



Appendix A

## Harmonia<sup>+PL</sup> – 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. Magda Podlaska – external expert
2. Stanisław Rosadziński – external expert
3. Adam Zajęc

acomment01.	Comments:	degree	affiliation	assessment date
(1)		dr inż.	Department of Botany and Plant Ecology, Wrocław University of Environmental and Life Sciences	09-02-2018
(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 peploides*** (Kunth) P.H. Raven

English name: Floating primrose



acommm02.

Comments:

Latin name acc. to The Plant List (2013 – B). Synonyms acc. to CABI (2018 – B): *Jussiaea diffusa* auct non Forssk *Jussiaea gomezii* Ram. Goyena, 1909 *Jussiaea patibilcensis* Kunth., 1823 *Jussiaea peploides* Kunth., 1823 *Jussiaea polygonoides* Kunth., 1823 *Jussiaea repens* var. *peploides* (Kunth.) Griseb., 1866 *Ludwigia adscendens* var. *peploides* (Kunth.) H. Hara, 1953 *Ludwigia clavellina* var. *peploides* (Kunth.) H. Hara. Other English names apart from those mentioned above: water primrose, California water primrose, floating primrose, floating water primrose, marsh purslane (CABI 2018 – B).

Polish name (synonym I)

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Polish name (synonym II)

–

Latin name (synonym I)

*Jussiaea californica*

Latin name (synonym II)

*Jussiaea gomezii*

English name (synonym I)

Creeping water primrose

English name (synonym II)

Floating primrose willow

**a03. Area under assessment:**

**Poland**

acommm03.

Comments:

–

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

- |                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/>            | native to Poland   |
| <input checked="" type="checkbox"/> | alien, absent from Poland                                    |
| <input type="checkbox"/>            | alien, present in Poland only in cultivation or captivity    |
| <input type="checkbox"/>            | alien, present in Poland in the environment, not established |
| <input type="checkbox"/>            | alien, present in Poland in the environment, established     |

aconf01.

Answer provided with a

low

medium

high

level of confidence

**X**

acommm04.

Comments:

*Ludwigia peploides* does not occur naturally in Poland and in its neighbouring countries. The species is not an object of cultivation in any botanical gardens and arboreta in Poland (Botanical Gardens employees...2018 - N). Information about the introduction of the species into a backyard pond in 2010 has been found on one of gardening message boards (Forum oczko wodne – I) , due to which the issue of the species' presence in individual cultivations is not certain. It is also difficult to verify how correctly the species is described by gardening centres (and due to this, whether it is not much more widespread than it seems). Analogical doubts concerning the trade name of the species (and its dissemination) originate from Germany (Rabitsch et al. 2013 – P).

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

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| <input checked="" type="checkbox"/> | the environmental domain        |
| <input checked="" type="checkbox"/> | the cultivated plants domain    |
| <input checked="" type="checkbox"/> | the domesticated animals domain |
| <input checked="" type="checkbox"/> | the human domain                |
| <input checked="" type="checkbox"/> | the other domains               |

acommm05.

Comments:

The species effects on the natural environment in negative way through competition with native hydro- and helophytes (aquatic and wetland species), which leads to their suppression and reduction of the biological diversity of flora and plantlife – the risk concerns particularly elodeids (submerged plants, rooted in the bottom of waterbodies and

