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. Alina Urbisz
2. Stanisław Rosadziński – external expert
3. Adam Zając

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	08-02-2018
(2)	dr	Faculty of Biology, Adam Mickiewicz University in Poznań	29-01-2018
(3)	prof. dr hab.	Institute of Botany, Jagiellonian University, Kraków	30-01-2018

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

Polish name: –

Latin name: ***Ludwigia grandiflora*** (Michx.) Greuter & Burdet

English name: Large-flower primrose-willow

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acomm02.	Comments:

The Latin name was adopted according to the Plant List (2013 – B). In addition to the more commonly used Latin names: *Jussiaea grandiflora* Michx. and *Ludwigia clavellina* var. *grandiflora* (Michx.) M. there are many synonyms of the species name: *Jussiaea repens* var. *grandiflora* M. Micheli, *Jussiaea uruguayensis* Camb., *Ludwigia grandiflora* (M. Micheli) Greuter & Burdet, *Ludwigia hexapetala* (Hook. & Arn.) Zardini, Gu & Raven, *Ludwigia uruguayensis* var. *major* (Hassler) Munz. (IPNI 2005, The Plant List 2013, CABI 2015 – B, Pest Risk Analysis 2018 – P). In addition to the name given below, there are many synonyms of the English name, such as: willowlarge-flower, primrose willow, Uruguay waterprimrose, Uruguayan Hampshire-purslane, Uruguayan primrosewillow (Pest Risk Analysis 2018 – P). In Polish gardening offers the species occurs under the name ludwigia wielkokwiatowa. By analogy to the approach to the name of another species of the genus *Ludwigia* (*Ludwigia palustris* - ludwigia błotna; Mirek et. al. 2002 – P) whose Polish name is - ludwigia (płytek) for *Ludwigia grandiflora* the name ludwigia (płytek) wielkokwiatowa is proposed.

Polish name (synonym I) Ludwigia wielkokwiatowa	Polish name (synonym II) –
Latin name (synonym I) *Adenola grandiflora*	Latin name (synonym II) *Jussiaea grandiflora*
English name (synonym I) water primrose	English name (synonym II) large flower primrose

a03. **Area** under assessment:

Poland

acomm03.	Comments:

–

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

	native to Poland
X	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

aconf01.	Answer provided with a	low	medium **X**	high	level of confidence

acomm04.	Comments:

Ludwigia grandiflora is not cultivated in any of the botanical gardens or arboreta in Poland (Botanical Gardens employees... 2018 – N). The species has also not been found in the natural environment of our country; there is a probability of keeping the species in private collections. It is a species of the aquatic (hydrophyte) and amphibious habitat, invasive in the western part of Europe. Its natural range covers South and Central America and part of the USA (IPAMS 2009 – B).

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

X	the environmental domain
X	the cultivated plants domain
X	the domesticated animals domain
X	the human domain
X	the other domains

acomm05.	Comments:

In its natural range, *Ludwigia grandiflora* significantly transforms aquatic ecosystems both physically and chemically. It often forms dense, floating mats displacing native plant species, limits fish breeding possibilities, overgrowths gaps between ponds, anti-flood and drainage systems, hinders navigation because of the overgrowth of channels and infrastructure elements and affects recreation (IPAMS 2009 – B, Pest Risk Analysis 2018 – P). The mass-occurring species causes a decrease in the oxygen content in water. Dead shoots also limit the possibility of obtaining water and increase the costs of its treatment. The plant also shows the allelopathic activity, which may lead to hypoxia of water reservoirs and the excessive accumulation of sulphides and phosphates in water significantly affecting the trophism of aquatic ecosystems (Dandelot et al. 2005 – P). A similar effect was identified in the secondary range of the plant (Pest Risk Analysis 2018 – P). At present, in Poland, we do not yet observe the influence of the species on these spheres.

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 **X**	high	level of confidence

acomm06.	Comments:

In Poland, *Ludwigia grandiflora* has not been found yet. *Ludwigia grandiflora* was imported from America to Montpellier in France in the 1830's and has become one of the most widespread and harmful aquatic invasive plants in this country (Ruaux et al. 2009 – P). In Europe, the species has also been found in Belgium (Bauchau et al. 1984, Denys et al. 2004 – P), Spain (EPPO 2004 – B), France (Dandelot 2004 – P), Germany, Switzerland (Vauthy et al. 2003 – P), the Netherlands (Kleuver and Holverda 1995 – P), Great Britain (Palmer 2008 – P), Ireland (Nehring and Kolthoff 2010 – P) and Italy (DEFRA 2018 - I). In France and Germany it is considered invasive, and in Germany it is placed on the so-called black list of invasive species (Dandelot et al. 2005, Nehring and Kolthoff 2011 – P). The transfer of fragments of plants or seeds (mainly by migrating birds) from Germany is very likely, although there is no detailed literature data on this method of dispersion on a specific example.

