Appendix A

Harmonia^{+PL} – procedure for 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

1. Teresa Nowak
2. Agnieszka Popiela
3. Barbara Sudnik-Wójcikowska

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	23-01-2018
(2)	prof. dr hab.	Department of Botany and Nature Conservation, Faculty of Biology, University of Szczecin	22-01-2018
(3)	dr hab.	Department of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw; Biological and Chemical Research Centre, University of Warsaw	31-01-2018

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

Polish name: Wąkrotka jaskrowata

Latin name: ***Hydrocotyle ranunculoides*** L. f.

English name: Floating pennyroyal

Współfinansowano w ramach projektu nr POIS.02.04.00-00-0100/16 pn. *Opracowanie zasad kontroli i zwalczania inwazyjnych gatunków obcych wraz z przeprowadzeniem pilotażowych działań i edukacją społeczną* ze środków Unii Europejskiej w ramach Programu Infrastruktura i Środowisko 2014-2020

acomm02. Comments:

The Plant List provides its Latin name and its synonyms (2013 – B). Despite the above names, other used synonyms are: *Hydrocotyle batrachioides* DC., *Hydrocotyle ranunculoides* f. *minima* Kuntze, *Hydrocotyle ranunculoides* var. *genuina* Urb., *Hydrocotyle ranunculoides* var. *natans* (Cirillo) Urb., *Hydrocotyle ranunculoides* var. *ranunculoides* (The Plant List 2013 – B).

The Polish name wąkrotka jaskrowata is common in commercial offers and on aquaristic webpages (e.g. Akwarium 2018 – I). The correct generic Polish name according to Mirek et al. 2002 – P) is wąkrota but in this case use, as a synonim..

The common English names for *Hydrocotyle ranunculoides* are floating pennywort and floating marshpennywort (GBIF 2017 – B).

Polish name (synonym I)	Polish name (synonym II)
Wąkrota jaskrowata	–
Latin name (synonym I)	Latin name (synonym II)
Hydrocotyle cymbalarifolia	*Hydrocotyle natans*
English name (synonym I)	English name (synonym II)
Floating marshpennywort	Floating marsh pennywort

a03. **Area** under assessment:

Poland

acomm03. Comments:

–

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

	native to Poland
	alien, absent from Poland
X	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

aconf01. Answer provided with a

low	medium	high
		X

level of confidence

acomm04. Comments:

The species *Hydrocotyle ranunculoides* does not belong to the native flora in Poland and has not been so far observed there (Zając A and Zając M. 2018; Popiela and Łysko 2018 – B; Tokarska-Guzik et al. 2012 - P). There are no available data on the species occurrence in aquatic environment in Poland, whereas it can be present in aquarium trade.

On the basis of the available information, the species is not kept in botanical gardens (Pracownicy ogrodów... 2018 – N). In Poland *Hydrocotyle ranunculoides* is only available in some aquatic stores, including the online shops. However, other species of this genus are more common (e.g. *H. leucocephala*, *H. tripartita*, *H. verticillata*). It is also used as an ornament plant in aquaria and paludariums.

Hydrocotyle vulgaris L. belongs to native flora in Poland (Mirek et al. 2002 – P). Moreover, this genus includes about 130 species from the temperate and subtropical zones, classified as the Araliaceae family (e.g. The Plant List, 2013 – B). Some authors classify it to the Apiaceae family (Stevens 2017– I).

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

X	the environmental domain
	the cultivated plants domain
	the domesticated animals domain

	the human domain
X	the other domains

acomm05. Comments:

