. 2005; EPPO datasheet on IAP 2009). The herbarium material was deposited in the herbarium (SOM) of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences. Data about the populations and habitats in Bulgaria are based on personal observations. The analysis of the invasiveness of the species is based on personal observations in the field and on the available literature on the biology, ecology and invasion success of the species (Davies & al. 2004; EEA, <https://eunis.eea.europa.eu/habitats-code-browser.jsp>; Nielsen & al. 2005; Jahodová & al. 2007; EPPO datasheet on IAP 2009; Kabuce & Priede 2010).

The chromosome number of *H. sosnowskyi* was counted in root meristematic cells at metaphase. Seeds of the species were collected from the field and put for germination in a pot. Root tips from the seedlings were collected and pre-treated with colchicine solution (0.01%) for *ca.* 90 min, then fixed in acetic alcohol (1:3) for at least 2 hours at room temperature, hydrolysed in 1N HCl for 25 min at 60°C, treated with 1:1 solution of conc. HCL in diethyl ether for 5–8 min at 60°C, and stained in Gomori's haematoxylin (Melander & Wingstand 1953) for 30 min at 60°C. The root tips were finally squashed in 45% acetic acid and observed with a light microscope.

## Results and discussion

So far two alien species of *Heracleum* have been recorded in the Bulgarian flora: *H. mantegazzianum* and *H. sosnowskyi*.

***Heracleum mantegazzianum*** Sommier & Levier, Nuovo Giorn. Bot. Ital., ser. 2, 2 (1895): 79 (Fig. 1).

Herbaceous short-lived perennial, monocarpic. Stems 1.0–3.0 m, erect, branched in the upper part, ridged and sparsely hairy, with conspicuous purple blotches. Leaves alternate, 60–120 cm, divided to a varying extent, usually two times ternate, acute, pubescent beneath. Compound umbels usually 2–6, slightly convex, 30–60 cm in diameter, the terminal is the largest, with 50–120 finely hirsute rays. Petals 9–12 mm long, white, the outer distinctly radiate. Fruit a pair of winged mericarps; each mericarp is elliptic in outline, (6)9–15 × (3)5–8 mm (the fruits of the terminal umbel are the largest), one-seeded, densely hairy when unripe, narrowly winged; vittae swollen, reaching  $\frac{3}{4}$  of the length of the fruit (Fig. 2).



Fig. 1. *Heracleum mantegazzianum*, Sofia City (photo V. Vladimirov).



Fig. 2. Mericarps of *Heracleum mantegazzianum*.



***Heracleum sosnowskyi*** Manden., Zametki Sist.

Geogr. Rast. 12 (1944): 17 (Figs. 3, 4).

Herbaceous short-lived perennial, monocarpic. Stems (1.0)1.5–3.5 m, erect, branched in the upper part, ridged and sparsely hairy, with conspicuous purple blotches. Leaves alternate, 60–120 cm, divided to a varying extent, usually two times ternate, acute, pubescent beneath. Compound umbels usually 2–6, slightly convex, 30–60 cm in diameter, the terminal is the largest, with 50–120 finely hirsute rays. Petals 9–10 mm long, white, rarely pink (Fig. 4), the outer distinctly radiate. Fruit a pair of winged mericarps; each mericarp is elliptic in outline, (8)9–13 × 5–8 mm, one-seeded; wings of ripe mericarps with upward-curved minute spines (*ca.* 0.1 mm) on small swellings; vittae strongly swollen, 0.6–1 mm wide, reaching  $\frac{3}{4}$  of the length of the fruit (Fig. 5).

In Bulgaria, both species flower in June – July and fruits ripen in July – August. Flowers are insect-pollinated, visited by many species, including bees.

