



# Harmonia<sup>+PL</sup> – procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland

## Questionnaire

### A0 | Context

Questions from this module identify the assessor and the biological, geographical & social context of the assessment.

**a01.** Name(s) of the assessor(s):

first name and family name  
Izabela Sachajdakiewicz

first name and family name  
Marian Szewczyk

first name and family name  
Barbara Tokarska-Guzik

acomment1.	Comments:	degree	affiliation	assessment date
		MSc	Expert group Barszcz.edu.pl	18.12. 2017
		PhD	Jan Grodek State Vocational Academy in Sanok	18. 12. 2017
		Professor	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	22. 12. 2017

**a02.** Name(s) of the *Species* under assessment:

Polish name  
barszcz Sosnowskiego

Latin name  
*Heracleum sosnowskyi* MANDEN.

English name  
Sosnowsky's hogweed

acommm02.

Comments:

Polish and Latin names are based on Flowering plants and pteridophytes of Poland – a checklist (Mirek et al. 2002 - P).

The most often used Polish and English synonyms include: cow parsnip, giant cow, parsnip, giant hogweed (Tokarska-Guzik et al. 2015 and literature cited therein - I).

Polish name (synonym I)

barszcz kaukaski (often together with *H. mantegazzianum*)

Polish name (synonym II)

.....

Latin name (synonym I)

*Heracleum wilhelmsii* Fischer et Avé-Lallemant

Latin name (synonym II)

*Heracleum pubescens* (Hoffmann) Marschall von Bieberstein

English name (synonym I)

giant hogweed

English name (synonym II)

cow parsley

**a03. Area under assessment:**

Poland

acommm03.

Comments:

**a04. Status of the *Species* in Poland. The *Species* is:**

native to Poland

alien, absent from Poland

alien, present in Poland only in cultivation or captivity

alien, present in Poland in the environment, not established

alien, present in Poland in the environment, established

<b>X</b>

aconff01.

Answer provided with a

low	medium	high <b>X</b>
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level of confidence

acommm04.

Comments:

in „Comments” (questions acomm04-41) experts should provide **explanations for their answers and list sources of information**. In particular, Comments should explain the decision in cases when data is lacking, incomplete or uncertain, or if the available information is contradictory.

Source of the information should also be provided here, with author and year of publication; data sources should be divided into P – published results of scientific research; B - databases; N – unpublished data; I - other; A – author’s own data. Detailed information (including full bibliographic record) should be provided at the end of the questionnaire "Data sources". Guidance on data sources citation is available at the end of the *Harmonia*<sup>PL</sup> – procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland.

Invasive alien species established in Poland (Sachajdakiewicz et al.2014, Tokarska-Guzik et al. 2012 - P). It is widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 r. - B).

**Because of difficulties in distinguishing *H. Sosnowskyi* from *H. mantegazzianum* in Poland, these species are often confused or considered as one due to toxic and invasive nature of both species. In this survey – in questions where it was not possible to find direct data about the discussed species, information was extrapolated from the kin species or sources combining both species were used.**

a05. The impact of the *Species* on major domains. The *Species* may have an impact on:

environmental domain

X

cultivated plants domain

X

domesticated animals domain

X

human domain

X

other domains

X

acommm05.

Comments:

The species has impact on all the considered domains (Sachajdakiewicz and Mędrzycki 2014, Gałczyńska et al. 2016 - P).

*Heracleum sosnowskyi* causes displacement of native species and loss of biodiversity in natural habitats (Sobisz 2007, Sachajdakiewicz et al. 2014 - P). Since it contains toxic components, it is dangerous for health and life of humans and animals, and also for livestock (Guzik 1994, Applegate et al. 1997, Nielsen et al. 2005, Wrzesińska 2006, Rzymiski et al.2014, Sachajdakiewicz et al.2014 - P). Probably it has negative impact on food products of animal origin (meat, milk) (Guzik 1994, Sachajdakiewicz et al.2014 - P).

Dense patches of *H. sosnowskyi*, as well as its management, are also likely to increase soil erosion along stream banks where the plant occurs (EPPO Report of a Pest Risk Analysis 2009 - B).

*Heracleum sosnowskyi* may cause some damage indirectly (Sachajdakiewicz et al. 2014 - P), but no data about such impact is available. The *Species* causes very relevant threats for ecology, society and economy (EPPO Report of a Pest Risk Analysis 2009 – B, Tokarska-Guzik et al. 2012 – P, Tokarska-Guzik et al. 2015 - I).

## A1 | Introduction

Questions from this module assess the risk for the *Species* to overcome geographical barriers and - if applicable - subsequent barriers of captivity or cultivation. This leads to Introduction, defined as the entry of The Organism

within the limits of The Area and subsequently into the wild.