This species does not occur in Poland except for cultivation purposes. However, many negative effects of its massive occurrence refer to its introduced range (EPPO 2009b; Hussner et al. 2012 – B). *Hydrocotyle ranunculoides* affects the natural environment by competing with the native species of aquatic and marsh plants, and finally by eliminating them. At the same time, the species populations growing in midwater form a dense (more than 20 cm thick) mat and reduces light for submerged macrophytes. Necrobiosis of the species shoots reduces oxygen in water, which can consequently be harmful to fish and invertebrates (EPPO 2009b; Hussner i in 2012 – B). The species also produces chemical compounds of allelopathic (harmful or beneficial effects of chemicals released by plants or fungi or derived from their decomposition) impact on algae (Della Greca 1994 – P). In addition, overgrown with a thick layer of biomass can mimic the permanent ground and contribute to drowning people and animals. Moreover, invasion of *H. ranunculoides* also affects other domains. Overgrowing of ditches, culverts, irrigation channels and other water courses distorts their walls and hinders water flow, navigation and increases the flood risk (EPPO 2009b; Hussner et al. 2012 – B). On the other hand, phytoremediation of *H. ranunculoides* has been considered as the positive aspect (EPPO 2009b – B). Just like its usage as food for plants, and even cattle (*Hydrocotyle ranunculoides* L. f. – Q-bank 2011 – I; Hussner et al. 2012 – B). Because the species is present in wetlands, habitats for many native species, its possible appearance can be dangerous to diversity of the native flora (Hussner et al. 2018 – B).

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* to 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
X	high

aconf02. Answer provided with a

low	medium	high	level of confidence
		X	

acomm06. Comments:

The natural range of *Hydrocotyle ranunculoides* covers North America, Cenral and South America (disjunctively), sometimes Africa. Some data also confirm its occurrence in Germany in the early Pleistocene period (Hussner et al. 2018 – B). There are still discrepancies in the opinions on their occurrence and analyses of the size of their natural range (EPPO 2009b – B). The species has widespread beyond those areas and has been observed in different parts of Asia (Kadono 2004 – P; EPPO 2009b – B), western part of Australia, and in Europe where it prefers milder and wetter climate. First information of its European expansions dates back to 1990s and refers to the United Kingdom. The species was introduced in Belgium in ca. 1990, and the Netherlands in 1995 and its spreading rate was fast. Nowadays, *H. ranunculoides* is mainly observed in Western and Southern Europe (in addition to the above mentioned countries): Ireland, Germany, France, Italy (EPPO 2009b – B; Hussner 2012 – P) and in the western part of Hungary (Vidéki 2012 – P). It is still absent from Poland (Zając A. and Zając M. 2018; Popiela and Łysko 2018 – B). The plants occurring in Western Europe as invasive species are said to be of American origin (Hussner et al. 2018 – B).

Hydrocotyle ranunculoides is present in Poland neighbourhood country, but relatively far from our western border, in North Rhine-Westphalia where it was observed for the first time in 2004 (Hussner and van de Weyer 2004; Hussner et al. 2005; Hussner and Lösch 2007 – P, Hussner et al. 2018 – B). It is currently spreading towards north - Lower Saxony (Hussner et al. 2010 - P). So far it has not been known in the northern-eastern part of Germany, Poland neighbourhood (Flora Mecklenburg-Pomerania 2018 – B). Due to the known invasion rate of the species, the probability of its self-propelled expansion in Poland is considered high. Waterfowl spreads disseminules (mainly smaller or larger parts of shoots) over greater distance (Huckle 2002 – P).

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

	low
X	medium
	high

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

acomm07. Comments:

The species entered the occurrence range with plant materials for gardening, or through contact during sailing or fishing (EPPO 2009b; Hussner et al. 2012 – B). On the basis of data on the introduced range, the probability of the species introduction to the natural environment in Poland by unintentional human actions is medium. The plant propagates vegetatively (Hussner and Lösch 2007 – P), it can enter the natural water bodies in Poland by being transported from foreign aquarium trade (Huckle 2002 – P). The species can be accidentally introduced through movable water containers (e.g. for fish fry) and water equipment.