Both species are easily distinguished from the native Bulgarian species by the bigger basal and lower cauline leaves (usually more than 60 cm long in the alien *Heracleum* species), bigger compound umbels (*ca.* 30–60 cm in diameter in the alien and up to 20–30 cm in the native species), and higher number of rays of the com-



Fig. 3. *Heracleum sosnowskyi*, Western Rhodopi Mts (photo V. Vladimirov).

pound umbels (*ca.* 50–120 in the alien and up to 35–50 in the native species). However, the recognition of the two species from each other in many cases may be rather problematic. The main distinguishing character seems to be the shape of the leaves. The well-developed basal, lower and middle cauline leaves of *H. mantegazzianum* are more widely incised, with ultimate leaf-lobes triangular to elongate-triangular in outline, with a wide space between them (nearly as wide as the lobes) and terminal lobe of the terminal primary leaf-segment



Fig. 4. Pink flowers in *Heracleum sosnowskyi*, Western Rhodopi Mts (photo V. Vladimirov).



Fig. 5. Mericarps of *Heracleum sosnowskyi*.



with a narrowly winged rachis and long-cuneate at base, whereas the ultimate leaf-lobes in *H. sosnowskyi* are short, ovate or elliptic, nearly touching each other (with a very narrow space between the ultimate lobes) and the terminal lobe of the terminal primary leaf-segment with a broadly winged rachis and not cuneate at base (Figs. 6–8). The mericarps are extremely variable in size and outline and the pattern in the outline of the fruits as presented by Nielsen & al. (2005) is not confirmed in the Bulgarian material.

#### Key to the species

[based on Peev (1982) with modifications]

1. Upper stem-branches whorled, petals show-white rarely pinkish ..... 2
- 1\*. Upper stem-branches not whorled, petals greenish or yellowish ..... 4
2. Terminal umbels with 30–50 rays, usually not more than 30 cm in diameter; outer petals up to 5 mm long ..... *H. verticillatum*
- 2\*. Terminal umbels with 50–120 rays, usually 30–60 cm in diameter; outer petals 8–12 mm long ..... 3



Fig. 7. Shape of the basal and lower cauline leaves in *Heracleum mantegazzianum* (photo V. Vladimirov).

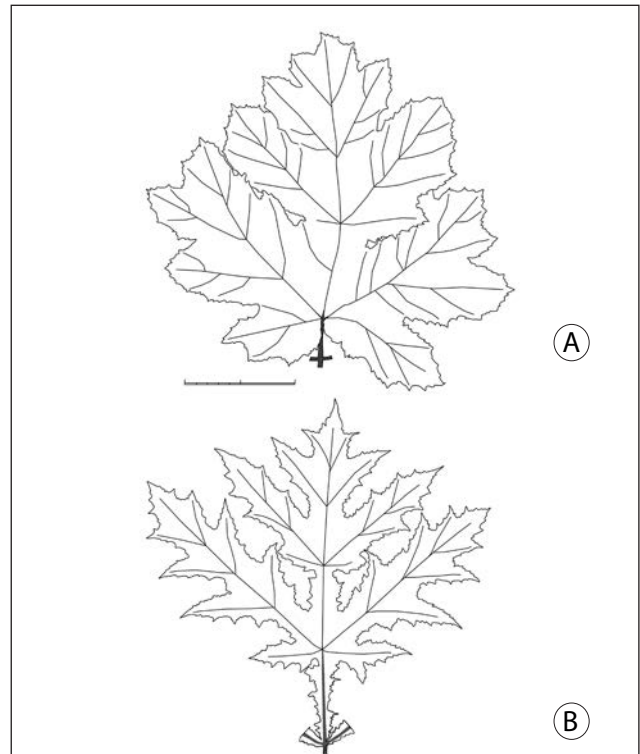
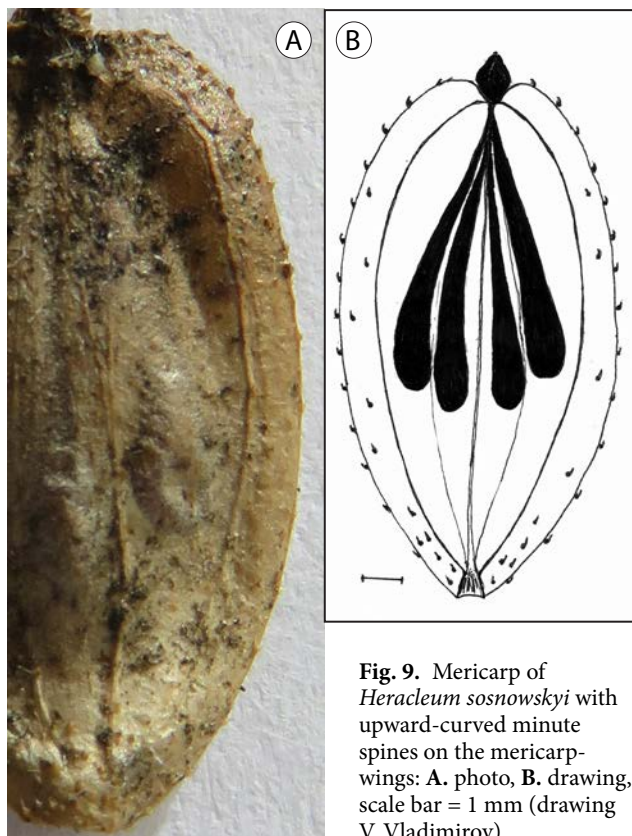


