Appendix A

Harmonia^{+PL} – 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

Katarzyna Bzdęga
first name and family name

Alina Urbisz

acomm01. Comments:

degree	affiliation	assessment date
M.Sc.	Zespół ekspertów Barszcz.edu.pl	15.12.2017
degree	affiliation	assessment date
Dr	Faculty of Biology and Environmental Protection University of Silesia in Katowice	18.12.2017
degree	affiliation	assessment date
Dr hab.	Faculty of Biology and Environmental Protection University of Silesia in Katowice	18. 12. 2017

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

Polish name

Barszcz perski
Latin name

Heracleum persicum Desf. ex Fisch., C.A.Mey. & Avé-Lall
English name

Persian hogweed

acomm02. Comments:

This name is unresolved. The record derives from WCSP (Web. 1 - I) which does not establish this name either as an accepted name or as a synonym with original publication details: Index Seminum (LE) 7: 50 1841. Full publication details for this name can be found in Web. 2.

There are many more synonyms of Latin names, e.g.: *Heracleum amplissimum* Wenderoth, *Heracleum carmeli* Hort. ex Wender (Web. 3 - I).

The multitude of the species names is partly connected its incorrect identification based on morphological characteristics (Web. 4 - I). Preferred common names are given below (Web. 4 - I).

Polish name (synonym I)	Polish name (synonym II)
.....	.....
Latin name (synonym I)	Latin name (synonym II)
Heracleum glabrescens Boiss. & Hohen.	*Heracleum laciniatum* Desf.
English name (synonym I)	English name (synonym II)
Golpar	

a03. **Area** under assessment:

Poland

acomm03. 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	**X**
alien, present in Poland in the environment, not established	
alien, present in Poland in the environment, established	

aconf01. Answer provided with a

low	medium	high
	X	

level of confidence

acomm04.	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*$^{+PL}$ – procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland. Information on the presence of *H. persicum* in Poland is unclear and divergent. According to some sources, the plant does not occur in the country (Sachajdakiewicz and Medrzycki 2014, OEPP / EPPO 2009a, Śliwiński 2009 - P), others do not exclude such possibility - oral reports and unpublished data on sporadic occurrence of plants in north-eastern Poland, requiring further verification (Tokarska-Guzik et al. 2015 - P). The species is related and morphologically similar to the other two invasive alien species of the genus Heracleum: *H. sosnowskyi* and *H. mantegazzianum* (Jahodová et al. 2007 - P), therefore it may not be identified in the country. The morphological characteristics of *H. persicum* vary depending on the environmental conditions in which it grows, which makes identification difficult (OEPP/EPPO 2009a - P). At the same time, according to the *Report of Pest Risk Analysis*, the analysis of climate models of the potential distribution of Caucasian hogweeds the software CLIMEX indicates that the species can also be found in Poland (Web. 5 - I). Tall alien *Heracleum* species other than *H. sosnowskyi* and *H. mantegazzianum*, including *H. persicum*, are present in Polish botanical gardens (e.g. in Botanical Garden of the Polish Academy of Science in Warsaw - N).

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**

acomm05. Comments:

Heracleum persicum generally occupies the same habitats as *H. mantegazzium*. These are disturbed habitats such as roadsides, railroads, abandoned agricultural land, ruderal areas as well as semi-natural habitats: meadows, grasslands, coastal beaches and banks of streams and rivers. It can be found in most of open areas around cities, including in Norway and Finland, in gardens and parks (OEPP/EPPO 2009a; Klingenstein 2006 - P). The species can also colonize natural habitats and it is expected that its impact might be higher than *H. mantegazzianum*. (Web. 5 - I). Along riverbanks, *H. persicum*, like the other two species (*H. sosnowskyi* and *H. mantegazzianum*), can almost totally replace the natural vegetation and threaten biodiversity, including fauna associated with (native) plants, building a 'giant hogweed landscape' (Nielsen et al. 2005 - P). Nevertheless, Thiele and Otte (2007 - P) suggest that loss of plant species diversity in habitats invaded by *H. mantegazzianum* in Germany is a general symptom of successional changes rather than a particular effect of the invasive alien species.