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

	low
	medium
X	high

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

acomm07.	Comments: The presence of the species is particularly endangered by thermally disturbed as well as natural, shallow oligo-, meso- and eutrophic reservoirs and slowly flowing linear water objects. The species can be unintentionally dragged by a man with the contaminated floating equipment (boats, pontoons), fishing accessories and other contaminated water plants introduced into water reservoirs. Effective cleansing reduces the chance of a plant transfer via human means (Pest Risk Analysis 2018 – P).

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: *Ludwigia grandiflora* is valued in many countries as an ornamental plant in ponds and other water reservoirs. However, due to its invasive nature, its introduction should be prohibited (Pest Risk Analysis 2018 – P). The possibility of introducing the species by intentional import as a water plant is very high. The sale of plants is done by many small enterprises (mainly horticultural), or small, one-person, often unregistered companies, especially in the western part of Poland. Plants are usually imported from the Netherlands, where they are displayed for sale at the horticultural fair (Beszczyńska M. own information - A). *Ludwigia grandiflora* is a species included in the European Parliament's regulation regarding the introduction and spread of invasive alien species. Therefore, the species is banned from entering the European Union, moving within its borders, keeping, cultivating, placing on the market, using or exchanging it, allowing for reproduction, growing or cultivation and release into the environment (Regulation 2014 – P). The species could in the first place appear in reservoirs with artificially elevated temperatures.

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	high **X**	level of confidence

acomm09.	Comments: The natural range of the species includes the countries of South America (Peru, Argentina, Chile, Costa Rica, Bolivia, South Brazil, Colombia, Ecuador, Guatemala, Paraguay, Uruguay (Pest Risk Analysis 2018 – P). The minimum temperature for the growth is not exactly known, but it can be from about 12°C to 15°C (water temperature) (DEFRA 2018 - I). Negative temperatures destroy above-ground parts of plants, while seeds can survive temperatures even down to -15°C, however, low temperatures reduce their lifespan up to 50% (Dutartre et al. 2007, Ruaux et al. 2009, Pest Risk Analysis 2018 – P). The secondary range covers the south-eastern and southern parts of the USA (Boersma et al. 2006 – P,

DEFRA 2008, USDA 2010 – B) and the European countries mentioned in the commentary to question a06. The similarity between the climate of Poland and the climate of both natural and secondary range of *Ludwigia grandiflora* (adopted on the basis of modeling included in the *Harmonia*$^{+PL}$ protocol) ranges from 0-45%, which should be interpreted as adverse climatic requirements. However, according to the Report of Pest Risk Analysis, the analysis of CLIMEX climatic models of the potential distribution of *Ludwigia grandiflora* indicated that the species may also be present in Poland, especially in western Poland, and the climatic probability is within the similar intervals (DEFRA 2018 - I).

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:

Ludwigia grandiflora occurs in freshwater, in slowly flowing rivers and streams, on the banks of lakes and reservoirs and in shallow canals, ponds, floodplains and wet meadows, where it is particularly dangerous as it significantly widens the list of potential habitats of the species (Laugareil 2002, Zotos et al. 2006 – P). The plant shows a high degree of adaptation and flexibility in its habitat requirements due to its phenotypic plasticity (Ruaux et al. 2009 – P). The species also tolerates fluctuations in the water level. In its range, the plant occurs in three types of habitats: 1) marshes and wetlands in depression areas with periodic floods; 2) along the shorelines and in shallow bays; 3) on sandy and gravel banks of streams (Chester and Holt 1990 – P). *Ludwigia grandiflora* has a high tolerance in terms of nutrient levels, substrate, pH and water quality (Matrat et al. 2006 – P). The species prefers full light, but also tolerates shading, however, the production of biomass decreases in the shade. Plant growth limits the flow rate of water (greater than 0.25 m/s) (Dandelot 2004 – P) and salinity (*L. grandiflora* tolerates up to 6 g/L). *Ludwigia grandiflora* prefers habitats rich in nutrients (Hussner 2010, Rejamánková 1992 – P). If, due to the climate change, the species settled in Poland, it could occur on this type of habitat

