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

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acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr	Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Lodz	22-01-2018
(2)	dr hab.	Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Lodz	25-01-2018
(3)	dr hab.	Department of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw; Biological and Chemical Research Centre, University of Warsaw	08-02-2018

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

Polish name: Lagarosyfon wielki

Latin name: ***Lagarosiphon major*** (Ridley) Moss

English name: Oxygen-weed

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

acomm02. Comments:

Lagarosiphon major (RIDLEY) MOSS, 1928, Synonyms: *Elodea crispa*, *Lagarosiphon muscoides* Harvey, 1841, *Lagarosiphon muscoides* var. *major*.

The preferred Latin name of the species was specified according to Plant List (2013 – B), synonyms according to databases (Plant List 2013; CABI 2017 – B),

The preferred English name is the name African elodea, moreover, the following names are often used as synonyms: African curly leaved waterweed; African oxygen-weed; African waterweed; coarse oxygen weed; curly water thyme; curly waterweed; fine oxygen weed; Lagarosiphon; oxygen weed; oxygen-weed; South African oxygen weed; submerged onocotyledon (CABI 2017 – B).

Polish name: Lagarosyfon wielki.

Polish name (synonym I)	Polish name (synonym II)
moczarka kędzierzawa	–
Latin name (synonym I)	Latin name (synonym II)
Elodea crispa	*Lagarosiphon muscoides*
English name (synonym I)	English name (synonym II)
South African oxygen weed	African elodea

a03. **Area** under assessment:

Poland

acomm03. Comments:

–

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

	native to Poland
	alien, absent from Poland
X	alien, present in Poland only in cultivation or captivity
	alien, present in Poland in the environment, not established
	alien, present in Poland in the environment, established

aconf01. Answer provided with a

low	medium	high
	X	

level of confidence

acomm04. Comments:

The plant occurs naturally in southern Africa. It is a perennial dioecious subaquatic plant with occasionally developing roots and rhizomes, which fix it to the ground. Its shoots grow up to 180 cm long, and are relatively stiff and fragile. Leaves arranged on a stem in an alternate way, often giving an impression of a spiral or whorled arrangement. They are light green, linear, with a sharpened tip. Their length is 1-2, exceptionally up to 3 cm, width 0,2-0,3 cm, the margin is finely serrated, and the entire leaf blade is arched downwards, especially in the proximity of the top (Kluczniok 1990 – I). The female flower is very small, with three transparently-white-pink petals. Only the female plant is known beyond its native range. The fruit is a capsule, containing approximately nine seeds (CABI 2017 – B). The species is a frequently cultivated and commercially available aquarium plant (Kluczniok 1990 – I); and in 1017 it was also found in a rearing pond in a garden in Greater Poland (Gąbka 2018 – N), therefore it is not certain whether it has already appeared in the natural environment. It is not kept in the collections of botanical gardens (Botanical gardens employees... 2018 – N).

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

	the human domain
X	the other domains

acomm05. Comments:

Currently, the presence of this species in the area of Poland, except cultivation, has not been found, but once it occurs, it may have a negative impact on the environment, and to a lesser extent also on other domains; it is unlikely to have an impact on cultivated plants, but considering that it is a host for a nematode attacking strawberry cultivations, such a possibility cannot be excluded. According to the data published on the CABI website (2017 – B) *Lagarosiphon major* can change a chemical composition of water, causing an increase in water alkalinity and a decrease in the level of carbon dioxide (James et al. 1999 – P). Thanks to photosynthesis *L. major* may cause an increase in pH of the environment to a level of above 10 (even up to 10,4) in small water reservoirs (Centre for Ecology and Hydrology 2004 – B). Such high pH levels inhibit effective photosynthesis of other native species, giving a competitive advantage to *L. major.* The species can also be an excellent competitor for light, defeating native aquatic vegetation and associated populations of invertebrates (Global Invasive Species Database 2018 – B). In this situation, it affects the biodiversity of ecosystems. Dense vegetation mats characteristic of this species, when the species occurs beyond its natural range, cause a reduction of oxygen level by limiting the circulation of water and increased decomposition of dead plants. Dense mats of *L. major* also have the ability to change hydrology and water quality, negatively affecting the ecosystem in which it occurs. According to the data published on the CABI website (2017 – B) *L. major* may block water intake in hydroelectric systems and limit the flow in drainage sewers. Moreover, the loss of recreational and aesthetic values associated with appearance of *L. major* can also cause a decrease in the value of properties situated on the lakes, as well as a possible reduction of tourism-related income.