watercourses), as well as seedlings of other hydrophytes (shading, allelopathic impact). In the case of fauna this concerns invertebrates, fish and amphibians (due to the shading of waterbodies and watercourses as a result of the creation of dense mats by the species), as well as birds (the disappearance of open water habitats; data from Belgium and France). The species' presence impacts habitat conditions (change in water pH value, disturbances in nitrogen and potassium contents, an increase in the concentration of insoluble phosphates and sulphides with a simultaneous decrease in the amount of absorbable nitrogen – dystrophication, deterioration of oxic conditions – anoxia, an increase in sedimentation and silting) as well as disturbances in mixing (circulation of water in a waterbody) and the hydrological regime of waterbodies. The species also affects land organisms – the blooming plant is visited by pollinators more frequently compared to native species, which may negatively affect their reproductive success. The species may interrupt agricultural production by limiting the areas of pastures on wet grasslands (EPPO 2011 – P). This effect is enhanced by the species' low digestibility for farm animals like cattle and horses, which eat the plant only when no other species are available. The impact on animal breeding may involve the overgrowing of fish ponds (a change in the physicochemical parameters of water, hypoxia). The presence of the plant may indirectly affect humans by creating perfect conditions for the development of the common house mosquito population, the impairment of aesthetic qualities of waterbodies and impeding the recreational use of water. In case of spreading all over the country, the quickly growing population of the species may obstruct watercourses, including channels and drainage ditches, affecting multiple branches of economy (e.g. fishing, agriculture, silviculture). Damming and slowing down the flow of water in overgrown channels also increases the risk of floods. The increased production of biomass results in an increased amount of sediments, which leads to the shallowing of watercourses and waterbodies and their conversion into land, also making the use of waters difficult (the overgrowing of channels and watercourses) (CEH 2007, EPPO 2011, Grewell et al. 2016 – P).

## A1 | Introduction

Questions from this module assess the risk for *the species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation. This leads to *introduction*, defined as the entry of *the organism* 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:

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

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

acomm06.	Comments:
	Due to the absence of the species in neighbouring countries, there is a low probability of a direct translocation of the species (e.g. by birds or with the current of watercourses and channels; there are no direct connections to the waters of countries occupied by the species). In Germany, from where the species could most easily penetrate into Poland, it has not yet been recorded free in nature. In the case of one, uncertain occurrence in a pond in Saxony, the species was most likely <i>Ludwigia grandiflora</i> ; currently the pond has been cleaned and the site no longer exists (Breitfeld et al. 2009, Nehring 2016 – P). However, the species is encountered in Germany more or less regularly as a decorative plant (both in botanical and in private gardens; it is probably also commercially available under different names) (Breitfeld et al. 2009, Nehring 2016 – P).

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

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

aconf03.	Answer provided with a	low	medium	high	level of confidence
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acomment07. Comments:  
Particular risk involves thermally distorted and natural waterbodies, shallow oligo-, meso- and eutrophic waterbodies and slowly flowing linear water objects. The species may be introduced by man inadvertently along with contaminated floating (boats, inflatable boats, barges, equipment used within river beds, e.g. dredgers) or fishing equipment, as well as other contaminations by aquatic plants introduced into waterbodies, rather than with aquarium plants. Effective treatment decreases the chance of the plant being transported by man (EPPO 2011 – B). Due to the species’ absence both in Poland and in the neighbouring countries, the probability of introducing the species due to inadvertent actions of man is low.

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

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

aconf04.	Answer provided with a	low	medium	high	level of confidence
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acomment08. Comments:  
*Ludwigia peploides* is a species listed in the Regulation of the European Parliament involving the introduction and spreading of invasive alien species. Because of this, the species is subject to a ban on: introduction into the area of the Union and transport within its boundaries, storage, breeding, introduction into trade, use or exchange, permission for reproduction, farming or breeding, release into the environment (Regulation 2014, 2016 – P). In many Union countries (e.g. in France, Portugal, Belgium, Great Britain and the Netherlands), the ban on the introduction and dissemination of the species within their territories had already existed previously, regardless of Union regulations (EPPO 2011 – B). However, *Ludwigia peploides* is still treasured in many countries as a decorative plant in garden ponds and waterbodies, which is why the possibility of introducing the species via intentional import as an aquatic decorative plant is still likely. The use of numerous gardening names largely impedes legal solutions, e.g. the ban on import and sales.

## 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:

<input type="checkbox"/>	non-optimal
<input checked="" type="checkbox"/>	sub-optimal
<input type="checkbox"/>	optimal for establishment of <i>the species</i>

aconf05.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
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acommm09. Comments:

*Ludwigia peploides* has been introduced in several European countries: Belgium, France, Italy, Greece, Spain, the Netherlands, Switzerland, Turkey and Great Britain (CEH 2007, EPPO 2011, Hussner 2012, Rabitsch et al. 2013 – P). It is particularly widespread in France, mainly south-eastern. Compared to *Ludwigia grandiflora*, less occurrences are observed in the north of the country. Although, according to its distribution, this species seems less resistant to cold in Europe, in the USA it occurs further towards the north in the states: Iowa, Nebraska, Ohio, Illinois and Indiana, which suggests that this species may be resistant to low temperatures. The similarity between the Polish climate and the climate of both the natural and secondary range of *Ludwigia peploides* (assumed based on modelling presented in the *Harmonia*<sup>+PL</sup> protocol) ranges from 0 to 45%, which should be interpreted as unfavourable climatic conditions. However, according to the Report of Pest Risk Analysis, an analysis of the CLIMEX climatic models of the potential distribution of *Ludwigia peploides* has indicated that the species may also occur in Poland, particularly in western Poland, and the climatic probability falls within similar ranges (EPPO 2011 – P).

