



# 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

Michał Śliwiński

first name and family name

Barbara Tokarska-Guzik

acomm01.	Comments:		
	degree	affiliation	assessment date
	M.Sc.	Expert group	8.12.2017
	degree	Barszcz.edu.pl	assessment date
	Dr	affiliation	18.12.2017
degree	affiliation	assessment date	
Prof.	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 Mantegazziego

Latin name

*Heracleum mantegazzianum* Sommier & Levier

English name

Giant hogweed

acom02.

Comments:

Latin and Polish names are provided according to *Flowering plants and pteridophytes of Poland – a checklist* (Mirek et al. 2002 - P). Latin name is widely accepted (The Plant List, 2012 - B).

There are more synonyms of Latin name is more than those provided below:

*Heracleum asperum* M. Bieb., *Heracleum caucasicum* Steven, *Heracleum circassicum* Mandenova, *Heracleum giganteum* Fischer ex Hornem., *Heracleum grossheimii* Mandenova, *Heracleum lehmannianum* Bunge, *Heracleum panaces* Willd. ex Steven, *Heracleum persicum* Desf. ex Fischer, *Heracleum sibiricum* Sphalm, *Heracleum speciosum* Weinm., *Heracleum stevenii* Mandenova, *Heracleum tauricum* Steven, *Heracleum villosum* Fischer ex Sprengel, (Tokarska-Guzik et al. 2015 - I).

The most often used Polish and English synonyms include:

Polish name (synonym I)

Barszcz mantegazyjski

Polish name (synonym II)

Barszcz kaukaski

Latin name (synonym I)

*Heracleum giganteum* Fischer ex Hornem

Latin name (synonym II)

*Heracleum caucasicum* Steven

English name (synonym I)

Giant cow parsnip

English name (synonym II)

Giant cow parsley

**a03. Area** under assessment:

Poland

acom03.

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

X

aconf01.

Answer provided with a

low	medium	high X
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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.

*Heracleum mantegazzianum* has the status of an invasive kenophyte in Poland (Tokarska-Guzik 2005 - P). In 2012, it was included in the group of established and invasive alien plant species (Tokarska-Guzik et al. 2012, p. 134, Sachajdakiewicz et al. 2014, p. 30-31 - P). It grows all over the country (Stanowiska kaukaskich barszczy w Polsce – database of Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017 - 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 affects the native components of invaded plant communities, absorbing sunlight and shading the remaining native plants, which results in decrease in species diversity; causes displacement of native species and loss of biodiversity in natural habitats (Sobisz 2007, Thiele and Otte 2007, Sachajdakiewicz et al. 2014, Pergl et al. 2016 - P). Due to expansion in grasslands, it reduces the area of meadows and pastures, thus hindering the meadow economy (Śliwiński 2009a - A). Since it contains toxic components, it is dangerous for health and life of humans and animals, and also for livestock (Applegate et al. 1997, Nielsen et al. 2005, Wrzesińska 2006, Thiele and Otte 2007, Rzymiski et al. 2014, Sachajdakiewicz et al. 2014 - P). It causes diseases of the digestive system of farm animals (Andrews 1985 - P). In skin contact, it causes second and third degree burns (Hattendorf et al. 2007 - P). In riverside areas, the mass occurrence of the species may cause erosion of river banks (Williamson and Forbes 1982, Thiele et al. 2007 - P). The species poses very serious threats for biodiversity, society and economy (Reinhardt et al. 2003, Tokarska-Guzik et al. 2012, Pergl et al. 2016 - P).

## 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	
medium	
high	<b>X</b>

aconf02.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm06.

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 can expand into Poland's natural environment from the bordering areas of the Czech Republic and Germany (Śliwiński 2009b - A), where it was planted as an ornamental plant. Some localities of *H. sosnowskyi* may actually belong to *H. mantegazzianum*, whose diaspores can be spread over longer distances. There are cases of spontaneous appearance of individuals of the species, which are not related to expansion of larger populations (Marciniuk and Wierzbza 2006 - P).

