



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. Agnieszka Kompała-Bąba
2. Gabriela Woźniak
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acomment01.	Comments:		
	degree	affiliation	assessment date
	(1) dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	15-01-2018
	(2) dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	25-01-2018
	(3) prof. dr hab.	Department of Plant Taxonomy, Institute of Environmental Biology, Faculty of Biology, Adam Mickiewicz University in Poznań	30-01-2018

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

Polish name: Alternatera krokodylowa

Latin name: ***Alternanthera philoxeroides*** (Mart.) Griseb.

English name: Alligator weed

acommm02.

Comments:

The Plant List (2013) – B provides the standing name. The Polish name has been adopted from the database Gatunki obce w Polsce [*Alien species in Poland*] (2009 – B). According to various sources, synonyms of the Latin name are the following: *Achyranthes philoxeroides* (Mart.) Standl.; *Achyranthes paludosa* Bunbury; *Alternanthera philoxerina* Suess.; *Bucholzia philoxeroides* Mart.; *Telanthera philoxeroides* (Mart.) Moq., *Mogiphanes philoxeroides* D. Parodi, *Celosia amphibia* Salzm. ex Moq.

More common synonyms of the English name are: alligator weed, pig weed, alligator grass (EPPO 2015; OEPP/EPPO 2016 – P; CABI 2017 – B; Thayer and Pflingsten 2018 – B); synonym of Polish name was taken from Botanical Dictionary (Szweykowska and kowski 2003)

Note: *Alternanthera philoxeroides* can be confused with other aquatic plants reported in Europe, particularly it is closely related to the following species: *Alternanthera caracasana* Kunth., *Alternanthera nodiflora* R.Br. and *Alternanthera sessilis* (L.) R.Br. ex DC. (OEPP/EPPO 2016 – P).

Polish name (synonym I)

krąglatka krokodylowa

Polish name (synonym II)

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Latin name (synonym I)

*Achyranthes philoxeroides*

Latin name (synonym II)

*Achyranthes paludosa*

English name (synonym I)

Pig weed

English name (synonym II)

Alligatorweed

a03. Area under assessment:

Poland

acommm03.

Comments:

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

- native to Poland
- alien, absent from Poland
- alien, present in Poland only in cultivation or captivity
- 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

acommm04.

Comments:

This species has not been registered in the Alien Species Database in Poland (Gatunki obce w Polsce [*Alien Species in Poland*] 2009 – B). It is also not included in European Network of Invasive Alien Species Database (NOBANIS 2013 – B). According to EPPO risk assessment analysis, this species is not recorded in Poland, and the closest locations are mainly in the Mediterranean area in France and Italy (EPPO 2015; OEPP/EPPO 2016 – P; CABI 2017 – B). This species is not cultivated in Poland. Other species of *Alternanthera* genus are recommended for aquaria and paludariums. However, the Internet users say this plant is not easy to grow ?

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

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

acomm05.

Comments:

Assuming the scenario that the species appears and spreads in the area if Poland as well as knowing the species biology and ecology, if it occurred and spread in Poland, it would affect the natural environment, humans, and other ecosystems, e.g. ponds (EPPO 2015 – P, CABI 2017 – B, Shi and Fu 2017 – P). Due to the intensive vegetative propagation, the species (its aquatic form) can occupy any water body and modify its abiotic conditions (light penetration, gaseous exchange, decomposition of organic matter) and compete with native species and to have impact on fish farming. The species (terrestrial form) develops the massive root system and thus it can effectively compete with terrestrial species. Intensive growth can limit the access to water and cause health problems because the species forms suitable conditions for mosquitoes. After some time, we can observe the impact of the species on cultivated plants (OEPP/EPPO 2016 – P). Also, irrigation channels and ditches are clogged (van Oosterhout 2007 – P), which simultaneously reduces the functionality of such objects and due to their overgrowing they affect the attractiveness of such water bodies (OEPP/EPPO 2016 – P; CABI 2017 – B).