**a06.** The probability for the *Species* to expand into Poland's natural environments, **as a result of self-propelled expansion** after its earlier introduction outside of the Polish territory is:

low	<input type="checkbox"/>
medium	<input type="checkbox"/>
high	<input checked="" type="checkbox"/>

aconf02. Answer provided with a 

low	medium	high
		<b>X</b>

 level of confidence

acommm06. Comments:  
According to the instruction (protocol *Harmonia*<sup>+PL</sup>) – for species, which are established in Poland (Mędrzycki et al. 2017; Sachajdakiewicz et al. 2014 – P), high probability with a high level of confidence was selected.  
High seed production (from 20 000 to 100 000), long seed viability and early germination (Nielsen et al. 2005, own observation, M. Szewczyk - A) combined with rapid spread in different ways (Sachajdakiewicz and Mędrzycki 2014 - P) causes high probability of expansion into new areas, particularly along rivers and near existing localities.  
The species occurs in countries neighbouring Poland – Belarus and Ukraine (Tokarska-Guzik et al. 2015 - I), from where it can expand in favourable conditions .

**a07.** The probability for the *Species* to be introduced into Poland's natural environments by **unintentional human actions** is:

low	<input type="checkbox"/>
medium	<input type="checkbox"/>
high	<input checked="" type="checkbox"/>

aconf03. Answer provided with a 

low	medium	high
		<b>X</b>

 level of confidence

acommm07. Comments:  
According to the instruction (protocol *Harmonia*<sup>+PL</sup>) – for species, which are established in Poland (Mędrzycki et al. 2017; Sachajdakiewicz et al. 2014 – P), high probability with a high level of confidence was selected.  
Unintentional human actions include activities related to the use of agricultural equipment in areas affected by the species, and then spreading its around, as well as transport of hay containing its seeds, spread of seeds along roads, or with soil (Sachajdakiewicz and Mędrzycki 2014 - P).

**a08.** The probability for the *Species* to be introduced into Poland's natural environments by **intentional human actions** is:

low	<input type="checkbox"/>
medium	<input type="checkbox"/>
high	<input checked="" type="checkbox"/>

aconf04. Answer provided with a 

low	medium	high
		<b>X</b>

 level of confidence

acommm08.

Comments:

According to the instruction (protocol *Harmonia*<sup>+PL</sup>) – for species, which are established in Poland (Mędrzycki et al. 2017; Sachajdakiewicz et al. 2014 – P), high probability with a high level of confidence was selected.

The species was introduced to Poland in 1950s, initially as a medicinal plant and then as fodder. From areas of cultivation it started spreading (Zajac and Zajac eds. 2015 - P). Nowadays the species is rarely used to feed animals. However, it is possible to intentionally propagate the species because of its melliferous qualities, as well as ornamental values and still low level of awareness about threats it may pose (Tokarska-Guzik et al. 2015 – I, Gałczyńska et al. 2016 - P).

## A2 | Establishment

Questions from this module assess the likelihood for the *Species* to overcome survival and reproduction barriers. This leads to *Establishment*, defined as the growth of a population to sufficient levels such that natural extinction within The Area becomes highly unlikely.

a09. Poland provides **climate** that is:

non-optimal

sub-optimal

optimal for establishment of the *Species*

<b>X</b>

aconf05.

Answer provided with a

low	medium	high
		<b>X</b>

level of confidence

acommm09.

Comments:

According to the instruction (protocol *Harmonia*<sup>+PL</sup>) – for species, which are established in Poland (Mędrzycki et al. 2017; Sachajdakiewicz et al. 2014 – P), high probability with a high level of confidence was selected.

The species originates from areas of temperate climate in the Caucasus and the South Caucasus, which is more continental than in Poland. Its secondary (introduced) range in Europe includes countries with climates similar to the one in Poland. It tolerates both continental moderate climates, with hot summers and cold winters (from -25°C to 45°C) (Czekalski 1979, Thiele et al. 2007 - P).

a10. Poland provides **habitat** that is:

non-optimal

sub-optimal

optimal for establishment of the *Species*

<b>x</b>

aconf06.

Answer provided with a

low	medium	high
		<b>x</b>

level of confidence

acommm10.

Comments:

According to the instruction (protocol Harmonia<sup>+PL</sup>) – for species, which are established in Poland (Mędrzycki et al. 2017; Sachajdakiewicz et al. 2014 – P), high probability with a high level of confidence was selected.

In the area of its natural occurrence, the species grows along mountain streams, along forests edges and in anthropogenic habitats (Vinogradova et al. 2011). In Poland it is found in similar habitats (Sachajdakiewicz and Mędrzycki 2014 - P). In the Carpathians it is most widespread along rivers and streams (Zajęc and Zajęc eds. 2015). Its occurrence is correlated with areas in which it was cultivated (Zajęc and Zajęc eds. 2015 – P).

Also the rate of invasion and the size of the plant, much larger than in the area of its natural presence, also indicate optimum habitat conditions in Poland.