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:

Dispersion from a single source (type A data) outside the breeding to the natural positions without the human participation is likely, although the nearest position is significantly distant from Poland. *Ludwigia grandiflora* is spread mainly through fragments of shoots

that are transmitted by animals (mainly through ornitochory - by birds) and water currents (Okada et al. 2009 – P). Most populations thrive, but sexual reproduction is less important than a vegetative reproduction. In southwestern France, in less than six years, the species completely mastered the 500-hectare, shallow lake. It has been calculated that under favorable conditions, the species may cover an area of 83 hectares per year (IAS 2018 - I). The number of seeds produced by *L. grandiflora* is variable. In the case of, for example, French populations, the species has the very high potential seed yield (about 10,000 seeds per square meter). Negative temperatures destroy above-ground parts of plants, while seeds can survive negative temperatures even up to -15°C, however, such low temperatures reduce their lifespan to 50%. It was found that the spread of the species as a result of sexual reproduction can be an important factor in the survival and spread of the plant thanks to the preserved seed bank (Ruaux et al. 2009, Pest Risk Analysis 2018 – P). So far, no detailed studies have been carried out on the quantitative assessment of the spread of the species taking into account the biotic vector (Pest Risk Analysis 2018 – P).

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

	low
X	medium
	high

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

acomm12. Comments:

Ludwigia grandiflora is valued in many countries as an ornamental plant in ponds and water reservoirs. However, due to the invasive nature, its introduction is prohibited (Pest Risk Analysis 2018 – P). The species could, in the first place, inhabit tanks with artificially elevated temperatures and warm, shallow waters of old river beds in the valleys of large rivers. Assuming that the species is present in Poland, its spreading as a result of deliberate and unintentional human activities (in the light of the existing prohibitions and unrecognized situation in industrial gardening and private breeding, and the lack of interest in the aquarium industry) should be estimated as medium.

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:

The species is a plant, it does not affect 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 **X**	level of confidence

acomm14. Comments:

Ludwigia grandiflora contributes to the reduction of species richness, creating extensive, dense, single-species aggregations in water and water muddy environments. The species displaces native species of plants and reduces the number of fish and other aquatic organisms, as the mass-occurring species causes a decrease in the oxygen content in water (IPAMS 2009 – B, Pest Risk Analysis – P). The plant also has an allelopathic effect, which can also lead to the excessive accumulation of sulphides and phosphates in water, significantly affecting the trophism of aquatic ecosystems (Dandelot et al., 2005, 2008 – P). By overgrowing wet meadows, the plant displaces native grass species and reduces the biological diversity of grassland. The phenomenon is particularly dangerous when the species penetrates protected areas. *Ludwigia grandiflora* can penetrate to Natura 2000 habitats, such as: shores or drained bottoms of water reservoirs with communities of *Littorelletea, Isoëto-Nanojuncetea* - 3130; old river beds and natural eutrophic water reservoirs with communities of *Nympheion* and *Potamion* - 3150; lowland and submontane rivers with communities of water buttercup (*Ranunculion fluitans*) - 3260; flooded muddy river banks - 3270 (IAS 2018 - I). Based on the preliminary observations, it was found that *Ludwigia grandiflora* is dominant in the frequency of pollinator visits (Stiers et al. 2014 – P, DEFRA 2018 - I). In Poland, no species has been found so far, but assuming that the plant would be settled on this type of habitat, its impact on native species as a result of competition would be high.

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

X	no / very low
	low
	medium
	high
	very high

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

acomm15. Comments:

There are currently no native species of the genus *Ludwigia* in Poland, therefore there is no risk of interbreeding of this species in natural conditions. In Poland under natural environmental conditions (in the Nysa Łużycka valley in Mielno on the Gubińskie Hills), *Ludwigia palustris* grew at the beginning of the 20th century, however, the presence of this species has not been confirmed since 1928 and was considered extinct in our country (Zarzycki 2014 – P).