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

low	
medium	
high	<b>X</b>

aconf03.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm07.

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.  
 Diasporas may of the species spread in the natural environment along with the water flow in rivers or during hurricanes. They can attach to car treads, clothing and animal hair (Klingenstein 2007 - P). The species spreads spontaneously from former crops, regardless human involvement (Piwowarczyk 2011 - P).

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

low	
medium	
high	<b>X</b>

aconf04.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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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 may be locally introduced by bee keepers or as an ornamental plant (Westbrooks 1991, Koutika et al. 2011 - P, Śliwiński 2009d - A). In the former Szczecin province, the species was intentionally introduced as a decorative plant, but only in individual localities (Ćwikliński 1973 - P). In other regions, the species could also be cultivated as a fodder plant; the same holds true for *H. sosnowskyi* (Piwowarczyk 2011 - 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*

X

aconf05.

Answer provided with a

low	medium	high
		X

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.

In contrast to areas in its native range, in its secondary (introduced) range the species is not restricted to high altitudes and spreads also in warmer regions (Pyšek et al. 2007 - P). High amplitude of temperature during the growing season may limit its occurrence (Willis and Hulme 2002 - P).

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

non-optimal

sub-optimal

optimal for establishment of the *Species*

X

aconf06.

Answer provided with a

low	medium	high
		X

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.

The species naturally occurs in the Caucasus Mts., as a component of meadows and thickets (Shetekauri et al. 2006, Otte et al. 2007 - P). In Poland, its favorable habitat conditions are available throughout the country, although it is not found in high mountain areas. In the study from the Carpathians (Zajac and Zajac eds. 2015) the species was recorded in the forelands and lower locations in the Beskidy Mts. Up to now, the species occurs mainly in anthropogenic areas, particularly related to transport and urban habitats (Pyšek 1991, Zajac and Zajac eds. 2015), and to a lesser degree – in semi-natural habitats (Pyšek 1991 - P).

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

aconf07. Answer provided with a 

low	medium	high
		<b>X</b>

 level of confidence

acomment11. Comments:  
Data on the expansion from a single source (Type A)  
The local expansion rate of the species was estimated at 1-2 m/year, while along linear landscape structures – up to 11 m/year (Nielsen et al. 2005, Koutika et al. 2011 - P). Seeds can be transported over greater distances along with the water flow (Śliwiński 2009c - A) and during hurricanes (Klingenstein 2007 - P).

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

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

aconf08. Answer provided with a 

low	medium	high
		<b>X</b>

 level of confidence

acomment12. Comments:  
Introducing *H. mantegazzianum* 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 (Lutyńska 1977, Westbrooks 1991, Tokarska-Guzik et al. 2012, Sachajdakiewicz et al. 2014, Pergl et al. 2016 - P, Śliwiński 2009d - A, Datasheet on *Heracleum mantegazzianum*, *H. sosnowskyi* and *H. persicum* 2009 - B), and the species is also used as fodder plant (Piwowarczyk 2011 – P). Due to the size and attractive appearance, it used to be planted as an ornamental plant (Kobylka 1977, Klingenstein 2007, Koutika i in. 2011, Tokarska-Guzik et al. 2012, Sachajdakiewicz et al. 2014, Pergl et al. 2016 – P, Śliwiński 2017 - A).  
Seeds of *H. mantegazzianum* 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, Pergl et al. 2016 - P). Seed dispersal may also occur during careless elimination of individuals during the period of fruiting.

## 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/EEG 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/EEG 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

low

medium

high

X

aconf09.

Answer provided with a

low

medium

high

level of confidence

acommm13.

Comments:

The species is a plant.

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

low

medium

high

X

aconf10.

Answer provided with a

low

medium

high

level of confidence

X

acommm14.

Comments:

*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 (Thiele and Otte 2007 - 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).