### A3 | Spread

Questions from this module assess the risk of the *Species* to overcome dispersal barriers and (new) environmental barriers within Poland. This leads to spread, in which vacant patches of suitable habitat become increasingly occupied from (an) already-established population(s) within Poland.

Note that spread is considered different from range expansions that stem from new introductions (covered by the *Introduction* module).

**a11.** The capacity of the *Species* to disperse within Poland by natural means, **with no human assistance**, is:

very low

low

medium

high

very high

<b>X</b>

aconf07.

Answer provided with a

low	medium	high
		<b>X</b>

level of confidence

acommm11.

Comments:

*Heracleum sosnowskyi* spreads to new areas by zoo-, anemo- or hydrochory (Tokarska-Guzik et al. 2015 – I).

Particularly dangerous in Poland are areas in which the species was cultivated. When cultivation was abandoned in 1980s and 1990s, the existing crops were not completely destroyed (Guzik 1994 - P). As a consequences, the species still expands from these areas without any further human intervention, invading e.g. abandoned land, roads, melioration channels ditches and river valleys; Tokarska-Guzik et al. 2015 – I). It also spreads along watercourses (Zajęc and Zajęc 2015 - P).

A: single source dispersal: single individuals may produce as many as 20 000 seeds; up to 90% falls within 4 m from the parental plant (Nielsen et al. 2005 - P); very low dispersal.

B: population expansions: seeds may be transported for longer distances in animal fur, with wind, or water from nearby watercourses (Wojtkowiak et al. 2008; EPPO 2009 - P); moderate expansion ability.

C: estimation of the species biological mobility:

- high seed production ;
- seeds transported by wind, on animals, and on clothes and shoes;
- hydrochory plays a role in dispersal for different distances, with longest dispersal by floods (Nielsen et al. 2005 - P);
- It was demonstrated that a single individual may start a new invasion (Nielsen et al. 2005); mobility high.

Biological characteristics of the species and seed ability to utilise different dispersal methods, including long-distance dispersal, classify overall dispersal ability of the species as medium.

**a12.** The frequency of the dispersal of the *Species* within Poland by **human actions** is:

low

medium

high

X

aconf08.

Answer provided with a

low	medium	high
		X

level of confidence

acommm12.

Comments:

Introducing the species into a new environment is forbidden by law in Poland (Sachajdakiewicz et al. 2014 - P); however it is still possible that the species is intentionally spread by humans. Its flowers are known to be a preferred nectar and pollen sources for honeybees (Datasheet on *Heracleum mantegazzianum*, *H. sosnowskyi* and *H. persicum* 2009 - B, Tokarska-Guzik et al. 2012, Sachajdakiewicz et al. 2014 - P). Due to the size and attractive appearance it used to be planted as an ornamental plant (Lutyńska 1977, Bracia Dębscy 2003, Tokarska-Guzik et al.2012, Sachajdakiewicz et al. 2014 - P).

Seeds of *H. sosnowskyi* are unintentionally dispersed along roads (Sachajdakiewicz et al. 2014, Mędrzycki et al.2017 - P). Accidental transport with soil and crops may also play some role (Sachajdakiewicz et al.2014 - P).

## A4a | Impact on environmental domain

Questions from this module qualify the consequences of the *Species* on wild animals and plants, habitats and ecosystems.

Impacts are linked to the conservation concern of targets. Native species that are of conservation concern refer to keystone species, protected and/or threatened. See, for example, Red Lists, protected species lists, or Annex II of the 92/43/EWG Directive. Ecosystems that are of conservation concern refer to natural systems that are the habitat of many threatened species. These include natural forests, dry grasslands, natural rock outcrops, sand dunes, heathlands, peat bogs, marshes, rivers & ponds that have natural banks, and estuaries (Annex I of the 92/43/EWG Directive).

Native species population declines are considered on the local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as a (near) extinction. Similarly, limited ecosystem change is considered as transient and easily reversible; severe change is considered as persistent and hardly reversible.

**a13.** The effect of the *Species* on native species, through **predation, parasitism or herbivory** is:

inapplicable	<input checked="" type="checkbox"/>
low	<input type="checkbox"/>
medium	<input type="checkbox"/>
high	<input type="checkbox"/>

aconf09. Answer provided with a 

low	medium	high
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 level of confidence

acomm13. Comments:  
The species is a plant.

**a14.** The effect of the *Species* on native species, through **competition** is:

low	<input type="checkbox"/>
medium	<input type="checkbox"/>
high	<input checked="" type="checkbox"/>

aconf10. Answer provided with a 

low	medium	high
		<b>X</b>

 level of confidence



acomm14.

Comments:

The species forms dense patches, dominating and altering conditions for other species. Most of native plants cannot compete successfully with the plant of this size and vigour (own observation in Sanok county, M. Szewczyk – A).