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:

X	low
	medium
	high

aconf02. Answer provided with a

low	medium	high	level of confidence
		X	

acomm06. Comments:

The water temperature limiting the development of *L.major* is 10°C (Matthews et al. 2012 – P). In neighbouring countries, e.g. Germany – the species was imported in 1966 as an aquarium and ornamental plant for waterholes, and currently it is considered invasive (CABI 2017 – B), however its occurrence is limited to reservoirs with heated water ("thermally contaminated"). *Lagarosyfon* can be unintentionally introduced by flooding ponds or waterholes by surrounding natural watercourses. However, there is no evidence that this plant can be transferred by birds, because it is a relatively large plant (CABI 2017 – B; but vide a12). Species develops poorly at water temperatures <10°C and dies below 0°C, the likelihood of overcoming a geographical barrier and probability of self-propelled expansion is low. Nevertheless, it should be remembered that the appearance of the species (and early stages of establishment) are very difficult to detect. Although the species occurs in the countries neighbouring with Poland, it does not create there populations,

	whose expansion related to the biological characteristics of the species (based on current knowledge) is fast enough to reach the Polish borders in the perspective of about 15 years.

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

	low
X	medium
	high

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

acomm07.	Comments: The species is available in Poland as an aquarium and ornamental plant for waterholes. Therefore, a possible way of introduction is its migration with other species imported for commercial purposes. Since the main method of reproduction of *L. major* is fragmentation of shoots, it can expand with water transport, fishing nets and all types of nautical tourism equipment (McGreogor and Gourlay 2002 – P)

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

	low
X	medium
	high

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

acomm08.	Comments: In the area of Poland, there is no information concerning the reasons of intentional introduction of the species to the environment. However, it should be remembered that in many countries *Lagarosiphon major* has been intentionally imported as a powerful oxygen producer and at the same time a species of high ornamental value, used in aquaristics (CABI 2017 – B). Lagarosiphon major may be unintentionally spread in new locations by the movement of boat, trailers, nets and other recreational equipment between water reservoirs (McGregor and Gourlay 2002 – P; Weed Management Guide 2003 – I). The level of popularity of this species is demonstrated by the fact that only in one year (2006), approximately 20000 of seedlings of *L. major* were imported to the Netherlands (Matthews et al. 2012 –P).

A2 | Establishment

Questions from this module assess the likelihood for *the species* to overcome survival and reproduction barriers. This leads to *establishment*, defined as the growth of a population to sufficient levels such that natural extinction within *the area* becomes highly unlikely.

a09. Poland provides **climate** that is:

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

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

acomm09.	Comments:

The minimum water temperature ensuring the survival of *Lagarosiphon major* in good condition is 10°C. Currently, in the climatic conditions prevailing in Poland, the temperature of water in winter drops significantly below 10°C. Under such conditions, the plant does not die completely, but limits its vertical range of occurrence to the bottom zone of the reservoirs, where the water is warmer. However it does not grow intensively and does not form monospecific aggregations. The data of CABI (2017 – B) demonstrate that the species prefers temperate climate – average temperatures of the coldest month >0°C and <18°C, the average of the warmest month >10°C. The leaves freeze at a temperature of -1°C (Bannister 1990 – P), and in the range of 0-10°C the plant significantly reduces its growth (Matthews et al. 2012 – P). Although the probability of the establishment of this species is generally low for climatic reasons, however, in the first place, it could establish in "thermally contaminated" reservoirs with heated water (e.g. from a power plant; Konin reservoirs). The spread of the species in Germany, the Netherlands, Belgium demonstrates the fact that it can survive in temperate climate (CABI 2017 – B), which can be favoured by warm winters in Poland. At the same time, it should be remembered that the regions of Western Europe, in which *Lagarosiphon* occurs are areas influences by the Atlantic climate with milder winters.