The species causes a decrease in the species composition of colonized plant communities (Nielsen et al. 2005, Thiele and Otte 2007 - P), statistically significant in the case of dense populations (Śliwiński 2012 - N). In wet meadows, possible competition with protected and endangered species of plants may occur – for example with *Trollius europaeus* (Śliwiński 2009e - A).

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

acommm15.

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 invasive alien *Heracleum* species are common e.g. *H. sphondylium*, which can hybridise with *H. mantegazzianum* (Ochsmann 1992, Weimarck et al. 1979, Tiley et al. 1996; – P). Hybrids were observed in near the Witka/Smeda river (A: Śliwiński 2007). However, *H. sphondylium* is not a species of special conservation concern and there is no threat to the loss of its genetic coherence. 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 the *Species* (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).

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). Riverbanks where the species occurs, are exposed to erosion because it displaces rhizome plants (Williamson and Forbes 1982, Kettunen et al. 2009 - P). Roots of *Heracleum mantegazzianum* have no soil strengthening properties (Tschiedel 2005 - P).

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

acomm18.

Comments:

According to Sachajdakiewicz et al. (2014 – P) *per analogiam* to *H. sosnowskyi*, the number of species in phytocoenoses with invasive *Heracleum* species 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.

*H.mantegazzianum* and *H. sosnowskyi* occur in different seminatural and natural habitats included in Appendix I of the Habitat Directive (Tokarska-Guzik i in 2012, Sachajdakiewicz i Mędrzycki 2014 - P).

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.

In Poland, the species is not the key element of the food chain. However, its pests can be bugs, e.g. aphids (Wróbel-Stermińska 1958 - P). In search of nectar, the species is visited by many insects species (Hansen et al. 2007 - P), which may reduce the chance of pollinating native plant species, e.g. *H. sphondylium* (Zych 2007 - P). So far, observations of insects pollinating *H. mantegazzianum* and its accompanying plants did not reveal any changes in the number of fruit seeds (Nielsen et al. 2008 - P).

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

X

aconf15.

Answer provided with a

low	medium	high
		X

level of confidence

acomm19.

Comments:

The species in a non-parasitic plant.

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

- inapplicable
- very low
- low


medium  
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 is not a threat to cereal and root crops - it does not withstand crop competition due to the short germination period and the negative response to agricultural treatments (Ćwikliński 1973 - P).

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).

**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:

The crossbreeding of the species with the native *H. sphondylium* may occur on meadows (Śliwiński 2007 - P). It does not affect the condition of accompanying meadow plants. There was no crossbreeding between the species and crop plants.

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

very low  
low  
medium


high  
very high

X

aconf18.

Answer provided with a

low	medium	high
	X	

level of confidence

acommm22.

Comments:

The mass occurrence of the species in meadows (probability = high) may cause a decrease of the share of meadow plants and hinder grazing of animals (consequences = medium) (Śliwiński 2009a - A).

**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	high
	X	

level of confidence

acommm23.

Comments:

*Per analogiam* to *H. sosnowskyi*, it can be assumed, that pathogenic species may attack *H. mantegazzianum*, including some that are not host-specific (Wrzesińska 2007, 2010 - P). They include crop pests (e.g. onion thrips, *Thrips tabaci* Lind., Wrzesińska 2006 - P, bean aphid, *Aphis fabae* Scop. Wrzesińska 2005 - P). However, these are not species of any importance to crops.

Only results of early studies assumed that the species can be a vector of crop diseases (Gray and Noble 1965 - P). No further information in this subject is available.

### 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

acomm24.

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

acomm25.

Comments:

The sap of *H. mantegazzianum* 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 *Heracluem* 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 (Tymczas 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). The species causes burns in the nose area of dogs, and breed animals with a light coat (Nielsen et al. 2005 - P).

The skin of wild animals is probably more resistant for toxic impact of the invasive alien *Heracluem* 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 *Heracluem* species stands were published (Łyszczarz 2012 - P). However, specific information on interactions between *H. mantegazzianum* 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
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 level of confidence

acomm26. Comments:  
The species is a plant. Plants are not hosts or vectors for pathogens or parasites threatening animals.