*H. mantegazzianum* and *H. sosnowskyi* are strong competitors, both with individuals of their own species and with other species. As many as 98% of seedlings die because of shading by fully-grown plants. However, in the following years the few survivors form dense stands (Nielsen et al. 2005 - P). Shading is also the key driver of displacement of seedlings of other species (Sachajdakiewicz et al. 2014 - P).

According to Sachajdakiewicz et al. (2014 – P), the mechanisms of the impact of both species include:

- Forming dense patches thanks to very high seed production and their close dispersal, and forming dense and persistent soil seed bank (up to 80 seeds/m<sup>2</sup> – Pyšek et al. 2007 - P),
- Shading of other species by elevated, flat leaves with high light-filtering capacity (Tappeiner and Cernusca 1996 - P),
- Tendency to form monocultures thanks to high reproduction (Pytlarczyk et al. 2013 - P),
- Transformation of physical, chemical and biological properties of soil (Jandova et al. 2014b - P),
- Allelopathic interactions (to a lesser degree; Jandova et al. 2014a, Wille et al. 2013 - P).

These mechanisms may decrease the number of plant species by 50-60 % (Hejda et al. 2009) or even by 62–69% (Sobisz 2007 - P) in comparison with not invaded areas, although after some time new ecological stability may develop (Dostal et al. 2013 - P).

a15. The effect of the *Species* on native species, through **interbreeding** is:

no / very low  
 low  
 medium  
 high  
 very high

X

aconf11.

Answer provided with a

low	medium	high
	X	

level of confidence

acomm15.

Comments:

Examples of cross-breeding of *Heracleum* species in nature are known (Stewart 1979, Klingenstein 2007 - P, Klingenstein 2007, Datasheet on *Heracleum mantegazzianum*, *H. sosnowskyi* and *H. persicum* 2009 - B). In Poland native species, which may interbreed with *H. sosnowskyi* are common (e.g. species from the same genera). Hybrids between *H. mantegazzianum* and *H. sibiricum* were reported from Lithuania (EPPO 2009 – P, B). Hybrids between *H. mantegazzianum* and *H. -sosnowskyi* are also known (Klingenstein 2007 - B).

Assessed impact – medium (no detailed data exists). More in: Sachajdakiewicz et al. 2014 – P, Tokarska-Guzik et al. 2015 - I.

a16. The effect of the *Species* on native species by **hosting pathogens or parasites** that are harmful to them is:

very low

low

medium

high

very high

X

aconf12.

Answer provided with a

low	medium	high
	X	

level of confidence

acommm16.

Comments:

Both in native and secondary range, fungal pathogens have been recorded on the leaves of *H. mantegazzianum* (Seier et al. 2003, Seier and Evans 2007 - P). Initially, it was assumed that the species may be a carrier of crop diseases (Gray and Noble 1965 - P), however, no cases of pathogen or parasite transfer to native species in the introduced range have been recorded so far. Mycobiota associated with *Heracleum* genus is narrowly specialized (Seier and Evans 2007 - P). The same may be assumed for *H. sosnowskyi*.

a17. The effect of the *Species* on ecosystem integrity, by **affecting its abiotic properties** is:

low

medium

high

X

aconf13.

Answer provided with a

low	medium	high
	X	

level of confidence

acommm17.

Comments:

Research into *H. mantegazzianum* indicates, that it may cause changes in physical, chemical and biological characteristics of soil (Jandova et al.2014b - P) – *per analogiam* *H. Sosnowskyi* may cause similar effects (Sachajdakiewicz et al.2014 - P). Dense patches of the Sosnowsky's hogweed change the insolation in the ground zone (own observation, M. Szewczyk - A).

a18. The effect of the *Species* on ecosystem integrity, by **affecting its biotic properties** is:

low

medium

high

X

aconf14.

Answer provided with a

low	medium	high
		X

level of confidence

acommm18.

Comments:

The species composition in areas seized by the Sosnowsky's hogweed are completely different from adjacent areas free of this species. Dense fields of the Sosnowsky's hogweed are only accompanied by a few other species (own observation, M. Szweczyk - A). The effects of the species on wild animals and birds sometimes found in dense patches are unknown. Traces of snail foraging on stems were observed in several places (Sanok county). Insect *Liparus glabrirostris* was found twice the species. Negative effects on animals can be expected due to the content of toxic substances in essential oils (Gałczyńska et al. 2016 - P). According to Sachajdakiewicz et al. (2014 – P), the number of species in phytocoenoses with *H. sosnowskyi* may decrease by 50-60% (Hejda et al. 2009) or even by 62-69% (Sobisz 2007 - P), but in a long time (50 yrs) a new ecological balance may arise (Dostal et al. 2013 - P). Those mechanisms are similar to mechanisms of high competitive native species, characteristic of meadows and grasslands (e.g. *Urtica dioica*, Thiele and Otte 2006 - P). However, the impact of invasive alien *Heracleum* species seems to be more persistent and pervasive, and therefore it more profoundly changes the structure of plant communities. Toxic compounds of *H. sosnowskyi* discourage vertebrate, and invertebrate herbivores to feed on the plants, except for the species which are specialised to feed on plants in *Apiaceae* family, Hansen et al. 2006 - P). Size and persistence of patches of *H. sosnowskyi* induce more significant negative influence on biocoenoses than that of native expansive species.