a10. Poland provides **habitat** that is

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

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

acomm10.	Comments:

Lagarosiphon major shows a wide tolerance to habitat conditions. In Europe, it occurs in both natural and artificial water reservoirs. The occurrence range of *L. major* is 0.1 – 6.6 m of water depth (Coffey i Wah 1988 – P). Analysing the preferences of this species in relation to pH, according to the results from the Netherlands (Matthews et al. 2012 –P) it occurs in the range of 6.5 – 7.0, but very well tolerates higher pH even up to 10.4. Oxygen weed grows best in reservoirs protected from wind, waves; in still or slow-moving water. Considering habitat requirements of the plant, it can develop in Poland in ponds, lakes, oxbow lakes, slow-moving watercourses, but it can also appear in drainage sewers and ditches (Global Invasive Species Database 2018; Centre for Ecology and Hydrology 2004 – B). Reservoirs with heated water, whose temperature does not drop below 10°C are especially exposed to invasion. Currently, in the area of Konin, where there is heated water and species preferring warm water (e.g.. *Vallisneria spiralis*) develop, no presence of *L. major* was observed (Gąbka 2018 – N).

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
X	medium

	high
	very high

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

acomm11. Comments:

Estimation (C type of data) Since the species has not yet been recorded in Poland, the estimation of its spread can be based only on data from European countries, in which the expansion took place. In Ireland, the occurrence of *L. major* in the years 1987-1999 was recorded on 700 km^2 and many additional cases of its occurrence were recorded within subsequent years (Nault and Mikulyuk 2009 – P). According to Matthews et al. (2012 – P), the spread rate of *L. major* in Europe is estimated at 1 km per year. If it is assumed that temperature of water does not limit a possibility of spread of this species, it can very easily spread without human assistance.

However, currently the temperature prevailing in our reservoirs in the winter (below zero°C) definitely prevents the species from surviving.

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:

The species does not occur in the natural environment of Poland. Therefore, the ability of the dispersal of the species by human actions cannot be assessed based on the data from Poland. Such an analysis can be based only on data from the European countries, in which the expansion took place. The main vector of the invasion of this species in Europe is unintentional spread by human actions (Matthews et al. 2012 – P). In the conditions of Poland, this vector can also be crucial. Vectors, depending on their importance include: plant trade, aquaristics, water transport, natural water flow, fishing and probably large aquatic birds (Matthews et al. 2012 – P).

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 non-parasitic plant.

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

	low
	medium
X	high

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

acomm14. Comments:

Lagarosiphon major can be a competitor for light displacing local aquatic vegetation and associated invertebrate populations (Global Invasive Species Database 2018 – B). In this situation, it affects biodiversity of ecosystems. Dense vegetation mats characteristic of this species, when the species occurs beyond its natural range, cause a reduction in oxygen level by limiting the circulation of water and increased decomposition of dead plants. Dense mats of *L. major* also have the ability to change hydrology and water quality, negatively affecting the ecosystem in which it occurs. As a result of the development of *L. major* in Ireland and New Zealand, many native species have lost their sites (Howard-Williams and Davies 1988; Caffrey and Acavedo 2007 – P). In particular, *L. major* competes with *Myriophyllum* spp., *Potamogeton* spp., (Rattray et al. 1994 – P) and *Elodea* spp. (James et al. 1999 – P). In this situation, it can be hazardous for species recognized as threatened in Poland (e.g. *Myriophyllum alternifolium*, *Najas minor*, or numerous species of the genus *Potamogeton* (Kaźmierczakowa et al. 2016 – P). It may threaten the habitat 3150: Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation and 3140: Hard oligo-mesotrophic waters with benthic vegetation of *Charetea* spp.