Heracleum persicum, similarly to the other two species: *H. mantegazzianum* and *H. sosnowskyi*, contains photosensitizing furanocoumarins. In contact with human skin and in combination with ultraviolet radiation, a phytotoxic reaction followed by burns (Web. 5 - I). Moreover, dense infestations can seriously interfere with access to amenity areas, riverbanks, etc., and along roadsides, large stands can reduce visibility and result in road safety hazards (Web. 5 - 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	
medium	
high	**X**

aconf02. Answer provided with a

low	medium	high
	X	

level of confidence

acomm06. Comments:

Heracleum persicum is very similar to *H. mantegazzianum* in terms of ecological requirements, including humidity, fertile substrate, sun exposure and climate (OEPP/EPPO 2009a - P). The analysis of climate models of the potential distribution of the Caucasian hogweed taxa, including *H. persicum*, with the CLIMEX software, indicated that the countries of Central Europe and Scandinavia are the areas most threatened by the invasion of the species (Web. 5 - I). Countries with a similar climate are: Austria, Belarus, Belgium, Czech Republic, Denmark, Estonia, Finland, France (north-east), Germany, Hungary, Latvia, Lithuania, Norway, Poland, Romania, Russia, United Kingdom (south-east), Slovakia, Sweden, Switzerland and Ukraine (Web. 5 - I). So far, the presence of *H. persicum* has been confirmed in Belgium, Czech Republic, Denmark, Estonia, Finland, Hungary, Latvia, Lithuania, Norway and United Kingdom (Nielsen et al. 2005, Jahodova et al. 2007b, Wasowicz i in. 2013, EPPO 2013 - P).

Therefore, the probability of occurrence of the species in the natural environment of Poland is high.

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

low	
medium	
high	**X**

aconf03.	Answer provided with a	low	medium **X**	high	level of confidence

acomm07. Comments:

Due to the similarity of *Heracleum persicum* to the other two species: *H. mantegazzianum* and *H. sosnowskyi* in terms of many traits, the three species are referred to as one group under the name *Heracleum* spp. (OEPP / EPPO 2009b - P). The morphological structure of this species (leaves, flowers, fruits), high individual variability, the ability to create hybrids within this group, especially with *H. mantegazzianum* (Elven 2005, Fröberg 2010 - P) and with the native species *H. sphondylium* (Rijal et al. 2015 - P), as well as the poorly documented history of introductions and sources of seeds, justify the assumption that the species probably occurs in Poland, but is not identified. Perhaps it is an element of hybrids swarms (Sachajdakiewicz and Mędrzycki ed. 2014 - P).

The plant reproduces generatively, producing fertile seeds that can spread with the wind even over 10 m. The main factor of transport for a larger number of seeds may be water, especially during floods (Sachajdakiewicz and Mędrzycki ed. 2014, Tokarska-Guzik et al. 2015 - P). Before they drown, seeds of *Heracleum* spp. may float for up to 3 days in still water and 1.5-2 days in flowing water (Gucker and Corey 2009). Additionally, they might be moved along with road transport e.g. on wheels of cars, railways or unintentionally by people e.g. stuck to shoes (Nielsen et al. 2005, OEPPO/EPPO 2009a - P). The form of long-distance seed dispersion is also transport with free-flowing substrates and soil (Tokarska-Guzik et al. 2015 - P). Seeds of *H. persicum* are used in Persian cuisine as a spice. They are available via Internet (Web. 5 - I). It may be a possible way of introduction into Poland's natural environments.

Spontaneous appearance of the species in the natural environment, without human intervention or as a result of its unintentional actions is, therefore, likely.

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

low	
medium	**X**
high	

aconf04.	Answer provided with a	low	medium	high **X**	level of confidence

acomm08.