### A4b | Impact on cultivated plants domain

Questions from this module qualify the consequences of the *Species* on cultivated plants (e.g. crops, pastures, horticultural stock).

For the questions from this module, consequence is considered 'low' when presence of the *Species* in (or on) a population of target plants is sporadic and/or causes little damage. Harm is considered 'medium' when The Organism's development causes local yield (or plant) losses below 20%, and 'high' when losses range > 20%.

**a19.** The effect of the *Species* on cultivated plants targets through **herbivory or parasitism** is:

inapplicable	<input type="checkbox"/>
very low	<input checked="" type="checkbox"/>
low	<input type="checkbox"/>
medium	<input type="checkbox"/>
high	<input type="checkbox"/>
very high	<input type="checkbox"/>

aconf15.

Answer provided with a

low	medium	high
		<b>X</b>

level of confidence

acommm19.

Comments:

The species in a non-parasitic plant.

**a20.** The effect of the *Species* on cultivated plants targets through **competition** is:

inapplicable	<input type="checkbox"/>
very low	<input type="checkbox"/>
low	<input type="checkbox"/>
medium	<input type="checkbox"/>

high  
very high

X

aconf16.

Answer provided with a

low	medium	high
	X	

level of confidence

acommm20.

Comments:

There are no records of direct impact of the species on crops. The *Heracleum* species are not normally weeds of crops but there are reports of their penetration into crop fields, for example in potatoes in Sweden; they have also been invading pastures (Datasheet on *Heracleum mantegazzianum*, *H. sosnowskyi* and *H. persicum* 2009 - B).

The species overgrows meadows and pastures, it also disturbs agricultural practices (Sachajdakiewicz et al. 2014 - P). Since the species often grows in close neighborhood of cultivated fields, due to its remarkable competition capacity and production of large numbers of seeds – it is possible, that in case of massive spread, *H. mantegazzianum* will be a potential competitor for crop plants.

Using herbicides limits the negative influence on crop plants; however, the long-term effects of pollution by furocoumarines are unknown and hardly predictable (Sachajdakiewicz, Mędrzycki ed. 2014 - P).T

Proper land cultivation is the only method of successful control of the species (Wrzeńska 2006, MacDonald 2012 - P). Its presence in crops may reduce the efficiency of agricultural treatments (Sachajdakiewicz 2008 - N). If it is found in the cultivation of cereals or root crops, it usually dominates over cultivated species (own observation, M. Szewczyk - A).

a21. The effect of the *Species* on cultivated plants targets through **interbreeding** with related species, including the plants themselves is:

inapplicable  
no / very low  
low  
medium  
high  
very high

X

aconf17.

Answer provided with a

low	medium	high
	X	

level of confidence

acommm21.

Comments:

No data available. Plants of *Heracleum* genus are not cultivated in Poland. Theoretically it is possible that hybridization with *Heracleum sphondylium* occurs (like in case of *H. mantegazzianum*) and that the hybrids may have some impact on meadow plant communities.

Hybrids of *H. sosnowskyi* i *H. sibricum* were reported from Lithuania (EPPO 2009 - P).

a22. The effect of the *Species* on cultivated plants targets by **affecting the cultivation system's integrity** is:

very low  
low  
medium  
high

X

very high

aconf18.

Answer provided with a

low	medium X	high
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level of confidence

acommm22.

Comments:

None of the cultivated plants can compete against the Sosnowsky's hogweed.

**a23.** The effect of the *Species* on cultivated plants targets by hosting **pathogens or parasites** that are harmful to them is:

very low

low

medium

high

very high

X

aconf19.

Answer provided with a

low	medium X	high
-----	-------------	------

level of confidence

acommm23.

Comments:

There are pathogen species noted on *H. sosnowskyi*, and some of them are unspecific (Wrzesińska 2010; Wrzesińska 2007 - P). They include crop pests (e.g. onion trpiss, *Thrips tabaci* Lind., Wrzesińska 2006 - P, bean aphid, *Aphis fabae* Scop. Wrzesińska 2005 - P). However, these are not species of any importance to crops.

## A4c | Impact on domesticated animals domain

Questions from this module qualify the consequences of The Organism on domesticated animals (e.g. production animals, companion animals). It deals with both the well-being of individual animals and the productivity of animal populations.