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

	low
X	medium
	high

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

acomm08. Comments:

Hydrocotyle ranunculoides was introduced into Europe and sold as an ornament plant until recently. It was also introduced for phytoremediation (technology that uses higher plants in the process of environmental cleaning) purposes (EPPO 2009a,b – B). *H. ranunculoides* has been included on the list of species of Union concern and its intentioan introduction is rather impossible. It should be emphasized that the species can be wrongly marked and mistaken for other species of *Hydrocotyle* genus, which are offered for sale, e.g. *Hydrocotyle verticillata*, *Hydrocotyle* sp. Japan, *Hydrocotyle leucocephala* (Akwarium 2018; Rośliny 2018 – I). This species is not kept in botanical gardens (Botanical Gardens employees...2018). In Poland, we cannot fully asses the scale the species occurrence in offers from garden trade and amateur cultivation, including exchanges between admirers of aquarium plants which can be the pathway of the species release to the natural environment. The test analysis of the trade offer range has indicated that the species is not quite common for sale. It was offered by two out of ten aquarium shops from south and central Poland, and by one out of 15 online shops. Three out of ten sellers did not show the species in their offer and considered them as *Hydrocotyle* genus. The offers including the species name, also indicated advantages of its cultivation. In one of the aquarium forum, people exchanged information on the list of harmful species in accordance with EU Regulation of 2014. No information has obtained whether in Poland there were some changes in the volume of *H. ranunculoides* sale (Popiela and Nowak 2018 – A).

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
X	sub-optimal
	optimal for establishment of *the species*

aconf05.	Answer provided with a	low	medium **X**	high	level of confidence

acomm09. Comments:

Despite *Hydrocotyle ranunculoides* grows the best in tropic climate, it also tolerates temperate zones (EPPO 2009b – B). This species grows the best at temperatures 25-35 °C. However, it can survive winter in Central Europe. At the maintained ice cover, the species partially dies and its minor forms that are complete immersed in water survive (Hussner and Lösch 2007 – P). The analysis of a map in the Harmonia^{+} Instruction shows that both the native range and a part of the introduced range are within all three similarity ranges between the Polish climate and the world climate, although in a considerable part in the range of 0-45% – unfavourable climatic conditions. However, in the European range, the similarity of the Polish climate reaches the highest range. Because the species can occupy another niche in the introduced range, we have increased the score – climatic conditions to moderately positive, especially that we do not know the potential ecological scale of the species that can be possibly introduced in Poland (where will it come from?, which clone will be introduced?) (CABI 2018 – B).

a10. Poland provides **habitat** that is

	non-optimal
	sub-optimal
X	optimal for establishment of *the species*

aconf06.	Answer provided with a	low	medium	high **X**	level of confidence

acomm10. Comments:

Aquatic plants easily spread and usually expand to broad geographical ranges. *Hydrocotyle ranunculoides* is present in stagnant water, slow flowing water, natural and artificial water bodies (rivers, streams, ditches, channels, lakes, ponds) and freshwater marshes. There are no requirements for water depth. The most intensive growth of the plant is observed in eutrophic water and it can also tolerate lower water pH (Newman and Dawson 1999 – P; Hussner et al. 2012 – B). The species was also recorded in waters with less trophies and even contaminated (Pot 2002 - P, Hussner and others 2018 - B). There are many such habitats in Poland, though humidity can be a limiting factor.

A3 | Spread

Questions from this module assess the risk of *the species* to overcoming dispersal barriers and (new) environmental barriers within Poland. This would lead 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 to be 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	high **X**	level of confidence

acomm11. Comments:

Various data were considered, but the assessments were made on the basis of data A: Single-source dispersal.
Hydrocotyle ranunculoides spread from a stand reported in the Chelmer River, UK, over 12 km till 1992 (Newman and Dawson 1999). We can assume the spread rate is 6 km per year – large dispersal. But there were some doubts whether dispersion was not facilitated by humans. The species has features that allow it to be introduced and relatively quickly spread, such as the ability to overwinter, phenotypic plasticity, through which it produces aquatic and terrestrial forms, resistance to herbivores and very effective vegetative reproduction (Newman and Dawson 1999 - P). The plant can grow up to 20 cm during the day (Newman 2006 - P). It grows by means of stolons, and leaves and roots grow from nodes. A single node (1 cm fragment) can already be a diaspora. It has a large regenerative capacity (Hussner and Lösch 2007 - P). Depending on the availability of nutrients, the plant can quickly increase its biomass - data from Australia say that the biomass will be doubled in three days (Newman 2006 - P). Water birds may contribute to spread over longer distances (Huckle 2002 - P) - large mobility. It can be assumed that when the taxon is in Poland, its spread will be equally fast.