### 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	<b>X</b>
very low	
low	
medium	
high	
very high	

aconf23. Answer provided with a 

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

 level of confidence

acomm27. 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	<b>X</b>

aconf24. Answer provided with a 

low	medium	high <b>X</b>
-----	--------	------------------

 level of confidence

acomm28. Comments:  
Sap of *Heracleum mantegazzianum* 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, Rzymiski et al. 2014 - P). This substances may cause photodermatosis and other systemic symptoms (Mimra 1963, Drever and Hunter 1970, Guzik 1994, Nielsen et al. 2005, Hattendorf et al. 2007, Kettunen et al. 2009, Klima 2014, Rzymiski et al. 2014 - P). They can also be carcinogenic, or may cause foetus distortion and eye damage (Nielsen et al. 2005, Archier et al. 2012 - P).

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

inapplicable	<b>X</b>
very low	
low	
medium	
high	
very high	

aconf25. Answer provided with a 

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

 level of confidence

acommm29. 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	<b>X</b>
very high	

aconf26. Answer provided with a 

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

 level of confidence

acommm30. Comments:  
Probability of negative influence – high x medium consequence = impact HIGH.  
In Poland indirect damages caused by *Heracleum mantegazzianum* and *H. sosnowskyi* include:

- decreasing area of meadows and pastures (Rozwadowska 2003 - P, Sachajdakiewicz 2008 - N) and making agricultural practices more difficult (Sachajdakiewicz 2008 - N),
- decrease in attractiveness for tourists (Rozwadowska 2003 - P, Sachajdakiewicz 2008 - N), including protected areas (Wróbel 2002, Wrzesińska 2006 - P),
- decreasing attractiveness for commercial investments (Sachajdakiewicz 2008 - N),
- decreasing visibility along roads (Sachajdakiewicz 2008 - N),
- negative influence the perception of landscape values (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).

### 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 X	high
-----	-------------	------

level of confidence

acommm31.

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 (Rozwadowska 2003; Sachajdakiewicz 2008; Sachajdakiewicz and Mędrzycki eds. 2014 - P). These effects may in turn contribute to lower food production.

Probably the species has negative impact on food products of animal origin (meat, milk) (Guzik 1994, Sachajdakiewicz et al. 2014). Its local occurrence may lead to a reduction in the meadow and pastures production value (Śliwiński 2009a - A). The occurrence of the species can be perceived as beneficial by the owners of apiaries due to its melliferous properties (Śliwiński 2009d - A).

**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 X	high
-----	-------------	------

level of confidence

acommm32.

Comments:

No research is known on this topic. 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 - P).

The occurrence of the species may transform physical, chemical and biological properties of soil (Jandova et al. 2014b - P). In areas invaded by the species, the soil is characterized by reduced dynamics of organic matter (Koutika et al 2011 - P).

Riverbanks overgrown with the species are prone to erosion (see a17). The species may also distract pollinators from native plants (see a18).

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

significantly negative	<input type="checkbox"/>
moderately negative	<input checked="" type="checkbox"/>
neutral	<input type="checkbox"/>
moderately positive	<input type="checkbox"/>
significantly positive	<input type="checkbox"/>

aconf29.	Answer provided with a	low	medium	high	level of confidence
				<input checked="" type="checkbox"/>	

acomm33.

Comments:  
 No direct research is known on this topic. Alien *Heracleum* species may cause difficulties in access to rivers and severely decrease the quality of touristic areas (Williamson and Forbes 1982, Bingham 1990, Lundström and Darby 1994, Sachajdakiewicz et al. 2014, Pergl et al. 2016 - P). It has an adverse effect on landscape values (Kettunen et al. 2009 - 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	<input type="checkbox"/>
decrease moderately	<input type="checkbox"/>
not change	<input checked="" type="checkbox"/>
increase moderately	<input type="checkbox"/>
increase significantly	<input type="checkbox"/>

aconf30.	Answer provided with a	low	medium	high	level of confidence
			<input checked="" type="checkbox"/>		

acomm34.