**a24.** The effect of the *Species* on individual animal health or animal production, through **predation or parasitism** is:

inapplicable

very low

low

medium

high

very high

X

aconf20.

Answer provided with a

low	medium	high
-----	--------	------

level of confidence

acommm24.

Comments:

The species is a plant.

**a25.** The effect of the *Species* on individual animal health or animal production, by having properties that are hazardous upon **contact**, is:

- very low
- low
- medium
- high
- very high

X

aconf21.

Answer provided with a

low	medium	high
		X

level of confidence

acommm25.

Comments:

The sap of *H. Sosnowskyi* contains psolarens (high density- Hattendorf et al. 2007 - P), which is dangerous for health and life of humans and animals, including farmed ones (Guzik 2005, Nielsen i in. 2005, Rzymiski i in. 2014 - P). This substances may cause photodermatitis and other systemic symptoms (Guzik 2005, Nielsen i in. 2005, Klima 2014, Rzymiski i in. 2014 - P). They can also be carcinogenic (Archier et al. 2012 - P).

Consumption of raw leaves by cows causes burns of the digestive system and bloody diarrhea, which leads to losses in the cattle stock. Poisoning was also observed in sheep (Kees and Krumrey 1983, Andrews 1985 - P).

According to Sachajdakiewicz et al. (2014 – P), the negative influence of *Heracleum* species can affect animals, especially those with bright coat (Nielsen et al. 2005 - P). In piebald animals injuries occurs usually on bright parts of body (Tymyszczan 2014 - P). The wounds are very difficult to cure. That is why some scientists claim that cows, which udders have been burnt, should be killed (Klima 2014 - P). Cattle willingly eats young specimens of the Sosnowsky's hogweed, without any negative effects (A: Self-observation in Płonna near Sanok).

The skin of wild animals is probably more resistant for toxic impact of the invasive alien *Heracleum* species. There are no specific data about relations between these plants and wild animals but some observations of boars hiding or birds nesting in invasive alien *Heracleum* species stands were published (Łyszczarz 2012 - P). However, specific information on interactions between *H. sosnowskyi* and wild animals is not available.

**a26.** The effect of the *Species* on individual animal health or animal production, by hosting **pathogens or parasites** that are harmful to them, is:

- inapplicable
- very low
- low
- medium
- high
- very high

X

aconf22.

Answer provided with a

low	medium	high

level of confidence

acommm26.

Comments:

The *Species* is a plant.

## A4d | Impact on human domain

Questions from this module qualify the consequences of The Organism on humans. It deals with human health, being defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (definition adopted from the World Health Organization).

**a27.** The effect of the *Species* on human health through **parasitism** is:

inapplicable  
very low  
low  
medium  
high  
very high

X

aconf23.

Answer provided with a

low

medium

high

level of confidence

acommm27.

Comments:

The species is not a parasite.

**a28.** The effect of the *Species* on human health, by having properties that are hazardous upon **contact**, is:

very low  
low  
medium  
high  
very high

X

aconf24.

Answer provided with a

low

medium

high

X

level of confidence

acommm28.

Comments:

Sap of *H. sosnowskyi* contains psolarens (in high density - Hattendorf et al. 2007 - P), which are dangerous for health and life of humans and animals, including farmed ones (Guzik 1994, Nielsen et al. 2005, Rzymyski et al. 2014 - P). This substances may cause photodermatosis and other systemic symptoms (Guzik 1994, Nielsen et al. 2005, Klima 2014, Rzymyski et al.2014 - P). They can also be carcinogenic (Archier et al. 2012 - P). Contact with the plant causes skin burns and other health disorders (Sahajdakiewicz and Mędrzycki 2014 - P) according to some researchers, burns can occur even without direct contact (Klima 2014 - P).

**a29.** The effect of the *Species* on human health, by hosting **pathogens or parasites** that are harmful to humans, is:

inapplicable  
very low  
low

X

medium  
high  
very high


aconf25.

Answer provided with a

low	medium	high
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level of confidence

acomm29.

Comments:

The species is a plant. Plants are not hosts or vectors for pathogens or parasites threatening humans.

## A4e | Impact on other domains

Questions from this module qualify the consequences of the *Species* on targets not considered in modules A4a-d.

**a30.** The effect of the *Species* on causing damage to **infrastructure** is:

very low  
low  
medium  
high  
very high

X

aconf26.

Answer provided with a

low	medium	high
		X

level of confidence

acomm30.

Comments:

Probability of negative influence – high x medium consequence = impact HIGH.

In Poland observed few indirect damages caused by *Heracleum mantegazzianum* and *Heracleum sosnowskyi* are:

- decreasing area of meadows and pastures (Rozwadowska 2003 - P, Sachajdakiewicz 2008 - N) and making agricultural works harder (Sachajdakiewicz 2008 - N),
- decreasing turistic attractiveness (Rozwadowska 2003 - P, Sachajdakiewicz 2008 - N), including protected areas (Wróbel 2002, Wrzeńska 2006 - P),
- decreasing attractiveness for investments (Sachajdakiewicz 2008 - N),
- decreasing road visibility (Sachajdakiewicz 2008 - N),
- negative influence on beauty of landscapes (Sachajdakiewicz 2008 - N).