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

	low
	medium
X	high

aconf08.	Answer provided with a	low	medium **X**	high	level of confidence

acomm12. Comments:

The species dispersed mainly due to human actions: entering into the trade, releasing to the natural environment by cleaning aquaria, ponds etc., doing water sports (sailing) or fishing. Mechanical elimination of the species results in a great number of shoot fragments that are disseminules. They also contribute to the species spread in flowing water because it is passively transported with water current. Thus, the anthropogenic dispersion is considered to be very effective (EPPO 2009b; Hussner et al. 2012 – B). The possible pathway of dispersion can include seeds produced by plants kept in aquaria. They are then unintentionally introduced with replaced water into the natural environment, or intentionally introduced as ornament plants to garden ponds or aquaria, or they are transferred from artificial water bodies to the natural ones. The human actions are probably responsible for the species dispersal over great distances (Lansdown 2017 – I). Assuming that the species is present in Poland, its spreading rate by human actions has been assessed as high. However, the regulations concerning the prohibition of the species growing and selling should be introduced.

A4a | Impact on the 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 species. 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 at a local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as (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**:

- [X] inapplicable
- [ ] low
- [ ] medium
- [ ] high

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

acomm13. Comments:

This species is a plant which does not affect the native species through predation, parasitism or herbivory.

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

- [ ] low
- [ ] medium
- [X] high

aconf10.	Answer provided with a	low	medium	high	level of confidence
				X	

acomm14. Comments:

There are not such data in Poland. However, the species from stands in Western Europe has a significant and adverse effect on native flora, and can even cause fish death (Preston et al. 2002; Kelly 2006 – P). Competing for food and light is one of the most noticeable phenomena during the species invasion. The intensive develop of the population resembles a tight "mat" which hinders or even stops the development of macrophytes that had been there earlier. In Belgium, a 50% drop in the diversity of aquatic species has been reported, and in case of submerged species up to 100% drop (Nijs et al. 2009 - P). This also refers to species present in the coastal zones (Hussner et al. 2012 - P). It is worth showing an example of "displacing" the native European *H. vulgaris*by *Hydrocotyle ranunculoides* (Hussner and Lösch 2007 – P). Their ecological niches largely overlap. Besides the effect on vascular plants, the already mentioned allelopathy restricts the occurrence of algae. The habitats occupied by *H. ranunculoides* are often protected, like the species present there (Robert et al. 2013 – P). Therefore, the invasion has a very significant impact on the environmental protection.

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

- [ ] no / very low
- [x] low
- [ ] medium
- [ ] high
- [ ] very high

aconf11.	Answer provided with a	low	medium **X**	high	level of confidence

acomm15. Comments:

The native and introduced ranges of *Hydrocotyle ranunculoides* include the related species with different numbers of chromosomes. The molecular studies performed in Great Britain indicated four clones of the same species, of which one was relatively close to the native *H. vulgaris* - the possible reason was hybridisiation (CABI 2018 – B). This aspect still requires further studies. Hybridisation *H. ranunculoides* with other species of the *Hydrocotyle* genus is probable (Allan 1982 – P). Due to ambiguous data - the effect through interbreeding is assessed to be low.

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

X	very low
	low
	medium
	high
	very high

aconf12.	Answer provided with a	low x	medium	high	level of confidence

acomm16. Comments:

Within the native range (mainly in California and Chile), the following fungi have been identified *Hydrocotyle ranunculoides*: *Cercospora hydrocotyles*, *Entyloma fimbriatum*, *Entyloma hydrocotyles*, *Physoderma hydrocotylidis* and *Puccinia hydrocotyles* (Farr and Rossman 2011; CABI 2018 – B). We did not find any data on the presence of species common for the representatives of the native flora (in the European part of the introduced range) and *Hydrocotyle ranunculoides*. Therefore, the impact in this subject was assessed as very small with a low level of confidence.