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:

This species is closely related to *Elodea canadensis* (also an invasive species) and can interbreed with it (Kluczniok 1990 – I). However, hybridization or introgression with native plants is not possible. No information about a possibility of interbreeding of the species with related waterthyme *Hydrilla verticillata* s available.

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

	very low
X	low
	medium
	high
	very high

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

acomm16.	Comments: *Lagarosiphon major* is a host of one nematode species – *Aphelenchoides fragariae* (CABI 2017– B), which in turn can affect strawberry plantations, however, there is no data on whether this nematode can also affect wild species of the genus *Fragaria* sp.

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: Assuming that the species is spread throughout Poland, it should be supposed that: according to the data published on the CABI website (2017 – B) *L. major* can change a chemical composition of water, resulting in conditions of high pH and low carbon dioxide level (James et al. 1999 – P). Thanks to photosynthesis *L. major* may cause an increase in pH of the environment to a level of above 10 (even up to 10,4) in small water reservoirs (Centre for Ecology and Hydrology 2004 – B). Such high pH levels inhibit effective photosynthesis of other native species, giving a competitive advantage to *L. major.* Dense vegetation mats characteristic of this species, when the species occurs beyond its natural range, cause a reduction in oxygen level by limiting the circulation of water and increased decomposition of dead plants. Dense mats of L. major also have the ability to change hydrology and water quality, negatively affecting the ecosystem in which it occurs.

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 **X**	high	level of confidence

acomm18.	Comments: The basic effect of *Lagarosiphon major* on biotic properties is achieved through interspecific competition (primarily for light but also by changing physicochemical conditions of water which often impedes the functioning of native species). Moreover, extensive development of *L. major* also affects the fauna of water reservoirs. Conducted studies demonstrate that it is less palatable for herbivorous fish in comparison to native species of macrophytes (Edwards 1974 – P). The negative impact of the described species may also result from its extensive development. Overgrowth of reservoirs is an unfavourable phenomenon for salmonid fish, which prefer reservoirs not overgrown with subaquatic vegetation (Caffrey and Acavedo 2007 – P). *Lagarosiphon major* can also cause significant changes in the invertebrate fauna of water reservoirs (Kelly and Hawes 2005; Caffrey and Acavedo 2007 – P). However, at the same time, other studies demonstrate that aquatic invertebrates do not reveal any preferences between native macrophytes and *L.major* (Biggs and Malthus 1982 – P).

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:

There are no such effects. The species is a non-parasitic plant.

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

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm20. Comments:

There are no such effects.

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

	inapplicable
X	no / very low
	low
	medium
	high
	very high

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

acomm21. Comments:

There are no such effects.

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

x	very low
	low
	medium
	high
	very high

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

acomm22.	Comments: Most likely, *Lagarosiphon major* does not affect the cultivation system's integrity.

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

	very low
X	low
	medium
	high
	very high

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

acomm23.	Comments: *Lagarosiphon major* is a host of *Aphelenchoides fragariae* strawberry crimp nematode (CABI 2017 – B). Strawberry crimp nematode is a species of nematode from the *Aphelenchoididae* family. Number of generations during the year: 10-15 (McCuiston et al. 2007; Cobon et al. 2011 – P). It occurs on strawberry plantations. The signs are visible on fruits, which are deformed, with twisted peduncles, dwarfish. However, this nematode is not mentioned on any of the EPPO lists.

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: There are no such effects. 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
X	medium
	high
	very high

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

acomm25.	Comments:

The plant, developing in rearing ponds may negatively affect the development of fish (e.g. salmonids or carps). Conducted studies (Edwards 1974 – P) demonstrate that it is less palatable for herbivorous fish in comparison to native species of macrophytes. The described species may negatively affect salmonid fish, which prefer reservoirs not overgrown with subaquatic vegetation (Caffrey and Acavedo 2007 – P).

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:

There are no such effects. Plants are not hosts or vectors of pathogens/parasites of 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:

X	inapplicable
	very low
	low
	medium
	high
	vert high

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

acomm27.	Comments:

There is no such effect. The species is not a parasite.