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

	very low
	low

	medium
X	high
	very high

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

acomm16. Comments:

The species is susceptible to being infected by *Xylella fastidiosa* and may be a vector of its transmission. As a result, the species may spread the bacterium to native species, e.g. *Agrostis gigantea, Fragaria vesca, Hedera helix, Urtica dioica*, species of the genus *Quercus* and others that may be successive carriers of this pathogen (Regulation of the Minister of Agriculture and Rural Development of 1st July 2016 2016 on detailed methods of dealing with the eradication and prevention of the spread of the *Xylella fastidiosa* – P). The *Xylella fastidiosa* bacterium is transmitted by sucking insects feeding on xylem juice, belonging mainly to the family of grasshoppers or spittlebugs. All European species of sucking insects feeding on xylem should be considered as potential vectors for *Xylella fastidiosa*. They can move on their own for short distances up to 100 meters, but with the help of the wind, they can overcome very long distances (Chief Inspectorate of Plant and Seed Protection of PRION 2018 – P). *Xylella fastidiosa* is a very serious threat to the EPPO region.

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 mass-occurring species causes a decrease in the oxygen content in the water. Dead shoots also limit the possibility of obtaining water and increase the costs of its treatment. The plant also exhibits allelopathic effects, which may lead to hypoxia of water reservoirs and the excessive accumulation of sulphides and phosphates in water significantly affecting the trophism of aquatic ecosystems (Dandelot et al. 2005 – P). These processes can have a significant negative impact on the habitats of special care: old river beds, streams with reophyllic vegetation, muddy communities or flood meadows.

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:

The presence of *Ludwigia grandiflora* leads to the depletion of native vegetation and displacement of native species of both plants and animals (Dandelot 2004 – P), because the mass-occurring species causes a decrease in the oxygen content in water (IPAMS, 2009 – B, Pest Risk Analysis 2018 – P). These processes lead to the degeneration of vegetation that covers habitats of particular concern (including: 3150 - old river beds and natural eutrophic reservoirs of *Nyphaenion, Potamion* vegetation, 3260 - lowland and submontane rivers with communities of water buttercup (*Ranunculion fluitantis*), and even the elimination of vegetation habitats associated with aquatic reservoirs (3130 - shores or drained bottoms of water reservoirs with communities of *Littorelletea, Isoëto-Nanojuncetea*, 3270 - flooded muddy river banks).

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 species is not a parasitic plant

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

	inapplicable
	very low
	low
X	medium
	high
	very high

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

acomm20.	Comments: The impact of the species on crops, and thus on the yield and/or quality of the cultivated plants is medium. *Ludwigia grandiflora* very rarely occurs in crops, such as rice and therefore it does not have a direct impact on its production (DEFRA 2018 - I). Through the mass presence on wet meadows the species may limit the presence of grasses (reduce the area of pastures), which makes these areas unsuitable for grazing livestock (Dutartre 2004 – P, DEFRA 2018 - I). *Ludwigia grandiflora* does not occur in Poland, but assuming that it would be settled in this type of habitat, its impact on growing crops as a result of competition would be medium.

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: Currently, we do not have cultivated plants related to the genus *Ludwigia* with which the species could form hybrids.

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

	very low
	low
X	medium
	high
	very high

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

acomm22.	Comments: *Ludwigia grandiflora* may cause the overgrowth of wet meadows and pastures, reducing their usefulness and hampering agrotechnical measures (DEFRA 2018 - I). Disorders may also occur in the case of overgrowing and shallowing of ditches and drainage channels by massively growing plants.

a23. The effect of *the species* on cultivated plant 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	high **X**	level of confidence

acomm23.	Comments: The species is susceptible to infection by *Xylella fastidiosa*, which causes the disease of vines and peach (Regulation of the Minister of Agriculture and Rural Development of 1st July 2016). The *Xylella fastidiosa* bacterium is transmitted by sucking insects feeding on xylem juice, belonging mainly to the family of grasshoppers or spittlebugs. All European species of sucking insects feeding on xylem should be considered as potential vectors for *Xylella fastidiosa*. They can move on their own for short distances up to 100 meters, but with the help of the wind, they can overcome very long distances (Main Inspectorate of Plant Health and Seed Inspection - PRION 2018 – P). This bacterium was first recorded in 2013 in Italy, where it caused serious damage to olive groves. In addition to olive trees, it was found in many other host plants, mainly decorative plants (EPPO 2018a – B). Because *Xylella fastidiosa* is a very serious threat to the EPPO region, it has been included in the A2 list of harmful pathogens and recognized as needing quarantine (EPPO 2018b – B).

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:

Ludwigia grandiflora is an autotrophic plant and shows no such effects.