Comments:

Currently, there is relatively high awareness of the threats to human health caused by the invasive Caucasian hogweeds among the Polish society. In Poland, *Heracleum sosnowskyi* was introduced as a fodder plant, while *H. mantegazzianum* as an ornamental plant, although there are no detailed data on the introduction for this purpose (Sachajdakiewicz and Mędrzycki ed. 2014 - P). On the other hand, *H. persicum* has never been traded in Poland. However, the species was massively planted in Scandinavia, where it was grown as decorative garden plant, but not in other countries (Web. 5 - I). Invasive nature and toxic properties of the species make it impossible to use it in horticulture (Tokarska-Guzik et al. 2015 - P).

H. persicum is a threat to biodiversity and human health. In Poland, this species has not been included in the Regulation of the Minister of the Environment of 9 September 2011 on the list of plants and animals of alien species, which in the case of release to the natural environment may threaten native species or natural habitats (Journal of Laws 2011 No. 210 item 1260), therefore it could be legally imported, cultivated and sold without the permission of authorities. However, the species has been placed on the list of alien species that might pose a threat to the nature of Poland and the European Union (Tokarska-Guzik et al. 2015 - P). Irrespective of legal regulations, the level of interest in the species as an ornamental plant, due to the well-known properties of the closely related species, should be rated as low. The risk of intentional introduction of the species is therefore unlikely/medium.

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

acomm09.

Comments:

Heracleum persicum is native in mountainous areas of Turkey, Iran and Iraq, and is naturalized in Scandinavia. The species seems therefore to be able to adapt to different climatic conditions (Web. 5 - I).

Similarly to the other invasive alien hogweeds in Europe, *H. persicum* tolerates the continental as well as cool and warm temperate climate, with hot summer and cold winter (down to -23 °C) (Nielsen et al. 2005, OEPP/EPPO 2009a - P).

The similarity between the climate of Poland and the climate of both the natural and the invasive range of the Persian hogweed is in the range of 45-94%, which means that the climate the species are optimal in Poland is optimal for its establishment. This assumption is confirmed by the *Report of Pest Risk Analysis* made by EPPO (Web. 5 - I).

Therefore, the climatic conditions of Poland do not constitute a significant barrier to the establishment and spread of *H. persicum* throughout the country, particularly that the other two invasive hogweed species (*H. sosnowskyi*, *H. mantegazzianum*) with similar requirements are established and widespread (Tokarska-Guzik et al. 2015 - 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

acomm10. Comments:

Data on the distribution and spread of *H. persicum* in Europe and features related to its biology and ecology, clearly indicate high tolerance and adaptability of the plant to diverse habitat conditions (Tokarska-Guzik et al. 2015 - P).

In terms of habitat preferences, *H. persicum* does not show significant differences in comparison with the other two invasive alien species of this genus, therefore it may potentially occupy e.g. roadsides, banks of rivers and streams, wastelands and other ruderal habitats. Considering the spreading capability of *H. persicum* in the Scandinavian countries, it should be assumed that after introduction (intendent or accidental) in Poland, this species is likely to be established and then spread (Tokarska-Guzik et al. 2015 - P).

Both species of hogweed: *H. persicum* and *H. mantegazzianum* are similar in terms of ecological requirements such as humidity, substrate fertility, insolation and climate (OEPPO/EPPO 2009a - P, compare also point a09). Under unfavourable conditions, besides self-fertilization, the Persian hogweed may delay flowering. The seeds ripen in a short time to form a durable soil seed bank which retains vitality under favourable storage conditions for up to 15 years (Krinke et al. 2005, Moravcová et al. 2007 - 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	
low	
medium	**X**
high	
very high	

aconf07.	Answer provided with a	low	medium **X**	high	level of confidence

acomm11.	Comments: *Heracleum persicum*, similarly to *H. sosnowskyi* and *H. mantegazzianum*, spreads to new areas through zoo-, anemo- or hydrochory and through unintentional human activity (e.g. seeds on wheels of cars or stuck to shoes). Particularly effective for species of this type is the transport of seeds with water, surface runoff - for short distances and with the flow of rivers and streams or with flood waters (Tokarska-Guzik et al. 2015 - P). Seeds can be dispersed by weak wind for a distance of 4 m from the mother plant, while by flood or along roads or railway lines within a radius of 2 km from the patch (OEPP/EPPO 2009b - P, compare point a07). Data on the population expansion (Type B) Assuming that the species is present in Poland, the dispersal capacity , depending on the dispersion vector can be assessed as: wind B - small, water B - large.