The above-water parts of the plant are sensitive to frost, however, the submerged organs are capable of surviving the winter (observations from the Netherlands) (EPPO 2011 – P). Other sources (Kelly and Maguire 2009 – P) state that in Europe the species exhibits resistance to frost. Artificially heated reservoirs (the surroundings of CHP plants, industrial plants, etc.) are at particular risk.

This species is highly fertile and each fruit contains approximately 60 seeds. One square metre of the lobe of *L. peploides* produces between 10 000 and 14 000 seeds which are capable of staying in the air for 2 to 3 years (Dandelot 2004 – N). Their longevity in water sediments is unknown, but the seeds sprout in the dark and in anoxic conditions. The indicators of sprouting are highly variable. In the river Loire in France it has been observed that the vitality of seeds is significantly higher in the case of *L. peploides* (82-87%) compared to *L. grandiflora* (48-58%, EPPO 2011 – P).

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

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

aconf06.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acommm10. Comments:

Thermal ponds or waters with artificially elevated temperatures may be proper habitats in countries in which no suitable general climate has been recorded. Habitats appropriate for the species include: wet shores of ponds and lakes, stagnant or slowly flowing waters, rivers, shallow ponds and lakes, channels, oxbow lakes, wetlands (including peat bogs), networks of ditches, sandbanks in river beds, wet meadows, brackish (slightly saline) waters. The species exhibits high tolerance in terms of trophic substrate conditions (from oligo- to eutrophic habitats) and is capable of settling in waterbodies and watercourses with high oxygen deficiency (EPPO 2011, Rabitsch et al. 2013 – P, Fried et. al. – I). *Ludwigia peploides* often occupies habitats characterised by a variable water level due to the impact of natural or anthropogenic factors; in river valleys it spreads in disturbed habitats, e.g. used for grazing (cattle, geese). The aquatic habitats of western Mediterranean and Atlantic countries of the EPPO region are considered to be at the highest risk (excluding waterbodies in the region of the Mediterranean Sea, which dry out in the summer period), along with wetland habitats in continental Europe (EPPO 2011 – P).

## 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:

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

aconf07.	Answer provided with a	low	medium	high	level of confidence
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acomm11.	Comments:
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Dispersion from a single source (data type A). *Ludwigia peploides* has high regenerative capabilities, with the ability to create new sprouts from individual nodes (Dandelot 2004 – N Rejmánková 1992 – P, Manual of the Alien Plants of Belgium – B, Ruaux et al. 2009 – P). Vegetative reproduction and regenerative capabilities are highly effective due to new sprouts formed from small stem fragments. Under controlled conditions, Dandelot (2004 – N, 2008 – P) noticed that *L. peploides* has lower vegetative regeneration capabilities than *L. grandiflora*. Nonetheless, she states that *L. peploides* is capable of recovering 67% of the initial biomass during just 45 days upon the removal of 95% of biomass from the occupied area. Due to the path of transporting diaspores by way of hydro- and ornithochory (via water and birds), dispersion from a single source is very high (above 50 km/year).

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

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

aconf08.	Answer provided with a	low	medium	high	level of confidence
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acomm12.	Comments:
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Assuming that the species is present all over Poland, its ability to spread with human participation should be estimated as average (more than 1 case but no more than 10 cases per decade are expected). In here one should consider, e.g. the inadvertent transport of diaspores by aquatic transport, the release of plants (or diaspores) into natural environment during the maintenance of backyard ponds, garden ponds, aquaria etc.

## 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:

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

aconf09.	Answer provided with a	low	medium	high	level of confidence
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acomm13. Comments:  
The species is a plant, it does not impact native species by predation, parasitism or herbivory.