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

X	very low
	low
	medium
	high
	very high

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

acomm28.	Comments:

No effect of the species on human health upon direct contact was observed.

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:

here is no such effect. Plants are not hosts or vectors of pathogens/parasites of humans.

A4e | Impact on other domains

Questions from this module qualify the consequences of *the species* on targets not considered in modules A4a-d.

a30. The effect of *the species* on causing damage to **infrastructure** is:

	very low
	low
X	medium
	high
	very high

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

acomm30. Comments:

Lagarosiphon major in the conditions of short circuit may hinder or even block water intake in hydroelectric systems and limit the flow of water in drainage sewers, which may lead to high water level resulting in flood. For example, in Great Britain, this species has a negative effect on the operation of power plants, as it limits the possibility of using water from reservoirs for cooling (CABI 2017 – B). Moreover, as a result of the invasion, a limitation to swimming and fishing in reservoirs overgrown with *L. major* is probable. As a consequence of such effect, a decrease in the material value and tourism-related attractiveness of the grounds situated in the areas covered by the invasion may occur.

A5a | Impact on ecosystem services

Questions from this module qualify the consequences of *the organism* on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of *the species*.

a31. The effect of *the species* on **provisioning services** is:

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

Lagarosiphon major may have a small negative impact on vegetable crops and aquacultures, In the case of aquaculture, it may result from its effect on the abiotic environment – it can change a chemical composition of water, resulting in conditions of high pH and low carbon dioxide level (James et al. 1999 – P); it can have a negative effect on breeding of fish, which are reluctant to consume *L. major*. For salmonid species *L. major* is also a threat, as it causes extensive overgrowing of reservoirs. With regard to vegetable crops, it may affect them by a parasitic nematode *Aphelenchoides fragariae* strawberry crimp nematode (McCuiston et al. 2007; Cobon et al. 2011 – P).

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

The presence of *Lagarosiphon major* may have an effect (both negative and positive) on self-purification of water. It may result from its effect on the abiotic environment – it can change a chemical composition of water, resulting in conditions of high pH and low carbon dioxide level (James et al. 1999 – P); thanks to photosynthesis *L. major* may cause an increase in pH of the environment to a level of above 10 (even up to 10,4) in small water reservoirs (CABI, 2017 – B), which inhibits effective photosynthesis of native species. *L. major* plants accumulate arsenic compounds.. In strongly disturbed ecosystems, in which the only species that can survive are alien species, *L. major* may provide an environment for aquatic fauna (McGregor and Gourlay 2002 – P). Moreover, *L. major* was intentionally planted as "oxygen generator" (CABI 2017 – B).

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:

Lagarosiphon major is very popular among aquarists, due to its attractive appearance and small needs related to its care. On the other hand *L. major* may form dense concentrations, which hinder tourism-related and recreational use of water bodies (fishing, swimming, canoeing) (CABI 2017 – B).

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	high **X**	level of confidence

acomm34. Comments:

An increase in the temperature of water may favour the cultivation of the species. Considering the fact that the limit of water temperature for *L. major* is -1°C (at this temperature it dies), an increase in the temperature by 1-2 grades can cause that more reservoirs will not freeze in winter.

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:

An increase in the temperature of water reservoirs will favour the development of the species. However, a factor which limits its occurrence is the water temperature below 10°C. Assumed changes from 1-2°C will not cause a significant improvement of the conditions for the development of this plant in Poland. Currently, it occurs extensively in Great Britain and in the south of Europe. The region which is threatened by its expansion, as a result of climate change, can be e.g. the Netherlands (Matthews et al. 2012 – P).

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
X	increase moderately
	increase significantly

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

acomm36. Comments:

An increase in the temperature of water reservoirs will favour the development of the species. However, a temperature which limits its occurrence is its drop in winter period below 10°C. Assumed changes from 1-2°C will not cause a significant improvement of the conditions for the development of this plant in Poland. Currently, it occurs extensively in Great Britain and in the south of Europe. The region which is threatened by its expansion, as a result of climate change, can be e.g. the Netherlands (Matthews et al. 2012 – P).