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

acomm12.	Comments: Each form of soil transport from the places of invasive alien hogweeds and their surroundings (e.g. associated with earthworks as a result of clearing or deepening drainage ditches or gardening works, etc.) may pose a danger of transferring the seeds contained therein to new areas. The seeds form a durable soil seed bank. In the autumn, it may contain 12,000 viable seeds / m^2, with an average of 2,000 seeds / m^2 surviving winter and capable of sprouting in spring (Nielsen et al. 2005 - P). Seeds of hogweeds may also be contaminants of, for example cereal products, which may favour their further potential spread (OEPP/EPPO 2009a). Compare also point a07 and a08. Due to the high similarity of *H. persicum* to *H. mantegazzianum* in terms of biology and ecological requirements, it should be borne in mind that in the event of potential appearance and/or spreading of the Persian hogweed in Poland, it might quickly form large patches in different habitat types for example along roads or watercourses (Tokarska-Guzik and others 2015 - P). Assuming that the species is present in Poland, the spread as a result of intentional and unintentional human activities should be estimated as high.

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	X
low	
medium	
high	

aconf09.	Answer provided with a	low	medium	high	level of confidence

acomm13. 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 X	level of confidence

acomm14. Comments:
Heracleum persicum and the other two invasive alien hogweed species in Europe, have a negative impact on the environment and native biodiversity (OEPP/EPPO 2009a - P). They contribute to the reduction of native species richness, forming extensive, dense and large aggregations where one species almost completely fills the entire area, thanks to the mass production of seeds and formation of a durable soil seed bank. It has been proven that the presence of *H. mantegazzianum*, closely related to *H. persicum*, in plant communities, reduces species diversity by 50%-60% (Hejda et al. 2009, Pytlarczyk et al. 2013 - P) while the presence of *H. sosnowskyi* – even by 62%–69% (Sobisz 2007 - P). However, with time, new ecological balance can be established (Dostál et al. 2013 - P). These plants also use the mechanism of competition, and as a result not only the majority of hogweeds seedlings die due to shading by older plants, but also seedlings of other species coexisting with hogweeds are eliminated (Tappeiner and Cernusca 1996, Nielsen et al. 2005, OEPP/EPPO 2009a - P). Due to the high content of allelopathic substances in the leaves, *H. persicum* may inhibit the germination of seeds of other species and their growth (Myrås 1978; Myrås and Junttila 1981; Jandová et al. 2014a; Wille et al. 2013 - P). Invasive alien hogweeds may also alter the physical and chemical properties of the soil (Jandová et al. 2014b - P). Their occurrence near watercourses and reservoirs is the cause of, among others, coastal erosion. Through their overgrowing, hogweeds displace and eliminate native plant species that have important functions in their stabilization, they can also cause a negative impact on the animals present there. The dying leaves of hogweeds change the chemical properties of the soil in the rivers, making them unsuitable for example for salmonids during spawning (Thiele et al. 2007 - P). Other adverse effects include reducing the area of meadows and pastures and penetrating into protected areas. Impact of *H. persicum* may be higher than that of *H. mantegazzianum*, particularly that *H. persicum* is polycarpic and blooms several times, while *H. sosnowskyi* and *H. mantegazzianum* are monocarpic, making *H. persicum*'s reproductive strategy more competitive; it means that the leaves of *H. persicum* wilt in the autumn, but the plant overwinters with buds below the soil surface (Web. 5 - I). Also compare point a05.