Comments:  
 The influence of climate on the colonization of new sites by the species is non-relevant (Pyšek 1994, Willis and Hulme 2002 - P). The species is already present in Poland (Tokarska-Guzik et al. 2012 - 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
- increase significantly

<b>X</b>

aconf31.

Answer provided with a

low	medium	high
	<b>X</b>	

level of confidence

acommm35.

Comments:

The influence of climate on the colonisation of new sites by the species is non-relevant (Pyšek 1994, Willis and Hulme 2002 - P). The species is already established in Poland (Tokarska-Guzik et al. 2012 - 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

<b>X</b>

aconf32.

Answer provided with a

low	medium	high
	<b>X</b>	

level of confidence

acommm36.

Comments:

*Heracleum mantegazzianum* is already established in Poland (Tokarska-Guzik et al. 2012 - P); widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017r.) - B. Higher temperatures in winter may cause an inhibitory effect on germination of the *Species* (Pyšek et al. 1998 - P). Results of studies so far confirm that they germinate in spring only after winter stratification at 1°C to 6°C and in moist and cool conditions (Moravcová et al. 2005 - P).

**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

<b>X</b>

aconf33.

Answer provided with a

low	medium	high
	<b>X</b>	

level of confidence

acom37.

Comments:

*Heracleum mantegazzianum* is already established in Poland (Tokarska-Guzik et al. 2012 - P); widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017r.) - B. It is assumed that changes of climate will not have influence on the impact of the species (no research is known on this topic).

Higher temperatures in winter may cause an inhibitory effect on germination of the *Species* (Pyšek et al. 1998 - P). Results of studies so far confirm that they germinate in spring only after winter stratification at 1°C to 6°C and in moist and cool conditions (Moravcová et al. 2005 - P).

**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:

*Heracleum mantegazzianum* is already established in Poland (Tokarska-Guzik et al. 2012 - P); widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017r.) - B. It is assumed that changes of climate will not have influence on the species and therefore on cultivated plants (no research is known on this topic).

**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:

*Heracleum mantegazzianum* is already established in Poland (Tokarska-Guzik et al. 2012 - P); widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017r.) - B. It is assumed that changes of climate will not have influence on the species and therefore on animal production (no research is known on this topic).

**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	level of confidence
	X		

acom40.

Comments:

*Heracleum mantegazzianum* is already established in Poland (Tokarska-Guzik et al. 2012 - P); widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017r.) - B. It is assumed that changes of climate will not have influence on the *Species* and in consequence on human (no research is known on this topic).

**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	high	level of confidence
X			

acom41.

Comments:

*Heracleum mantegazzianum* is already established in Poland (Tokarska-Guzik et al. 2012 - P); widespread all over the country (Stanowiska kaukaskich barszczy w Polsce – database of the Expert group barszcz.edu.pl, <http://barszcz.supportit.pl>, access: 08.12.2017r.) - B. It is assumed that changes of climate will not have influence on the *Species* and in consequence on other domains (no research is known on this topic).

## Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.0	1.0
Establishment (questions: a09-a10)	1.0	1.0
Spread (questions: a11-a12)	0.75	1.0
Environmental impact (questions: a13-a18)	0.55	0.7
Cultivated plants impact (questions: a19-a23)	0.35	0.5
Domesticated animals impact (questions: a24-a26)	0.75	1.0
Human impact (questions: a27-a29)	1.0	1.0
Other impact (questions: a30)	0.75	1.0
Invasion (questions: a06-a12)	0.92	1.0
Impact (questions: a13-a30)	1.0	0.84
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.

acomment42.

Comment:

*Heracleum mantegazzianum* was classified in this assessment as very invasive alien species, scoring high in all modules used for calculations except for impact cultivated plants (0.35; 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) – 0.55. 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. mantegazzianum* as the priority species that requires control (Tokarska-Guzik et al. 2015 - I).

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