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:

An increase in the temperature of water reservoirs will favour the development of the species. However, a temperature which limits its occurrence is its drop in winter period below 10°C. Assumed changes from 1-2°C will not cause a significant improvement of the conditions for the development of this plant in Poland. Therefore, it can be assumed that the probability of the effect of the species on the natural environment will increase.

a38. IMPACT ON THE CULTIVATED PLANTS DOMAIN – Due to climate change, the consequences of *the species* on cultivated plants and plant domain in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm38. Comments:

An increase in the temperature of water reservoirs will favour the development of the species. However, a temperature which limits its occurrence is its drop in winter period below 10°C. Assumed changes from 1-2°C will not cause a significant improvement of the conditions for the development of this plant in Poland, and therefore the effect of the species on cultivated plants or plant production in Poland will not change.

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
X	not change
	increase moderately
	increase significantly

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

acomm39. Comments:

The species does not affect domesticated and farm animals, it can affect fish breeding. The plant, developing in rearing ponds may negatively affect the development of fish (e.g. salmonids or carps). An increase in the temperature of water reservoirs will favour the development of the species. However, a factor which limits its occurrence is the water temperature below 10°C (however, it can survive at 0-10°C, while it limits its growth). Assumed changes from 1-2°C will not cause a significant improvement of the conditions for the development of this plant in Poland, and therefore a change in the the effect of the species on animals and animal production.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm40. Comments:

The species does not affect humans directly. Climate change, which may contribute to its appearance in the environment or even spread, will have no consequences related to a possible effect on 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
X	increase moderately
	increase significantly

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

acomm41. Comments:

Lagarosiphon major in the conditions of short circuit may hinder or even block water intake in hydroelectric systems and limit the flow of water in drainage sewers, which may lead to high water level resulting in flood. Moreover, as a result of the invasion, a limitation to swimming and fishing in reservoirs overgrown with *L. major* is probable. As a consequence of such effect, a decrease in the material value and tourism-related attractiveness of the grounds situated in the areas covered by the invasion may occur. An increase in the temperature of water reservoirs will favour the development of the species. However, a temperature which limits its occurrence is its drop in winter period below 10°C. Assumed changes from 1-2°C will not cause a significant improvement of the conditions for the development of this plant in Poland. On this basis, it can be assumed that the effect of this species on other domains in Poland will increase moderately.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.33	0.83
Establishment (questions: a09-a10)	0.50	0.75
Spread (questions: a11-a12)	0.50	0.50
Environmental impact (questions: a13-a18)	0.65	0.70
Cultivated plants impact (questions: a19-a23)	0.05	0.90
Domesticated animals impact (questions: a24-a26)	0.50	0.50
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.50	1.00
Invasion (questions: a06-a12)	0.44	0.69
Impact (questions: a13-a30)	0.65	0.82
Overall risk score	0.29	
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:

According to the present assessment, oxygen weed was considered a "moderately invasive alien species", usually obtaining low values of the assessment in the majority of the discussed modules of negative effect, except human impact (a27-a29), the module, in which it obtained zero – with no evidence of such effect. The species obtained the highest values of the assessment in the module "Environmental impact" (0.65; questions a13-a18) and this assessment had the largest effect on the assessment of "Negative effect" (a13-a30). Because of the fact that this species is not yet established in Poland and has little ability to spread in our climate (its establishment and spread are limited by low water temperatures in winter), the result obtained in the present assessment in the modules related to the invasion process (questions: a06-a12) is low and equals 0.44.

Because of the fact that this species is not yet established in Poland, there is no recommendation for its control, while it is recommended to conduct observations of its potential occurrence sites (primarily non-freezing thermally disturbed water reservoirs – e.g. reservoirs in the proximity of mines with heated water), remembering that first stages of the invasion are often difficult to perceive. Over time, the assessment of the invasiveness of the species may change.

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