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

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

aconf10.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm14. Comments:  
*Ludwigia peploides* contributes to reducing the biodiversity of species by creating vast, dense single-species aggregates in wetland environments. It locally causes a decrease in biological diversity. The species replaces native plant species and limits the occurrences of fish and other aquatic organisms, since the mass presence of the species causes a decrease in the oxygen content of water (EPPO 2011 – B). By overgrowing wet meadows, the plant replaces native grass species and reduces biological diversity. The phenomenon is particularly dangerous when the species penetrates into protected areas (EPPO 2011 – B). *Ludwigia peploides* can penetrate Natura 2000 habitats: 3130 – Shores or dried bottoms of waterbodies with vegetation of the *Littorelletea*, *Isoëto-Nanojuncetea*, 3150 – Oxbow lakes and natural eutrophic waterbodies with vegetation of the *Nympheion*, *Potamion*, 3260 – Lowland and submontane rivers with vegetation of the *Ranunculion fluitantis*, 3270 – Flooded silted river banks (EPPO 2011 – B). *Ludwigia peploides* is pollinated by various insects (bees, beetles, etc.) which are widespread in the EPPO region (Dandelot 2004 – N). No presence of the species has been recorded in Poland yet, however, assuming the plant would be established in these types of habitats, its impact on native species would be high due to competition.

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

<input checked="" type="checkbox"/>	no / very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf11.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm15. Comments:  
Currently in Poland there are no native species of the genus *Ludwigia*, due to which the interbreeding of this species in natural conditions is not possible. In western Poland (Mielno near Gubin, Gubin Hills) there were once occurrences of *Ludwigia palustris*, however, no sites have been confirmed since 1928 and the taxon has been considered extinct within the

country (Mirek et al. 2006, Zarzycki 2014 – P). The species may interbreed with other alien species of this genus if they are introduced simultaneously. Laboratory samples exhibited the ability to interbreed with *L. grandiflora* (EPPO 2011 – B); the possibility of hybridisation with European species is not excluded either (Rabitsch et al. 2013 – 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
- high
- very high

aconf12. Answer provided with a 

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

acomm16. Comments:  
No transmission of pathogens and parasites by the species has been recorded; none of the available databases which include this species contain such information. No information on this subject has been found in the available literature either. Rabitsch et al. (2013 – P) state that no transmission of pathogens and parasites by the species is known according to the current state of knowledge.

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

- low
- medium
- high

aconf13. Answer provided with a 

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

acomm17. Comments:  
The species significantly contributes to decreasing flow rates and water levels in watercourses, changes in the hydrological regime of watercourses and disruptions in the circulation of water in waterbodies, increasing sedimentation and changing the chemical and physical parameters of water (lowering the pH, disturbances in the nitrogen and potassium contents, an increase in the concentration of insoluble phosphates and sulphides with a simultaneous drop in the amount of absorbable nitrogen – dystrophication, deterioration of oxic conditions – anoxia, resulting from an intense vegetative growth (2 kg/m<sup>2</sup> of dry matter), disturbances in the access to light, temperature changes.  
The species causes changes which are difficult to reverse involving processes occurring in special care habitats (oxbow lakes, lakes, rivers, wetland and alluvial habitats).

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

- low
- medium
- high

aconf14. Answer provided with a 

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

acomm18. Comments:  
The presence of *Ludwigia peploides* leads to the impoverishment of native plantlife and replacement of native species of both plants and animals (Dandelot 2004 – N), since densely growing individuals will cause a drop in the oxygen content of water [dissolved oxygen drops below 1 mg / l] and acidity (IPAMS 2009 – B). The species causes changes which are difficult to reverse involving processes occurring in special care habitats (oxbow lakes, lakes, rivers, wetland and alluvial habitats).