There are no statistics about those damages in Poland, but it is certain that their scale may increase. More research in this field is required (Sachajdakiewicz et al. 2014 - P). It can also cause damage to agricultural equipment that is not suitable for mowing such large plants (own observation, M. Szewczyk).

## A5a | Impact on ecosystem services

Questions from this module qualify the consequences of The Organism on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of the *Species*.

**a31.** The effect of the *Species* on **provisioning services** is:



significantly negative  
moderately negative  
neutral  
moderately positive  
significantly positive

X

aconf27. Answer provided with a 

low	medium	high
	X	

 level of confidence

acomm31. Comments:  
No research is known on this topic. Taking into account the possible damages caused by the species, the species may impede access to infrastructure (e.g. it may overgrow storage facilities/ areas/ premises), may make agricultural practices more complicated, or may decrease areas of meadows and pastures (Sachajdakiewicz 2008; Sachajdakiewicz and Mędrzycki eds. 2014 - P). These effects may in turn contribute to lower food production. Probably the species also has negative impact on food products of animal origin (meat, milk) (Guzik 1994, Sachajdakiewicz et al. 2014).

a32. The effect of the *Species* on **regulation and maintenance services** is:

significantly negative  
moderately negative  
neutral  
moderately positive  
significantly positive

X

aconf28. Answer provided with a 

low	medium	high
	X	

 level of confidence

acomm32. Comments:  
The species significantly alters the biotic and abiotic environment, thus it affects regulatory services, but currently there is no data on its positive and negative impact. However, the possibility of migration of traces of toxic compounds to the air through the transpiration, leaks or burst cannot be excluded (Sachajdakiewicz et al. 2014).

a33. The effect of the *Species* on **cultural services** is:

significantly negative  
moderately negative  
neutral  
moderately positive  
significantly positive

X

aconf29. Answer provided with a 

low	medium	high
		X

 level of confidence

acomm33.

Comments:

No direct research is known on this topic. The species influences the native natural systems and damaging their aesthetics. It hinders recreation (fishing, collection of herbs, recreation along streams and in meadows). This plant causes fear of the effects of contact (skin burns and other health disorders) and inadvertently causes destruction of similar native species (Sahajdakiewicz and Mędrzycki 2014 - P, own observation - A). It may cause difficulties in access to rivers, touristic areas (EPPO Report of a Pest Risk Analysis 2009 - B, Sachajdakiewicz et al. 2014 - P).

For several years threat posed by *H. sosnowskyi* and *H. mantegazzianum* is a topic of TV and press news. It may be considered as positive side effect, which increases awareness about invasive alien species in general.

### A5b | Effect of climate change on the risk assessment of the negative impact of the Species

Below, each of the Harmonia+ modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest to take into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes of atmospheric variables listed in its 2013 report on the physical science basis may be used for this purpose. The global temperature is expected to rise by 1 to 2 °C by 2046-2065.

Note that the answers to these questions are not used in the calculation of the overall risk score, but can be but can be considered when decisions are made about management of the *Species*.

**a34. INTRODUCTION** – Due to climate change, the probability for the *Species* to overcome geographical barriers and - if applicable - subsequent barriers of captivity or cultivation in Poland will:

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

X

aconf30.

Answer provided with a

low	medium	high
	X	

level of confidence

acomm34.

Comments:

The species already occupies a wide range of habitats in warmer climates than the one in in Poland, which indicates that its expansion will not change with climate. There may be more competition and displacement of *H. sosnowskyi* by *Heracleum mantegazzianum* which is more thermophilous and more frequent in countries south of Poland (Sachajdakiewicz and Mędrzycki 2014 - P).

**a35. ESTABLISHMENT** – Due to climate change, the probability for the *Species* to overcome barriers that prevented its survival and reproduction in Poland will:

- decrease significantly
- decrease moderately
- not change
- increase moderately

X

increase significantly

aconf31.

Answer provided with a

low	medium	high
	X	

level of confidence

acom35.

Comments:

The species is already established (Tokarska-Guzik et al. 2014 - P).

**a36. SPREAD** – Due to climate change, the probability for the *Species* to overcome barriers that prevented its spread in Poland will:

decrease significantly

decrease moderately

not change

increase moderately

increase significantly

X

aconf32.

Answer provided with a

low	medium	high
	X	

level of confidence

acom36.

Comments:

The species is already established in Poland (Tokarska-Guzik et al. 2014 - P), widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - B).

The high tolerance of the species to the climatic factors suggests that it will maintain the current rate of spread.