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

no / very low	
low	
medium	**X**
high	
very high	

aconf11. Answer provided with a

low	medium	high
	X	

level of confidence

acomm15. Comments:

Heracleum persicum hybridizes with the native *H. sphondylium* and produces fertile and vigorous hybrids (Rijal et al. 2015 - P). *Heracleum sphondylium* is rare in northern Norway, where hybridization with *H. persicum* is common. Most of the suitable habitats for the native species are occupied by vigorous hybrids. Thus, there is a risk of local extinction of *H. sphondylium* due to hybridization, especially in northern Norway. This indicates that hybridization is much frequent between *H. persicum* and *H. sphondylium* in the absence of *H. mantegazzianum* (Rijal et al. 2015 - P, Web. 4 - I). In Poland, *H. sphondylium* is a common species.

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

very low	
low	**X**
medium	
high	
very high	

aconf12. Answer provided with a

low	medium	high
	X	

level of confidence

acomm16. Comments:

A nematode *Heterodera persica* (Tylinchida: *Heteroderidae*), has been reported to parasitize *H. persicum* in its native range (Maafi et al. 2006 - P). However, it has not been used yet to control *H. persicum* (Web. 4 - I). There is no data on pathogens and parasites for the species in the invasive range.

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

low	
medium	**X**
high	

aconf13. Answer provided with a

low	medium	high
	X	

level of confidence

acomm17.	Comments: *Heracleum persicum* may alter soil composition by repeated decomposition of its own biomass, thereby making soil hostile for other resident vegetation. In the long run, it may monopolize resources and can form monocultures, leading to soil erosion (Fremstad and Elven, 2006). Compare also a14.

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

low	
medium	**X**
high	

aconf14.	Answer provided with a	low	medium	high **X**	level of confidence

acomm18.	Comments: *Heracleum persicum* quickly develops dense stands and shades out native species. The allelopathic chemicals it produces do not allow other species to germinate and grow. For example, it inhibits the germination and growth of *Alchemilla subcrenata*, *Phleum pratense* and *Poa pratensis* (Myrås 1978 - P). Thus, the dominance of *H. persicum* could displace other species. This leads to the reduced density of native vegetation. In the long run, residential species may be locally extinct from the areas where *H. persicum* grows (Web. 4 - I, compare points a05, a14). The species threatens biodiversity also by creating hybrids. Compare also point a15. *Per analogiam* do *H. sosnowskyi* and *H. mantegazzianum*, according to Sachajdakiewicz et al. 2014 - P, the number of species in phytocoenoses with *H. sosnowskyi* may decrease by 62-69% (Sobisz 2007 - P), but in a long time (50 yrs) a new ecological balance may develop (Dostal et al. 2013 - P). Those mechanisms are similar to mechanisms found in highly competitive native species, characteristic for 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 changes more profoundly the structure of plant communities. Toxic compounds of *H. sosnowskyi* discourage vertebrate, and invertebrate herbivores to feed on the plants, except for species which are specialised to feed on *Apiaceae* family plants, Hansen et al. 2006 - P). Size and endurance of patches of *H. sosnowskyi* have more severe negative influence on biocoenoses than that exerted by 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	
very low	**X**
low	
medium	
high	

very high	

aconf15.	Answer provided with a	low	medium **X**	high	level of confidence

acomm19. Comments:
There is no data suggesting that the species could parasite on plants.

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

inapplicable	
very low	
low	
medium	
high	**X**
very high	

aconf16.	Answer provided with a	low	medium **X**	high	level of confidence

acomm20. Comments:
There are no records of direct impact of the species on crops. Invasive alien *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 seen invading pastures (OEPP/EPPO 2009a - P).
Invasive alien *Heracleum* species overgrow meadows and pastures, they also disturb agricultural practices (Sachajdakiewicz and Mędrzycki eds. 2014 - P). Considering the species competition mechanism, production of a large number of seeds and policarpy – it is possible, that in case of massive spread, *H. persicum* 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 furocumarines are unknown and hardly predictable (Sachajdakiewicz, Mędrzycki red. 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	**X**
low	
medium	
high	
very high	

aconf17.	Answer provided with a	low	medium	high **X**	level of confidence

acomm21.	Comments: Currently, there are no crops in Poland related to the genus *Heracleum*, thus the species has no effect on the cultivation of species important from an economic point of view.