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

aconf15. Answer provided with a 

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

aconf16. Answer provided with a 

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

acomm20. Comments:  
Negative impact on crops and/or the quality of cultivated plants and the costs of control is probably the same as in the case of *Ludwigia grandiflora* (EPPO 2011 – B). Most of the data has been collected in France, where the two species are present, and it is difficult to separate the impact of each individual species. Although the impact on crops and/or the quality of cultivated plants is low, the costs of control are considerable (EPPO 2011 – B). *Ludwigia peploides* occurs very rarely in the crops of, e.g. rice, and therefore it does not affect its production directly (EPPO 2011 – B). Due to its mass presence on wet meadows, the species may limit the occurrence of grasses, due to which these areas are unsuitable for the grazing of farm animals (CEH 2007, EPPO 2011 – B). *Ludwigia peploides* does not occur in Poland, but assuming it was established on these types of habitats, its impact on grasslands in river valleys would be moderate due to competition.

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

- inapplicable
- no / very low
- low
- medium
- high
- very high

aconf17. Answer provided with a 

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

acommm21. Comments:  
Currently, we have no cultivations of plants related to the genus *Ludwigia*, with which the species could create hybrids.

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

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

aconf18. Answer provided with a 

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

acommm22. Comments:  
The species' impact may be associated with changes in the physical properties of flowing and stagnant waters (watercourses and waterbodies, both natural and of anthropogenic origin – including land amelioration systems, canals, ponds, etc.): blocking the flow of water causing problems with irrigation or drainage; the accumulation of necromass (EPPO 2011 – B). The impact is also manifested by competition (replacement) with meadow species, in the case of the species' penetration into wet meadow habitats. This limits or prevents the use of grasslands according to their intended purpose (Dutartre 2004 – P, CEH 2007, EPPO 2014 – B).

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

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

aconf19. Answer provided with a 

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

acommm23. Comments:  
No transmission of pathogens and parasites by the species has been recorded; none of the available databases which include this species contain such information. No information on this subject has been found in the available literature either. Rabitsch et al. (2013 – P) state that no transmission of pathogens and parasites by the species is known according to the current state of knowledge.

## 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:

- inapplicable
- very low
- low

- medium
- high
- very high

aconf20. Answer provided with a 

low	medium	high
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 level of confidence

acomm24. Comments:  
The species is a plant.

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

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

aconf21. Answer provided with a 

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

acomm25. Comments:  
Large areas occupied by the species, especially overgrown waterbodies and wetlands, can be dangerous to animals which may treat such surface as land (A). There is no sufficient data involving the impact on animal production associated, e.g. with eating the plant. The species has no biological, physical and/or chemical properties which act harmfully during contact with farm animals and pets or animal production (e.g. toxins or allergens).

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

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

aconf22. Answer provided with a 

low	medium	high
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 level of confidence

acomm26. Comments:  
In the available sources there is no information about the transmission of pathogens or parasites which are harmful to animals.

## 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:

- inapplicable
- very low
- low
- medium

- high
- vert high

aconf23. Answer provided with a 

low	medium	high
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 level of confidence

acommm27. Comments:  
The species is not a parasite.

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

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

aconf24. Answer provided with a 

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

acommm28. Comments:  
When covering 100 % of the area of a waterbody or wetland, there is a possibility of treating such surface as land, which may be dangerous to people, particularly children, in recreational areas.

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

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

aconf25. Answer provided with a 

low	medium	high
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 level of confidence

acommm29. Comments:  
The species is a plant. The plants are not hosts or vectors of humans 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
- high
- very high

aconf26. Answer provided with a 

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

 level of confidence

acommm30. Comments:  
Dense concentrations of *Ludwigia peploides* prevent the performance of a number of activities, such as: hunting, fishing, water sports, etc. Dense mats may create favourable conditions for the growth of common house mosquitoes, also causing increased risk of

floods (EPPO 2011 – B). *Ludwigia peploides* overgrows culverts between ponds, flood control and drainage systems, impedes sailing by overgrowing channels and elements of infrastructure, and it affects navigation and recreation (EPPO 2011 – B). The probability of harmful impact on infrastructure can be assessed as high with average results. Damage caused by the species may also involve lowering the appeal related to tourism and investments.