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

	very low
X	low
	medium
	high
	very high

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

acomm25. Comments:

The species does not have properties that are harmful when in contact with farm or domestic animals or to animal production (e.g. toxins or allergens). Large areas occupied by the species, especially overgrown water reservoirs and marshy areas, can be dangerous for animals that can treat such a surface as land. There is insufficient data on the impact on animal production associated, for example, with eating the plant. It was observed that the species can be eaten by cattle and horses grazing on the meadows where *Ludwigia* occurs, but this plant is eaten by them only when no other species is available (DEFRA 2018 - I).

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:

The species is a plant. Plants are not hosts or vectors of animal parasites/pathogens.

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: 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
X	low
	medium
	high
	very high

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

acomm28.	Comments: The species does not have properties that negatively affect the physical, psychological or social comfort of people (e.g. toxins or allergens). However, covering 100% of the surface of the reservoir or wetland it may result in treating the area as land, which can be dangerous for people, especially children, in recreational areas (Pillsbury 2005 – P).

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 species is a plant. Plants are not hosts or vectors of human parasites/pathogens.

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
X	high
	very high

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

acomm30.	Comments:

Ludwigia grandiflora overgrows gaps between ponds, anti-flood and drainage systems, hinders navigation through the overgrowth of channels and infrastructure elements and affects recreation (IPAMS 2009 – B, Pest Risk Analysis 2018 – P). The probability of harmful effects of *L. grandiflora* on the infrastructure can be assessed as high with an average effect. Damages caused by the species may also reduce tourist and investment attractiveness. The presence of the species in the meadows obstructs agrotechnical treatments. In the west of France, the species overgrows drainage ditches, which has a huge impact on irrigation and drainage of fields (DEFRA 2018 - I). It may also cause flood risk (especially in autumn) through canal obstruction (Dandelot 2004 – 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:

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31.	Comments:

Ludwigia grandiflora significantly transforms aquatic ecosystems in physical and chemical terms. The mass-occurring species causes a decrease in the oxygen content in water. Dead shoots also limit the possibility of obtaining water and increase the costs of its treatment. The plant also has an allelopathic effect that can lead to the excessive accumulation of sulphides and phosphates in water, which significantly affects the trophism of aquatic ecosystems (Dandelot et al. 2005 – P).

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:

Ludwigia grandiflora causes damage by limiting the flow of water in drainage ditches. Due to the reduction of the throughput of the channels by the deposited biomass, it may (especially in autumn) lead to the flood risk (Dandelot 2004 – P). The species overgrows gaps between ponds, anti-flood and drainage systems, hinders navigation through the overgrowth of channels and infrastructure elements (IPAMS 2009 – B, Pest Risk Analysis 2018 – P).

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:

Plants growing on water reservoirs can increase mosquito populations, preventing fish eating larvae free access to them (Pillsbury 2005 – P), this can lead to an increase in mosquito population, which is particularly troublesome e.g. in the places of sport and recreation. Water completely overgrown by the plant also loses its recreational attractiveness. At the same time, the plant, due to its aesthetic value, may be a desirable element of decorative ponds.

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
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 the occurrence in Poland will increase moderately. The range of tolerance of the species to the preferred climatic parameters is provided (DEFRA 2018 - I) compare also a09. The species originates from tropical regions, so even a slight increase in temperatures in the temperate zone will favor the dynamics of the species.

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:

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 survival and reproduction in Poland will increase moderately. Seeds of the species are resistant to low temperatures, which is why winters in Poland are currently not a factor limiting their survivability.

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
X	not change
	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 that have prevented it from spreading in Poland will increase moderately. The current climate of Poland is not a limiting factor for *Ludwigia grandiflora*. Climatic and habitat barriers do not pose a threat for the species to spread – in Poland the species can currently spread (only from breeding with the intentional or unintentional human participation).

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
X	increase moderately
	increase significantly

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

acomm37. Comments:

It is assumed that due to the climate change, the impact of the described species on wild plants and animals as well as habitats and ecosystems in Poland may increase moderately. The species comes from tropical regions, so even a slight increase in temperatures in the temperate zone will favor the dynamics of the species.

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
	not change
X	increase moderately
	increase significantly

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

acomm38.	Comments: It is assumed that due to the climate change the impact of the species on arable crops or plant production in Poland will increase moderately . The current climate of Poland is not a barrier for *Ludwigia grandiflora*. The species tolerance range for preferred climatic parameters is provided (DEFRA 2018 – I); compare also a09.