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

very low	
low	
medium	**X**
high	
very high	

aconf18.	Answer provided with a	low **X**	medium	high	level of confidence

acomm22.	Comments: Invasive alien *Heraclelum* species overgrow meadows and pastures, they also disturb agricultural practices (Sachajdakiewicz and Mędrzycki eds. 2014 - P).

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

very low	
low	**X**
medium	
high	
very high	

aconf19.	Answer provided with a	low	medium **X**	high	level of confidence

acomm23.	Comments: By extrapolation of the data on the other invasive alien hogweeds, it can be assumed that *H. persicum* may have some influence on cultivated plants as a host or a vector of harmful pathogens and parasites. In favorable conditions (optimal shading, humidity and temperature) it cannot be excluded that the species may be attacked by fungal pathogens, thus increasing their local prevalence (author's own data - A).

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	**X**
very low	
low	

medium	
high	
very high	

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	**X**
very high	

aconf21.	Answer provided with a	low	medium	high **X**	level of confidence

acomm25. Comments:
Heracelum persicum, like the other Caucasian hogweeds, can be dangerous to farm animals, especially with a light coat (Nielsen et al. 2005 - P). There have been reports that piebald animals were only burned in light parts of the body. The wounds are very difficult to treat (Sachajdakiewicz and Mędrzycki eds. 2014 – P; Tymszan 2014 - P). That is why some scientists claim that cows whose udders have been burnt, should be killed (Web. 6 - I).
The sap of *H. persicum* contains psolarens, dangerous for health and life of humans and animals (*per analogiam* to *H. sosnowskyi* – Guzik 2005, Nielsen et al. 2005, Rzymski et al. 2014 - P, Web. 6 - I). These substances may cause photodermatosis and other systemic symptoms (Guzik 1994, Nielsen et al. 2005, Rzymski et al. 2014, Klima 2014). They can also be carcinogenic (Archier et al. 2012 - P).
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. persicum* 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	**X**
very low	
low	
medium	
high	
very high	

aconf22.	Answer provided with a	low	medium	high	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	**X**
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	**X**

aconf24.	Answer provided with a	low	medium	high **X**	level of confidence

acomm28. Comments:
Invasive alien hogweeds, including *H. persicum*, pose a serious threat to human health, mainly in tourist and recreational areas, as well as in densely built-up urban and suburban areas. Their toxic furanocoumarins and essential oils sensitize the skin to ultraviolet radiation. Skin contact with furanocoumarins leads to the formation of long-healing and painful burn blisters. It is equally dangerous to stay close to hogweeds patches, as airborne oils can also cause burns to the skin and respiratory tract (Tokarska-Guzik et al. 2015 and literature cited there - P). Compare also point a05 and a25.

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

inapplicable	**X**
very low	
low	
medium	
high	
very high	

aconf25.	Answer provided with a	low	medium	high	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	**X**
very high	

aconf26.	Answer provided with a	low	medium **X**	high	level of confidence

acomm30. Comments:
Per analogiam to *H. sosnowskyi* and *H. mantegazzianum*, the probability of negative influence of *H. persicum* on other domains can be assessed as high, with medium consequence.
Indirect damages caused by *Species* include decreasing attractiveness of invaded areas for tourism, recreation, commercial development, making agricultural practices more difficult, decreasing visibility along roads, and negative influence on the perception of landscape values (Rozwadowska 2003, Sachajdakiewicz 2008 - P). There are no statistics on those effects in Poland, but it is certain that their volume may grow. More research in this field is required (Sachajdakiewicz and Mędrzycki eds. 2014 - P). Compare also point a05.