## 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:

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

aconf27.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
----------	------------------------	-----	--------	------------------	---------------------

acomm31.	Comments: <i>Ludwigia peploides</i> transforms aquatic ecosystems to a considerable degree, both physically and chemically. Mass presence of the species causes a drop in the oxygen content of water. Dead sprouts also limit the possibilities of acquiring water and increase the costs of its treatment. The plant also exhibits allelopathic activity, which may lead to the hypoxia of waterbodies and acidification of waters, which affects the trophic conditions of aquatic ecosystems considerably (Dandelot et al. 2005 – P, Krypludwigia 2017 – I, DEFRA 2018 –I).
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**a32.** The effect of *the species* on **regulation and maintenance services** is:

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

aconf28.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
----------	------------------------	-----	--------------------	------	---------------------

acomm32.	Comments: <i>Ludwigia peploides</i> causes damage by limiting the flow of water in drainage ditches. Due to a decrease in the flow rate of channels caused by deposited biomass, it can lead (particularly in autumn) to the risk of floods (Dandelot 2004 – N). The species overgrows culverts between ponds, flood control and drainage systems, impedes sailing by overgrowing channels and elements of infrastructure (EPPO 2011 – B).
----------	---

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

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

aconf29.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
----------	------------------------	-----	--------	------------------	---------------------

acomm33. Comments:  
Mats densely growing in waterbodies may facilitate the growth of common house mosquitoes, making it impossible for fish which feed on larvae to freely reach them (DEFRA 2018 – I); this may lead to an increase in the population of common house mosquitoes, which is particularly cumbersome, e.g. in centers of sports and recreation, as well as in resorts. Waters completely overgrown by the plant lose their recreational appeal (hindering the recreational use of watercourses and waterbodies – water sports, fishing, hunting) (CEH 2007 – P, Krypludwigia 2017– I).

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

Below, each of the Harmonia<sup>+PL</sup> 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
- increase significantly

aconf30.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
----------	------------------------	-----	--------------------	------	---------------------

acomm34. Comments:  
Assuming that the temperature in the future will increase by 1-2°C, the probability that the species will break further barriers related to survival and reproduction in Poland will increase moderately. The species' scope of tolerance in relation to preferred climatic parameters is specified by (DEFRA 2018 – I). The species originates from tropical regions, which is why even a slight increase in the temperatures of the moderate zone will favour the species' dynamics.

**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
- increase moderately
- increase significantly

aconf31.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
----------	------------------------	-----	--------	------------------	---------------------

acomm35. Comments:  
Currently, the species usually occupies European regions with warm summers and gentle winters; it was not until recently that it began spreading towards the north. The warming of

climate will be a factor facilitating the expansion towards the north (Rabitsch et al. 2013 – P). The possibility of the species’ spreading in Ireland is indicated as highly probable (Kelly and Maguire 2009 – P). There are even concerns that due to the warming climate and the existence of cultivations in gardens, the species may become established in southern Sweden (DEFRA 2018 – I). Assuming that the temperature in the future will increase by 1-2°C, the probability that the species will break further barriers related to survival and reproduction in Poland will increase moderately. The species’ scope of tolerance in relation to preferred climatic parameters is specified by (DEFRA 2018 – I).

**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
- increase significantly

aconf32. Answer provided with a 

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

acommm36. Comments:  
Assuming that the temperature in the future will increase by 1-2°C, the probability that the species will break further barriers, which have so far prevented its spreading in Poland, will increase moderately. The species’ scope of tolerance in relation to preferred climatic parameters is specified by (DEFRA 2018 – I). The species originates from tropical regions, which is why even a slight increase in the temperatures of the moderate zone will favour the species’ dynamics.

**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
- increase significantly

aconf33. Answer provided with a 

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

 level of confidence

acommm37. Comments:  
It is assumed that due to changes in climate, the impact of the described species on wild plants and animals as well as habitats and ecosystems in Poland may increase moderately. The species originates from tropical regions, which is why even a slight increase in the temperatures of the moderate zone will favour the species’ dynamics.

**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
- increase moderately
- increase significantly

aconf34. Answer provided with a 

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

 level of confidence

acommm38.

Comments:

It is assumed that, as a result of climatic changes, the impact of the described species on cultivated plants or crop production in Poland will not change, since even the current climate of Poland does not constitute a barrier for *Ludwigia peploides*. The range of the species' tolerance regarding its preferred climatic parameters is specified by (DEFRA 2018 – I). In case of the species' spreading, the impact on crops under Polish conditions would be relatively small (the species poses the highest threat to rice crops, not existing at our geographic latitudes, and this will not be changed by the warming of the climate).