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:

The massive occurrence of the species causes chemical and physical changes in water. Significant drop in oxygen is one of those changes. Such a large biomass causes strong eutrophication, and potential release of toxic substances. Sedimentation changes the bottom structure, e.g. shoaling of water bodies. In case of flowing water, we can observe intensive sliming (Hussner et al. 2012 – B). Attacked water loses its optimal oxygen supply and clarity. We can observe intensified accumulation of biogens, increased trophic level in water. Water flow is likely to be hindered, including blocked drainage systems and sluices (Preston et al. 2002 - P).

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:

Invasion of the species changes biotic factors on all level of diversity. Elimination of algae and vascular plants causes the modification and depletion of the ecosystem and also affects its other elements, such as invertebrates and vertebrates (fish, birds) (EPPO 2009a; Hussner et al. 2012 – B). The studies conducted in a lake in Zimbabwe demonstrated a connection between the size of *H. ranunculoides* population and the type of species of waterfowl (Simbanegavi et al. 2017 - P). Invasion of the species changes decreases the number of birds and changes a structure of the ecosystem. In the sites of the massive occurrence of *H. ranunculoides*, there is a smaller number of bird species living in open water. However, the authors underline that long-term studies are necessary to confirm results from the observations (Simbanegavi et al. 2017 - P). In Great Britain, *H. ranunculoides* competes with many native species living in wetland habitats (e.g. *Carex* sp., *Juncus* sp., *Rorippa amphibia*, *Myosotis palustris*, *Nasturtium officinale* (Preston et al. 2002 - P). In Germany, the population of *H. ranunculoides* has been reported to displace the following plants: *Myriophyllum spicatum*, *Callitriche* sp., *Potamogeton crispus*. And shaded surfaces ("mats") of water and reduced oxygen level have also an adverse effect on groups of plant and animal species living in water (Hussner and Lösch 2007 – P). In Belgium, a drop over 50% in the diversity of native aquatic species has been reported as a result of the growth of *H. ranunculoides* (Nijs et al. 2009 - P). Assuming the species occurrence throughout the territory of Poland, they cause hardy reversible changes in biotic factors in wetland ecosystems - the habitats of particular concern. High impact.

A4b | Impact on the cultivated plants domain

Questions from this module qualify the consequences of *the species* for 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 plant targets through **herbivory or parasitism** is:

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm19.	Comments:

The plant is not a parasite (low probability x low effect).

a20. The effect of *the species* on cultivated plant targets through **competition** is:

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm20.	Comments: There is no information on the direct impact on cultivated plants through competition. In Poland, cultivations in wetland areas are rather seldom, although it cannot be excluded in the future (low probability x low effect).

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

	inapplicable
X	no / very low
	low
	medium
	high
	very high

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

acomm21.	Comments: There is not any cultivated plant related to*Hydrocotyle ranunculoides* (low probability x low effect).

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

X	very low
	low
	medium
	high
	very high

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

acomm22.	Comments: No cultivation of plants has been reported in the habitat occupied by *Hydrocotyle ranunculoides*. If the species potentially overgrows drainage ditches in the fields, it can incidentally affect the integrity of a cultivation system, but will not affect the crop itself. No such cases have been found in the literature. Therefore, the selected answer is a "very low" effect (low probability x low effect).

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

X	very low
	low
	medium
	high
	very high

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

acomm23.	Comments: Currently there are no known pathogens common to the species and cultivated plants and no assumptions that they can be discovered as research progresses.

A4c | Impact on the 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:

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf20.	Answer provided with a	low	medium	high	level of confidence

acomm24. Comments:

This species is a non-parasitic plant.

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

X	very low
	low
	medium
	high
	very high

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

acomm25. Comments:

Hydrocotyle ranunculoides does not have any properties that can affect individual animal health or animal production. It can be even used as food for cattle (Hussner et al. 2012 – B). The selected answer is a "very low" effect (low probability x low effect).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf22.	Answer provided with a	low	medium	high	level of confidence

acomm26. Comments:

This species is neither a host nor a vector for pathogens/parasites to animal targets.

A4d | Impact on the 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:

X	inapplicable
	very low
	low
	medium
	high
	vert high

aconf23.	Answer provided with a	low	medium	high	level of confidence

acomm27. Comments:

This plant species is not a parasite.