Fig. 6. Shape of the terminal leaf-segment of the basal and lower cauline leaves in *H. sosnowskyi* (A) and *H. mantegazzianum* (B), scale bar = 10 cm (drawing by Z. Gudžinskas).



Fig. 8. Shape of the basal and lower cauline leaves in *Heracleum sosnowskyi* (photo V. Vladimirov).

3. Ultimate leaf-lobes of the well-developed lower and middle cauline leaves triangular to elongate-triangular, with a distance between them about as wide as the width of the lobes; terminal lobe of the terminal primary leaf-segment with a narrowly winged rachis and long-cuneate at base (the base is 2–5 times longer than wide, see Fig. 6); wings of ripe mericarps without minute spines on swellings ..... *H. mantegazzianum*
- 3\*. Ultimate leaf-lobes of the well-developed lower and middle cauline leaves short, ovate to elliptic, nearly touching each other; terminal lobe of the terminal primary leaf-segment with a broadly winged rachis and not cuneate at base (the base is up to about twice longer than wide, see Fig. 6); wings of ripe mericarps with sparse upward-curved minute spines on small swellings (Fig. 9) ..... *H. sosnowskyi*
4. Ultimate leaf-lobes lanceolate, decurrent at base ..... *H. angustisectum*
- 4\*. Ultimate leaf-lobes obovate, elliptic to broadly lanceolate, not decurrent at base ..... 5
5. Basal and larger cauline leaves ternate, with rounded to acuminate ultimate lobes ..... *H. ternatum*
- 5\*. Basal and larger cauline leaves with 5–9 segments, each divided into acute ultimate lobes ..... *H. sibiricum*



**Fig. 9.** Mericarp of *Heracleum sosnowskyi* with upward-curved minute spines on the mericarp-wings: **A.** photo, **B.** drawing, scale bar = 1 mm (drawing V. Vladimirov).

## Distribution in Bulgaria, pathways of introduction and spread

*Heracleum mantegazzianum* has been recorded in the following two floristic regions: **1). Sofia region:** Sofia City, grasslands among the blocks of flats in Lyulin – 1 residential district, ca. 560 m a.s.l., 42.727026°N, 23.254605°E, 28.06.2017, in flower, V. Vladimirov & B. Assyov obs. (photos); *loc. ibid.*, 13.07.2017, in flowers and unripe fruits, leg. V. Vladimirov (SOM) (Fig. 10); *loc. ibid.*, 15.07.2017, B. Assyov & A. Petrova obs.; **2). Rhodopi Mts (Western):** near Borino village, on the right bank of Borinska river, under *Salix* spp. trees and mixed with *H. sosnowskyi*, ca. 1100 m a.s.l., 41.67143°N, 24.30037°E, 13.07.2019, coll. V. Vladimirov (SOM; photo) (Fig. 11).