**a37. IMPACT ON ENVIRONMENTAL DOMAIN** – Due to climate change, the consequences of the *Species* on wild animals and plants, habitats and ecosystems in Poland will:

decrease significantly

decrease moderately

not change

increase moderately

increase significantly

X

aconf33.

Answer provided with a

low	medium	high
	X	

level of confidence

acom37.

Comments:

The species is already established in Poland (Tokarska-Guzik et al. 2014 - P), widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - B). It is assumed that changes of climate will not have influence on the species (no research is known on this topic).

**a38. IMPACT ON CULTIVATED PLANTS DOMAIN** – Due to climate change, the consequences of the *Species* on cultivated plants and plant domain in Poland will:

decrease significantly

decrease moderately

not change

increase moderately

increase significantly

X

aconf34.

Answer provided with a

low	medium	high
	X	

level of confidence

acom38.

Comments:

The species is already established in Poland (Tokarska-Guzik et al. 2014 - P), widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - B). It is assumed that changes of climate will not have influence on the species (no research is known on this topic). A small impact on the crop (a20) is likely to be maintained.

**a39. IMPACT ON DOMESTICATED ANIMALS DOMAIN** – Due to climate change, the consequences of the *Species* on domesticated animals and animal production in Poland will:

decrease significantly

decrease moderately

not change

increase moderately

increase significantly

X

aconf35.

Answer provided with a

low	medium	high
	X	

level of confidence

acom39.

Comments:

The species is already established in Poland (Tokarska-Guzik et al. 2014 - P), widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - B). It is assumed that changes of climate will not have influence on the species (no research is known on this topic). Because almost same animals are bred in warmer climates (south of Poland), no change is expected.

**a40. IMPACT ON HUMAN DOMAIN** – Due to climate change, the consequences of the *Species* on human in Poland will:

decrease significantly

decrease moderately

not change

increase moderately

increase significantly

X

aconf36.

Answer provided with a

low	medium	high
	X	

level of confidence

acom40.

Comments:

The species is already established in Poland (Tokarska-Guzik et al. 2014 - P), widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - B). It is assumed that changes of climate will not have influence on the species (no research is known on this topic). The effects on humans are related to sunlight and humidity or sweating. It is therefore possible to assume a slight increase of the impact in case of climate warming.

**a41. IMPACT ON OTHER DOMAINS** – Due to climate change, the consequences of the *Species* on other domains in Poland will:

decrease significantly

decrease moderately

not change

increase moderately

increase significantly

X

aconf37.

Answer provided with a

low	medium X	high
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level of confidence

acom41.

Comments:

The species is already established in Poland (Tokarska-Guzik et al. 2014 - P), widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - B). It is assumed that changes of climate will not have influence on the species (no research is known on this topic).

## Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.75	1.00
Environmental impact (questions: a13-a18)	0.65	0.70
Cultivated plants impact (questions: a19-a23)	0.40	0.60
Domesticated animals impact (questions: a24-a26)	0.75	1.00
Human impact (questions: a27-a29)	1.00	1.00
Other impact (questions: a30)	0.75	1.00
Invasion (questions: a06-a12)	0.92	1.00
Impact (questions: a13-a30)	1.00	0.86
Overall risk score	0.92	
Category of invasiveness	very invasive alien species	

## A6 | Comments

This assessment is based on information available at the time of its completing. It has to be taken into account, however, that biological invasions are, by definition, very dynamic and unpredictable. This includes introductions of new alien species and detection of their negative impact. As a result, the assessment of the species may change in time. For this reason it is recommended that it regularly repeated.

Below you can include your own comments on the assessment.

acomm42.

Comment:

*Heracleum Sosnowskyi* was classified in this assessment as very invasive alien species, scoring high in all modules used for calculations except for impact cultivated plants (0.40; questions: a19-a23). In the human impact module (questions: a27-a29), the species scored the maximum value (1.0) and in the environmental impact module (questions: a13-a18) – 0.65. It is noteworthy that the value of 0.75, scored in the two remaining modules (on domesticated animals impact (questions: a24-a26 and other impact (question: a30) is merely 0.01 lower than the threshold value that allows classification of species as very invasive.

As the species is widespread in Poland and its dispersal capacity is high, the score for modules related to the process of invasions (questions: a06-a12) is high – 0.92.

This assessment was carried out using the expert knowledge and available sources of information. Because of its invasiveness and toxicity it is recommended to control the species (Tokarska-Guzik et al. 2015 - I). With no control, further invasion will continue. Threat to human health should be the primary argument for considering *H. Sosnowskyi* as the priority species that requires control (Tokarska-Guzik et al. 2015 - I).

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## 5. Author's own data (A)

Realization of the project “Native flora protection program for Sanok District against invasive species and their spreading limitation and penetration in the area of “The International Biosphere Park East Carpathians”.