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	**X**
neutral	
moderately positive	
significantly positive	

aconf27.	Answer provided with a	low	medium **X**	high	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 (Rozwadowska 2003; Sachajdakiewicz 2008; Sachajdakiewicz and Mędrzycki eds. 2014 - P). These effects may in turn contribute to lower food production.

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

significantly negative	
moderately negative	**X**
neutral	
moderately positive	
significantly positive	

aconf28.	Answer provided with a	low	medium	high **X**	level of confidence

acomm32. Comments:
The species may transform soil composition by repeated decomposition of its own biomass, making it unsuitable for other plants. In a longer time perspective, it may form extensive monocultures, causing erosion (Fremstad and Elven 2006 - P). The possibility of migration of traces of toxic compounds to the air through the transpiration or leaks cannot be excluded (Sachajdakiewicz et al. 2014 - P). Compare also a18.

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

significantly negative	
moderately negative	**X**
neutral	
moderately positive	
significantly positive	

aconf29.	Answer provided with a	low	medium	high **X**	level of confidence

acomm33.	Comments: Because of its toxic properties, the species poses serious threat in areas used for tourism and recreation, as it may cause burns (author's own data - A).

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 atmospherical 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	**X**
increase moderately	
increase significantly	

aconf30.	Answer provided with a	low	medium **X**	high	level of confidence

acomm34.	Comments: Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will break the subsequent barriers related to introduction to Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf31.	Answer provided with a	low	medium **X**	high	level of confidence

acomm35.	Comments: Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will break the subsequent barriers related to establishment in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf32.	Answer provided with a	low	medium **X**	high	level of confidence

acomm36. Comments:
Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will break the subsequent barriers related to spread in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf33.	Answer provided with a	low	medium **X**	high	level of confidence

acomm37. Comments:
Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will have an impact on environmental domain in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf34.	Answer provided with a	low	medium **X**	high	level of confidence

acomm38.	Comments: Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will have an impact on cultivated plants in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf35.	Answer provided with a	low	medium **X**	high	level of confidence

acomm39.	Comments: Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will have an impact on cultivated plants in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf36.	Answer provided with a	low	medium **X**	high	level of confidence

acomm40.	Comments: Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will have an impact on human domain in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

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	**X**
increase moderately	
increase significantly	

aconf37.	Answer provided with a	low	medium **X**	high	level of confidence

acomm41. Comments:
Assuming that in the future the temperature will increase by 1-2 °C, the probability that the species will have an impact on other domains in Poland will not change. The species tolerance range for the preferred climatic parameters is given in Web. 4 - I.

Summary

Module	**Score**	**Confidence**
Introduction (questions: a06-a08)	0.83	0.67
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.75	0.75
Environmental impact (questions: a13-a18)	0.55	0.70
Cultivated plants impact (questions: a19-a23)	0.30	0.50
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	0.50
Invasion (questions: a06-a12)	0.86	0.81
Impact (questions: a13-a30)	1,00	0.74
Overall risk score	0.86	
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: The Persian hogweed was classified in this assessment as very invasive alien species in Poland, scoring high in all modules used for calculation except for impact on cultivated plants (0.30; questions: a19-a23). In the human impact module (questions: a27-a29) the species scored the maximum value (1.0) and in environmental impact module (questions: a13-a18) this value was 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. Although occurrence of this species in the natural environment in Poland has not been confirmed, because of the difficulties in its identification, this possibility cannot be ruled out. Nevertheless, scores in the modules connected with the invasion process indicate that the risk of introduction (questions: a06-a08 – score 0.83), establishment (questions: a09-a10) and spread (questions a11-a12) of the Persian hogweed in Poland are very high (values 0.83, 1.0 and 0.75, respectively). These considerations should be taken into account when decisions are made about the management approach for the assessed species, including their prioritisation.

Data sources

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2. Databases (B)

3. Unpublished data (N)

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5. Author's own data (A)

Own data on fungal attack on the species.

Own data on the presence of invasive alien hogweeds near a popular tourist trail.