In the first locality the population comprised about 150–200 individuals which were clustered into three groups – one large, covering about 50–60 m<sup>2</sup>, and two smaller of about 10–15 m<sup>2</sup> each. The plants of *H. mantegazzianum* were rather dense, ca. 100–150 cm tall and overtopped the native grassland vegetation dominated by *Arrhenatherum elatius*, *Dactylis glomerata*, *Elymus caninus*, *E. repens*, *Hordeum murinum*, *Poa pratensis*. Since 2017 the grassland has been regularly mowed 2–3 times per year for maintenance of the urban landscape, and the formation of seeds has been prevented. Therefore, it can be expected that if the regular mowing continues, the population will gradually decline. The cut biomass from the grassland is used for composting in some of the settlements near Sofia and accidental spread of viable seeds of *Heracleum* is possible during the transportation of the green biomass.

In the second locality only 4–5 plants resembling very closely *H. mantegazzianum* were detected growing mixed with the much more abundant *H. sosnowskyi*. Hybrid plants between the two species have not been detected during the field studies in 2019 based solely on morphology. However, hybridisation is a possible option bearing in mind the very low number of specimens of *H. mantegazzianum* and the very common and abundant *H. sosnowskyi* in the area.

***Heracleum sosnowskyi*: Rhodopi Mts (Western):** ca. 0.5 km from Borino village, to the left of the road to Devin town, margin of a potato field and a ditch along the road, a few flowering specimens seen, ca. 1140 m, 41.67900°N, 24.30530°E, 22.06.2018 &





Fig. 10. *Heracleum mantegazzianum*, the locality in Sofia City, June 2017 (photo V. Vladimirov).

13.07.2019, V. Vladimirov obs.; near a sawmill by the road from Borino to Chala village, hundreds of fruiting plants, ca. 1130 m a.s.l., 41.677067°N, 24.301583°E, 12.09.2018, Zh. Barzov obs. (photos); in the valley of Borinska River under the sawmill situated by the road from Borino to Chala village, 1110–1130 m a.s.l., ca. 41.676801°N, 24.301052°E, 17.10.2018, A. Petrova obs. (photos); near a sawmill and around private gardens close to Borino village, in the valley of Borinska river, over a thousand of flowering specimens, 1110–1120 m, 41.67445°N, 24.30194°E, V. Vladimirov obs. (photo) (Fig. 12), accompanying species were *Alopecurus pratensis*, *Anthoxanthum odoratum*, *Cirsium arvense*, *Deschampsia cespitosa*, *Festuca pratensis*, *Galium verum*, *Holcus lanatus*, *Lathyrus pratensis*, *Lychnis flos-cuculi*, *Persicaria amphibia*, *Rumex acetosa*, *Trifolium hybridum*, etc.; by Borinska river, 1100–1110 m, 41.67374°N, 24.30020°E, 13.07.2019, coll. V. Vladimirov (SOM), accompanying species were *Salix fragilis*, *Arctium*

*tomentosum*, *Arrhenatherum elatius*, *Artemisia vulgaris*, *Dactylis glomerata*, *Filipendula ulmaria*, *Galium aparine*, *Heracleum sibiricum*, *Mentha longifolia*, *Pastinaca sativa*, *Urtica dioica*, etc.; by Borinska river, several flowering plants, ca. 1080 m, 41.65614°N, 24.30224°E, 13.07.2019, V. Vladimirov obs.; Borino village, by the asphalt road from Dospat to Devin towns, one flowering specimen, ca. 1130 m, 41.68121°N, 24.29830°E, 13.07.2019, V. Vladimirov obs.; **Rhodopi Mts (Central)**: Byunovsko Gorge, on the left bank of Byunovska river, six flowering plants seen, ca. 890 m, 41.65791°N, 24.34363°E, 13.07.2019, V. Vladimirov obs. (photo); left bank of Buynovska river, a single flowering specimen, ca. 880 m, 41.66508°N, 24.34226°E, V. Vladimirov obs.; right bank of Vacha River, under Teshel village, Devin Municipality, ca. 855 m a.s.l., 41.67622°N, 24.35155°E, 13.07.2019, V. Vladimirov obs. (photo).

In most of the above mentioned localities near Borino village, *H. sibiricum* is present and a relatively





Fig. 11. *Heracleum mantegazzianum*, the locality by Borinska River, Western Rhodopi Mts, July 2019 (photo V. Vladimirov).

common species. The latter species flowers earlier and at the time of full blossoming of *H. sosnowskyi*, most of the umbels of *H. sibiricum* are already with young fruits. Nevertheless, some overlap in the flowering period of the two species does occur. However, hybrid plants have not been detected yet.