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 **X**	high	level of confidence

acomm39.	Comments: It is assumed that due to the climate change the impact of the species on livestock and domestic animals as well as on animal production in Poland will increase. The current climate of Poland is not a barrier for *Ludwigia grandiflora*. The species tolerance range for preferred climatic parameters is provided (DEFRA 2018 – I). The mass appearance of the species in breeding tanks may cause a decrease in fish production as a result of the deterioration of living conditions (the lack of light, no oxygen, anaerobic processes of necromass decay).

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 **X**	high	level of confidence

acomm40.	Comments: It is assumed that due to the climate change the impact of the species on people in Poland will not change. The current climate of Poland is not a barrier for *Ludwigia grandiflora.*

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: It is assumed that due to the climate change the impact of the species on other objects in Poland will increase moderately. The species comes from tropical regions, so even a slight increase in temperatures in the temperate zone will favor the species dynamics.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	0.83
Establishment (questions: a09-a10)	0.75	1.00
Spread (questions: a11-a12)	0.63	0.75
Environmental impact (questions: a13-a18)	0.75	0.90
Cultivated plants impact (questions: a19-a23)	0.30	0.90
Domesticated animals impact (questions: a24-a26)	0.25	1.00
Human impact (questions: a27-a29)	0.25	1.00
Other impact (questions: a30)	0.75	1.00
Invasion (questions: a06-a12)	0.79	0.86
Negative impact (questions: a13-a30)	0.75	0.96
Overall risk score	0.59	
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:

In Poland, *Ludwigia grandiflora* has not yet been found in the "wild state". The species is also not cultivated in any of the botanical gardens or arboreta in Poland (Botanical Gardens employees… 2018 – N). In Western European countries, the species has an invasive status (CABI 2015 – B).

After the risk assessment for Poland, *Ludwigia grandiflora* was included in the category – "medium invasive alien species". The highest score – 1,00 the species obtained in the module 'Introduction (questions: a06-a08)'. This result is very likely to be associated with the high transferability of plant or seed fragments by e.g. migratory birds from Germany where the species is an invasive plant (Dandelot et al. 2005, Nehring and Kolthoff 2011 – P). The species may unintentionally be dragged by a man with contaminated floating equipment (boats, pontoons), fishing accessories and other contaminated water plants introduced into water reservoirs (Pest Risk Analysis 2018 – P). *Ludwigia grandiflora* is valued in many countries as an ornamental plant in meshes and water reservoirs, which can also be a source of invasion (Pest Risk Analysis 2018 – P). A relatively high score was obtained in the module 'Spreading (questions: a11-a12)' – 0.63. The easiness of vegetative reproduction and the ability to spread are arguments for recognizing *Ludwigia grandiflora* as a species with high invasiveness potential, which in the case of getting into the natural environment in Poland, can reach the status of a settled species, the more so that our country is rich in potential habitats for this plant. *Ludwigia grandiflora* occurs in freshwater, in slowly flowing rivers and streams, on the banks of lakes and reservoirs and in shallow canals, ponds, floodplains and wet meadows, where it is particularly dangerous as it significantly widens the list of potential habitats of the species (Laugareil 2002, Zotos et al.

2006 – P). High scores (0.75) were also obtained by the species in the modules 'Establishment' (questions: a09-a10) 'Impact on the natural environment (questions: a13-a18)' and 'Impact on other objects (question: a30)'. The plant shows a high degree of adaptation and flexibility in its habitat requirements due to its phenotypic plasticity and has a high tolerance in terms of nutrient levels, substrate, pH and water quality. *Ludwigia grandiflora* contributes to the reduction of species richness, creating extensive, dense, single-species aggregations in water and wetland environments. The species displaces indigenous plant species and reduces the presence of fish and other aquatic organisms, as it causes a decrease in the oxygen content in water and has an allelopathic effect (IPAMS 2009 – B, Pest Risk Analysis – P). The species is susceptible to being infected by *Xylella fastidiosa* and may be a vector of its transmission. *Xylella fastidiosa* is a very serious threat to the EPPO region causing the disease of vines and peach (EPPO 2018b – B). The species has a low impact on humans (score 0.25) (questions: a27-a29) and on animal husbandry (questions: a24-a26).

Due to the fact that this species has not yet been found in Poland in the "wild state" early actions (public education, sales ban) will effectively prevent the introduction of the plant into water reservoirs, and thus its penetration into natural and semi-natural communities (e.g. meadows or pastures).

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