**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
- increase moderately
- increase significantly

aconf35.

Answer provided with a

low	medium <b>X</b>	high	level of confidence
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acommm39.

Comments:

The current climate of Poland does not constitute a barrier for *Ludwigia peploides*. Due to the fact that the species' impact on the breeding of land animals is extremely low, it is assumed that this impact will not change in Poland because of changes in climate. The spreading of the species in watercourses and waterbodies, including in particular fish ponds, may have a negative impact on the populations of fish inhabiting them – due to changes in water chemistry, the shading of the surfaces of waterbodies as a result of the creation of dense mats, reduction of the amount of oxygen available in water (anoxia leading to oxygen squeeze) (Grewell et al. 2016 – P).

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

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

aconf36.

Answer provided with a

low	medium <b>X</b>	high	level of confidence
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acommm40.

Comments:

The species' impact on man is rather indirect. It is assumed that because of changes in climate, the impact of the described species on humans in Poland will not change – no new factors will emerge that would negatively affect humans.

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

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

aconf37.

Answer provided with a

low	medium <b>X</b>	high	level of confidence
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acommm41.

Comments:

The species originates from tropical regions, which is why even a slight increase in the temperatures of the moderate zone will favour the species' dynamics.

## Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.17	0.67
Establishment (questions: a09-a10)	0.75	0.75
Spread (questions: a11-a12)	0.75	0.50
Environmental impact (questions: a13-a18)	0.60	1.00
Cultivated plants impact (questions: a19-a23)	0.20	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)	0.56	0.64
Negative impact (questions: a13-a30)	0.75	0.98
Overall risk score	0.42	
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.

acommm42.

Comments:

In the final module involving climate changes, the responses given are mostly based on subjective experts' assessments; the authors are not familiar with any papers presenting, e.g. models of potential impact of the species on individual elements in climatic gradients. In the case of *Ludwigia peploides* (and other species from this genus), a species which has not been recorded in the country, it is very difficult to consider the impact of climatic changes on the species' behavior separately from the current impact, which in this case is potential, although the current climate does not constitute a barrier for the chorological expansion of the taxon.

The occurrence of *Ludwigia peploides* in its "wild state" has not yet been recorded in Poland. The species is not an object of cultivation in any botanical gardens and arboreta in Poland either (Botanical Gardens employees...2018 - N). In Western European countries the species has an invasive status (CABI 2018 –B).

After a risk assessment conducted for Poland, *Ludwigia grandiflora* has been categorised as a "minimally invasive alien species". The highest result – 0.75 was achieved by the species in the following modules: 'Establishment' (questions: a09-a10), 'Spread' (questions: a11-a12) and 'Impact on other objects' (question: a30). There is a high probability that these results can be associated with: the existence of optimal habitats in Poland for this species

and the absence of climatic barriers, negative impact on hydro-technical facilities and natural environment. In numerous countries *Ludwigia peploides* is treasured as a decorative plant in ponds and waterbodies, which may also constitute a source of invasion. The easiness of vegetative reproduction and the ability to spread constitute arguments for recognising *Ludwigia peploides* as a species with a high potential of invasiveness, which in case of penetrating into natural environment in Poland could achieve the status of an established species, especially considering that our country has the abundance of potential habitats for this plant. *Ludwigia peploides* occurs in freshwaters, in slowly flowing rivers and streams, on the shores of lakes and waterbodies and in shallow channels, ponds, as well as in flood areas and on wet meadows, where it is particularly dangerous, since it extends the list of potential habitats of the species considerably. *Ludwigia peploides* contributes to reducing the biodiversity of species by creating vast, dense single-species aggregates in aquatic and wetland environments. The species replaces native plant species and limits the occurrences of fish and other aquatic organisms, since it causes a decrease in the oxygen content of water and exhibits allelopathic activity (IPAMS 2009 – B). The species exhibits very low impact on people (result 0.00) (questions: a27-a29) as well as on animal breeding and the cultivation of crops.

Due to the fact that this species has not yet been recorded in Poland in its “wild state”, early initiation of proper actions (social education, a ban on sale) will successfully prevent the appearance of the species in natural environment, and as a consequence the spreading of the taxon in natural and anthropogenic communities.

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