*Heracleum mantegazzianum* was first introduced to Europe in early XIX century to the Kew Botanic Gardens as an ornamental plant, and already in 1828 the first naturalised population was detected in Great Britain. Soon afterwards, it was spread to other botanical gardens in West and North Europe (Nielsen & al. 2005) and most likely, this initiated the invasion in Europe. *Heracleum sosnowskyi* was introduced as an agricultural crop to Europe, e.g. in North-East Russia, Latvia, Estonia, Lithuania, Belarus, Ukraine, former German Democratic Republic, to provide silage fodder for livestock (Nielsen & al. 2005). Also, it was transported to some botanical gardens as an ornamental plant (Kabuce & Priede 2010).



Fig. 12. *Heracleum sosnowskyi* near Borino village, Western Rhodopi Mts, July 2019 (photo V. Vladimirov).



In Bulgaria, we were unable to detect the exact years and pathways of introduction of the species, despite the interviews with the local residents. For *H. mantegazzianum* in Sofia City, there are two main options: 1). The species was unintentionally introduced by seeds which were attached to a suitable vector, e.g. vehicle or human shoes/clothes, and this involves very long distance dispersal from another European or Asiatic country where the species is present. 2). The species was intentionally introduced as an ornamental plant and cultivated in the grassland between the blocks of flats. None of the two pathways can be proved at this stage but the first one seems to be more likely. Bearing in mind the current population size, with already three separate groups of well-established and flowering plants, the species must have been present in this locality for at least 10 years (Vladimirov & al. 2017 sub *H. sosnowskyi*). For the localities of both species in the Rhodopi Mts, undeniably, the invasion started from Borino village. Interviews with the local villagers showed that the species has been present there for already more than 30 years. This is also supported by the locally widespread and rather abundant population of *H. sosnowskyi*. The largest and most abundant fragments of the population of the latter species are situated around a sawmill. It is likely, that the introduction of the species is connected somehow with the activities of this sawmill. Since both species are present in this locality, it is likely that there have been more than one introduction event. Another option is an accidental transportation of seeds attached to agricultural machineries used in the area or to other suitable vectors (cars, human clothes/shoes). Introduction in the area as an ornamental plant is unlikely, since none of the species has been seen in any garden in the village and the local population did not have a specific local name for any of the species (which is not the case with the popular ornamental plants). Nobody of the several persons we spoke with was aware that the species may be harmful to human health.

Mericarps of the species are dispersed by wind, watercourses, and by attaching to animal fur or human shoes and clothes, and to tyres of vehicles (Nielsen & al. 2005; EPPO datasheet on IAP 2009, and personal observations). At a local scale, mericarps are dispersed usually at short distances mainly by wind or just falling down from the mother plants, and thus, smaller or larger groups of plants are formed. This was observed in the known localities of both species in the country. Longer distance dispersal may be achieved by strong

winds, accidental attachment of mericarps to a suitable vector (humans, agricultural machinery, vehicles, animals) and by running water of a stream/river, after heavy rain or snow melting. The role of the running water as a transport agent is obvious especially in the localities in the Rhodopi Mts. The most abundant and perhaps the earliest to establish in the region are the occurrences of *H. sosnowskyi* around the sawmill near Borino village. This area is situated at the highest position of a small slope on the left bank of Borinska river. Once established on the banks of the river, the plants spread further down along Borinska river, which flows into Chitak-Dere river, which is a left tributary to Buynovska river, and the latter is a left (the main) tributary of Vacha river. Thus, we have recorded numerous and abundant stands of *H. sosnowskyi* along Borinska river, scattered groups of 1–10 plants by Buynovska river, and a single flowering specimen by Vacha river. It is worth mentioning, that a small dam (Teshel dam, used for the local hydroelectric power station) is constructed at Buynovska river, just before the confluence with Vacha river, and the seeds of *H. sosnowskyi* managed to pass through the dam and to colonize further down the river bank of Vacha river.