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

X	very low
	low
	medium
	high
	very high

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

acomm28. Comments:

No data on harmful properties to people. The selected answer is a "very low" effect (low probability x low effect).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf25.	Answer provided with a	low	medium	high	level of confidence

acomm29. Comments:

The plant species is neither a host nor a vector for pathogens/parasites to human targets.

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

X	medium
	high
	very high

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

acomm30. Comments:

Hydrocotyle ranunculoides overgrows ditches, flows and other infrastructure elements that hinder navigation and fish culture (the species can damage infrastructure, that is, clog pumps and water supply lines – Preston et al. 2002 – P). But that effect is reversible if proper methods of the species elimination are applied. However, no detailed data on the number of reported cases have been found. Costs bore by the country are mentioned as the main effect. They refer to the species invasion, including the costs of consequent floods. The expert assessment was made while analysing the territory of Poland. The species impact on the infrastructure is "medium" (medium probability x medium effect).

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
X	moderately negative
	neutral
	moderately positive
	significantly positive

aconf27.	Answer provided with a	low	medium	high X	level of confidence

acomm31. Comments:

In line with the previous score (questions a19-a26), the species invasion can have the greatest impact on deterioration of the degree of oxygenation and water quality in the reservoir. (EPPO 2009b – B). In this aspect, we can talk about the negative impact on the supply of drinking water *Hydrocotyle ranunculoides* does not have a direct impact on cultivated plants. Sometimes, it can have an indirect effect in case of channel overgrowing in fields. There are no data on hazards considering food from wild sources. Additionally, the species can be food for animals (*Hydrocotyle ranunculoides* L. f. – Q-bank 2011 – I).

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32.	Comments: Overgrowing of ditches, channels, culverts and water bodies with shoots of *Hydrocotyle ranunculoides*, which form dense "mats", affects an increased flood risk (EPPO 2009b – B). At the same time, there is a positive aspect of the species for regulation and maintenance services, that is, phytoremediation. But the score has not been lowered due to the large scale and high costs of eliminating the flood consequences mentioned in almost every local report.

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm33.	Comments: The negative effect on recreational water bodies is observed, they lose their aesthetic qualities and their functional properties as pools and as a place for sailing and fishing (Preston et al. 2002 - P).

A5b | Effect of climate change on the risk assessment of the negative impact of *the species*

Below, each of the *Harmonia*$^{+PL}$ modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest taking into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes in 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
X	increase significantly

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

acomm34.	Comments: Due to the introduced regulations concerning the prohibition on the growth, maintenance and sale of the species, the probability for its intentional introduction is unlikly. In the case of climate change on a warmer basis and assuming that the diasporas will be available and then transferred by water birds, the likelihood of species introduction will increase. Additional support for introducing the species are floods, which in recent years occur quite often, among others in Germany, which can also be a consequence of climate change . We also took into account a very quick spread rate of *Hydrocotyle ranunculoides* in countries from the Atlantic region (Great Britain, the Netherlands, Belgium or Germany - North

	Rhine-Westphalia), which have much warmer climate than Poland. However we cannot expect the same degree of similarity. According the climate analyses, the Mediterranean region and the region of Black Sea are particularly prone to invasion of the species (EPPO 2009b – B).

a35. ESTABLISHMENT – Due to climate change, the probability for *the species* to overcome barriers that have 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: Temperature is a factor limiting establishment and spread of the species. Thus, an increased temperature can facilitate the establishment. However, we cannot be certain about other changes observed in the climate. Unsuitable humidity level can limit the establishment despite an increased temperature. Due to the introduced regulations concerning the prohibition on the growth, maintenance and sale of the species, and actions to eliminate the species in countries where it occurs, the probability for its intentional introduction seems to be relatively low. The limited number of habitats suitable for the species (the reduced level of surface water) is also probable.