## Distribution worldwide

*Heracleum mantegazzianum* originates from the Western Caucasus (Nielsen & al. 2005). It has been introduced to Europe in the beginning of XIX century and today it is naturalised and invasive in many countries in North, West, Central and Eastern Europe (Nielsen & al. 2005; EPPO datasheet on IAP 2009; Hand 2011). In the Balkans, it has been recorded so far in Bosnia and Herzegovina (Maslo 2010), Croatia (Stunković 2009; Boršić & al. 2015), and Slovenia (Martinčič 1999).

*Heracleum sosnowskyi* is native to central and eastern Caucasus, western, central, eastern, south-west Transcaucasia, and north-east Turkey (Nielsen & al. 2005). It was introduced to Europe in mid-XX century as an agricultural crop and nowadays it is a naturalised and often invasive alien in many countries in Central and Eastern Europe (Nielsen & al. 2005; EPPO datasheet on IAP 2009; Hand 2011). In the Balkans and among the neighbouring to Bulgaria countries, it has been recorded in Romania (Anastasiu & al. 2017) and Serbia (Stojanović & al. 2017).



## Habitats

In its native range, *H. mantegazzianum* inhabits forest edges and glades, streamsides. The species is a good coloniser of open and bare ground. In its alien range, the species invades mostly man-made habitats, e.g. railways, roadsides, rubbish dumps and waste grounds, abandoned arable land, but also natural and semi-natural habitats, e.g. along rivers and streams, margins of woodland and grassland (EPPO datasheet on IAP 2009). In Bulgaria, the species has been recorded both in man-made and semi-natural habitats – riparian vegetation dominated by *Salix* spp. (mostly *S. fragilis* and *S. alba*) and relatively large grasslands created some 40–50 years ago between the buildings of the residential area and maintained by yearly mowing. Most of the occurring native species in the locality in Sofia are typical for the mesic meadows around the city. According to the EUNIS classification (Davies & al. 2004 & EEA, <https://eunis.eea.europa.eu/habitats-code-browser.jsp>), the habitats belong to: G1.1: Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*, and X23: Large non-domestic gardens.

In its native range, *H. sosnowskyi* grows in meadows, river valleys, forest margins and flood-plains of water bodies. In the invaded range, the species occurs mostly in man-made and semi-natural habitats, roadsides, disturbed habitats, agricultural fields, abandoned agricultural land, parks, pastures (Kabuce & Priede 2010). In Bulgaria, the species was recorded both in human-made and semi-natural habitats: C3.6: Unvegetated or sparsely vegetated shores with soft or mobile sediments; E2.3: Mountain hay meadows; E2.7: Unmanaged mesic grassland; G1.1: Riparian and gallery woodland, with dominant *Alnus*, *Betula*, *Populus* or *Salix*; X25: Domestic gardens of villages and urban peripheries (Davies & al. 2004; EEA, <https://eunis.eea.europa.eu/habitats-code-browser.jsp>).

## Chromosome number

Diploid chromosome number of  $2n = 2x = 22$  (Fig. 13) has been established in plants from Rhodopi Mts (Western), in the valley of Borinska River under the sawmill situated by the road from Borino to Chala village, 1110–1130 m a.s.l., ca. 41.676801°N, 24.301052°E, 17.10.2018, seeds collected by A. Petrova.

This is the first report of a chromosome number for the species from a Bulgarian accession. It confirms earlier counts (Gagnidze & Chkheidze 1974; Rostovtseva 1979; TROPICOS 2019).

## Invasive potential

Both *Heracleum* species have enormous reproductive potential. The number of fruits in the terminal compound umbels in the recorded population of *H. mantegazzianum* in Sofia ranged from 2100 to 4500 (Vladimirov & al. 2017). Taking into account that each stem usually bears 3–5 lateral compound umbels, although smaller than the terminal one, the number of seeds per plant may be over 20 000. There are literature data for up to 100 000 seeds per plant (Nielsen & al. 2005). Seeds have dormancy and require cool stratification for optimal germination (Nielsen & al. 2005; Moravková & al. 2007; EPPO datasheet on IAP 2009). Seed bank is rapidly depleted for one (Moravková & al. 2007) or two years (Nielsen & al. 2005).

Both alien *Heracleum* species have negative effects on the native flora and vegetation since they outcompete the native grassland species and form tall and dense stands which eventually become monodominant, replacing the native vegetation (Fig. 12). Even

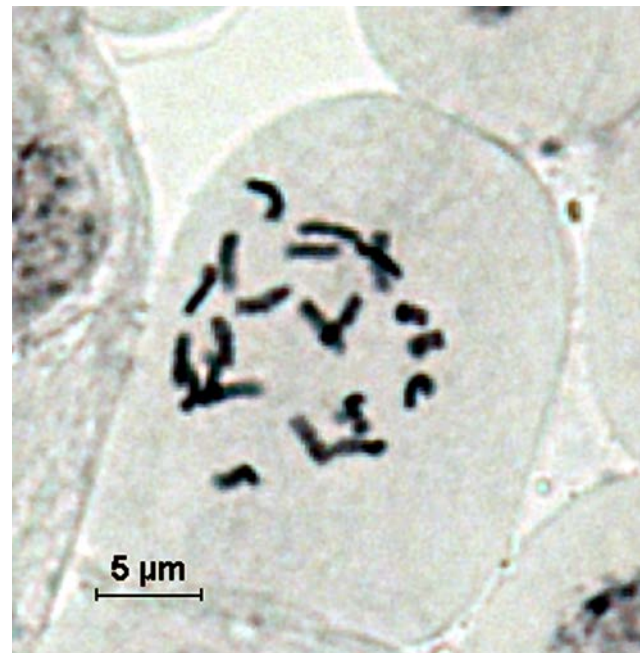


Fig. 13. Metaphase plate in root meristematic cell of *Heracleum sosnowskyi*,  $2n = 22$ .

the reproduction of the native tree species (e.g. *Salix* spp.) is suppressed in the dense and tall stands of *Heracleum*. This is especially visible in the population of *H. sosnowskyi*, which in summer 2019 comprised ca. 2 500–3 000 flowering specimens and some of the monodominant spots occupied areas of a few hundred sq. m. with almost no other plant species growing therein. At present, *H. sosnowskyi* should clearly be regarded as an invasive alien species in the Bulgarian flora, whereas, *H. mantegazzianum* is potentially invasive. The latter species has high invasive potential and it is very likely that it will become invasive if no proper control or eradication measures are implemented in the near future.

Both species threaten human health (e.g. Kabuce & Priede 2010). They contain furanocoumarins which are activated in sunlight. In contact with human skin and under ultraviolet radiation, these chemicals cause burning of the skin. Interviews with local people, both in Sofia and near Borino village, showed that no cases of skin-burns had been recorded yet. Thank to social media (Facebook), the harmful effect of *H. mantegazzianum* has become well known to many of the residents near the locality of the species since its discovery in 2017. The situation near Borino village is much more hazardous given the very high number and large size of the individuals of *H. sosnowskyi*. Most likely, the lack of cases of skin-burns in the village is due to the specific customs of the local Muslim population to work well-dressed in the field.

Despite the negative impacts of the two *Heracleum* species, they may have some positive uses as well, e.g. they are spectacular ornamentals. They can be used for extraction of essential oils (Tkachenko 2015) or for production of biobutanol (Zihare & Blumberga 2017). The use of the species as fodder-plants for the domestic stock has been abandoned in most countries it was practiced due to the fact that the specific anise scent of the plants affects the quality of the meat and milk of the animals, and because of the health risks for the humans and livestock.

## EU legislation and national obligations

*Heracleum mantegazzianum* and *H. sosnowskyi* are included in the List of invasive alien species of Union concern (CIR 2016, 2017). The list is compiled and regularly updated in relation with the implemen-

tation of Regulation (EU) No. 1143/2014 of the European Parliament and of the Council of 22 October 2014 (Regulation 1143 2014). According to this Regulation, each Member State is obliged to notify the European Commission, in writing, about the detection of an invasive alien species of Union concern (Article 16 of Regulation 1143). After the early detection and within three months after notifying the Commission, Member States are obliged to apply eradication measures and inform the Commission and the other Member States on these measures (Article 17 of Regulation 1143).

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