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

	decrease significantly
	decrease moderately
	not change
	increase moderately
X	increase significantly

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

acomm36.	Comments: An increase in temperature should facilitate the establishment and spread of the species. The limited number of habitats suitable for the species (the reduced level of surface water) is also probable. However, due to the introduced regulations concerning the prohibition on the growth, maintenance and sale of the species, and its control in the UE countries, the probability for its occurrence in the natural environments seems to be relatively low. In a scenario where the species is introduced in Poland, the probability of its spread would certainly increase.

a37. IMPACT ON THE 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
X	increase significantly

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

acomm37.	Comments: In a scenario where the species is present in the natural environment in Poland, and the climatic changes are favourable, it would have a greater effect as seen in the example of the introduced range.

a38. IMPACT ON THE 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
X	not change
	increase moderately
	increase significantly

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

acomm38.	Comments: The species does not affect cultivated plants. Thus, any climatic change should not produce a different result providing there are no cultivated plants in wetlands.

a39. IMPACT ON THE 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	high **X**	level of confidence

acomm39.	Comments: In a scenario where the species is present in the natural environment in Poland, its adverse effect on fish production could be greater. However, considering the legal status of the species in Europe, we have given a lower score.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm40.	Comments: The species has no effect on humans. Possible changes in climate will be inert.

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	high X	level of confidence

acomm41. Comments:

In a scenario where the species is present in the natural environment in Poland, its negative effect on the infrastructure related to waterways would considerably increase as seen in the example of the introduced range (cf. question a30).

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.67	0.83
Establishment (questions: a09-a10)	0.75	0.75
Spread (questions: a11-a12)	0.88	0.75
Environmental impact (questions: a13-a18)	0.65	0.70
Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.00	1.00
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.50	1.00
Invasion (questions: a06-a12)	0.76	0.78
Impact (questions: a13-a30)	0.65	0.94
Overall risk score	0.50	
Category of invasiveness	moderately invasive alien species	

A6 | Comments

This assessment is based on information available at the time of its completion. It has to be taken into account. However, that biological invasions are, by definition, very dynamic and unpredictable. This unpredictability includes assessing the consequences of introductions of new alien species and detecting 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.

acomm42. Comments:

The risk score confirms key elements of risk posed by the species that is absent in Poland. They refer to the following modules": "Introduction" (score 0.67) and "Establishment" (score 0.75). In this group, the highest score got the module "Spread" – 0.88. The score has been influenced by the limited growth and cultivation of the species. At the same time, the confidence level of the provided answers was not high due to many unknowns. As a result, the score for "Invasion" was relatively low – 0.76. It is therefore concluded that the potential occurrence of *Hydrocotyle ranunculoides* in Poland will cause a problem. The analysis of obtained data has shown that the species has a significant adverse effect mainly on "Environmental domain" - 0.65 and "Other domains" – 0.50. The overall score of 0.65 for the module "Negative impact"classifies the analysed species as "moderately invasive alien

species".

An assessment of the invasion risk of *Hydrocotyle ranunculoides* made for the European countries shows that the Mediterranean region and the region of Black Sea are particularly prone areas (EPPO 2009b – B). However, numerous lists of alien species present in very sensitive habitats, such as aquatic and waterside areas in, inter alia, Europe increase our awareness of the scale, at which alien species are used as ornaments of the natural environment (e.g. Hussner 2012 – P). The species can initially exhibit no consistence with climate and habitats in the given area, but after the adaptation process it can create serious problems. *Hydrocotyle ranunculoides* has not been reported in Poland except for cultivation. But the reports of its relatively fast spreading rate in Poland western neighbourhood country (Hussner et al. 2010; EPPO 2015 – P) increases our watchfulness. Commission Implementing Regulation (EU) 2016/1141 seems to be a kind of protection. The prohibition on the species introduction to Poland, particularly on the sale for ornament and aquarium purposes should be legislated. The report on controlling and monitoring the aquatic and invasive species in the countries from the Mediterranean region can be helpful (EPPO 2014 – P). In Western Europe, first stands of the species in the natural environment originated from the cultivation (e.g. Newman and Dawson 1999; Robert et al. 2013 - P). Therefore, to assess the scale of the species in trade and amateur cultivation is the most important aspect with reference to the risk for its occurrence in many wetlands in Poland. Awareness campaigns that are conducted on a large scale and that include experience from the countries, where the species is established, should be the basic element of preventive measures undertaken at this stage.

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