## A1 | Introduction

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

**a06.** The probability for *the species* to expand into Poland’s natural environments, **as a result of self-propelled expansion** after its earlier introduction outside of the Polish territory is:

<input checked="" type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input type="checkbox"/>	High

aconf02.

Answer provided with a

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

level of confidence

acomm06.

Comments:

According to the risk assessment analysis for *Alternanthera philoxeroides* (EPPO 2015 – P), there is some risk for the species occurrence in Poland. It may spread to other Mediterranean countries, apart from countries mentioned above (a04) such as: Portugal, Spain, Greece, Turkey, Morocco, Algeria, Tunisia, Monaco, Israel and countries of Central Europe that have thermal water bodies (the Czech Republic, Slovakia, Hungary, Denmark, and Poland) (EPPO 2015 – P). So far, this species has been observed only in Southern Europe - in France and Italy (Garbari and Pedulla 2001; OEPP/EPPO 2016 – P). It does not form dense populations in the south-eastern part of France, and is not considered as invasive. A new plant location was found in the south of France, at a tributary of the River Rhone. The species is regarded as invasive in the French region of the Mediterranean area due to quickly growing population (OEPP/EPPO 2016 – P). The analysed species has not been noticed in Poland neighbourhood countries, so the probability of its self-expansion is low. Furthermore, it is mainly vegetatively propagated in the introduced range (CABI 2017 – B).

**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 <b>X</b>	high	level of confidence
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acommm07. Comments:  
 This species is assumed to migrate beyond South America on the ballast tanks of ships or with the transported products (Westphal et al. 2008; OEPP/EPPO 2016 – P). This species has optimal conditions for growth at 30<sup>0</sup>C, however it tolerates lower temperatures 10-20<sup>0</sup>C, pH 4.8-7.7, as well as relatively high salinity and pollution (EPPO 2015 – P). There is some risk that this species can be introduced into area of Poland by mistaking it with other species *A. sessilis* (species is imported intentionally as a plant used in paludarium and wet orangeries) or due to contaminated material used as mulching material (Coventry et al. 2002; Brunnel 2009 – P). The possible identified routes of its introduction due the unintentional human activities are bird feed with seeds contaminated with that species, which was imported from non-European countries and *A. philoxeroides* seedlings transported with bonsai plants (OEPP/EPPO 2016 – P). This species could be also introduced into the natural environment as a result of disposing material form aquaria or accidental transporting it with other plants (EPPO 2015 – P). However, this probability for Poland can be considered as low because such cases are incidental in Europe.

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

<b>X</b>	Low
	Medium
	High

aconf04.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acommm08. Comments:  
 The species is unlikely to be introduced into the environment in Poland as a result of intentional human activities. There has been no such information in the literature and databases. This species is not kept in botanical gardens and aboreta in Poland (Botanical Garden employees ...2018). Moreover, in 2017 this species was included on the list of invasive species and adopted by the European Commission after the positive opinion of the Committee on invasive alien species (Rozporządzenie Wykonawcze Komisji UE 2017/1263 of 12 July 2017 – P). There are specific prohibitions for the species included on the list of invasive alien species considered as hazardous for EU. Thus, there are prohibitions of introducing the species into EU, and transiting them under customs supervision; keeping the species, including contained holding; cultivating the species, including contained holding; transporting to EU, removing from EU or transporting within EU, except for transporting the species to facilities for their elimination; placing the species on the market; using or exchanging them; breeding, farming or cultivating the species, including contained holding; releasing the species into the environment. It is also mentioned in books on ornamental plants (Cheers 1999 – P) or plants recommended for aquaria (Tervers 1995 – P) along with the information about its invasive nature. The risk assessment analysis on possible establishment of the species in the Mediterranean countries indicates that it is not common to import the species as the aquarium plants or as any other type (EPPO 2015 – P). An increasing ecological awareness of negative impact of the species on different ecosystem services causes that the plant is more effectively recognized and differentiated from *Alternanthera denticulata* used as a vegetable, or other related taxa. Thus, it is not intentionally cultivated or introduced into the environment (OEPP/EPPO 2016 – 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:

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

aconf05.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm09.	Comments:
	<p>According to the climatic similarity map for Poland, attached to the instruction for procedure of negative impact risk assessment Harmonia<sup>PL</sup>, the native extent of <i>Alternanthera philoxeroides</i> is within the range of 0-45%, like in case of introduced range. So far, this species has been observed only in France and Italy, in the Mediterranean region (Garbari and Pedulla 2001; OEPP/EPPO 2016 – P).</p> <p>The species originates from South America and prefers tropic rainforest climate (&gt;60mm precipitation per month), tropical monsoon climate (&lt; 60mm precipitation in dry season, and &gt; 100 in other months) and tropical savannah climate with dry summer or dry winter (temp. in warm months &gt;10°C and in cold months &gt;0°C) (CABI 2017 – B). The species can tolerate cool winter, but does not tolerate sustained freezing temperatures (Geng et al. 2006, 2007; Langeland et al. 2008; Chen et al. 2013 - P). The values of climatic similarity between Poland and the region of current occurrence of this species should be interpreted as unfavourable for the species. Changes in daily temperatures and low temperatures &lt;-3°C can be an important barrier against the species establishment in Poland.</p>

a10. Poland provides **habitat** that is

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

aconf06.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm10.	Comments:
	<p><i>Alternanthera philoxeroides</i> grows in wetland and terrestrial habitats, often in the transition zone between those two types of habitats. In terrestrial habitats, it develops a massive underground root system (up to 2 m) to survive in longer dry seasons (Government of South Australia 2011 – I; EPPO 2015 – P). The species occurs in a wide spectrum of habitats, such as surface water (ditches, rivers, lakes and dams), wetlands, forests, agricultural lands or ruderal habitats (Julien et al. 1992 – P; ISSG 2016 – B; OEPP/EPPO 2016 – P; USDA-NRCS 2016 – B). According to Julien et al. (1995 – P), much of Africa, Asia and southern Europe provide a suitable habitat for this species and are favourable for its establishment. After overcoming the climatic barrier in Poland, the species could find a convenient site in geothermal water bodies (e.g. in Podhale) or post-industrial reservoirs used for e.g. cooling water from power plants. Such reservoirs can be found e.g. in Silesian Province (an artificial lagoon in Rybnik, where water temperatures are not lower than 15°C), in Wielkopolskie Province (Konińskie Lake), or in Szczecin Province (Lower Odra River heated with water from Dolna Odra power plant, from where alien species of plants and animals can invade natural habitats (Najberek and Solarz 2008 – I).</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 checked="" type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf07.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
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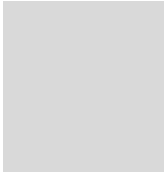
acomment11. Comments:  
Assessment (C-type data)  
On the basis of current data, the species ability to spread in Poland without human impact is assessed as a medium. There are no detailed data to assess the species ability to spread: dispersion from a single point (A-type data) or expansion of the population (B-type data). Data on evaluating biological mobility of that species (C-type data) show that it is a perennial, clonal and fast-growing plants. The analysed species propagates primarily through vegetative means in its introduced range, from axillary buds at nodes of shoots and roots (EPPO 2015; OEPP/EPPO 2016 – P; CABI 2017 – B). In 2013, in the location reported in France (cf. question a06) the population grew from 10 m<sup>2</sup> to more than 1500-2000 m<sup>2</sup> during one year (OEPP/EPPO 2016 – P). Parts of plants can be dispersed over larger distance by water currents and animals (CABI 2017 – B). In Poland, restricted access to habitats - water bodies with higher thermal conditions can be a limiting factor. It can be assumed that the species will suffer from freeze on terrestrial habitats. Data on ecological requirements show that the development of the species is inhibited at 7°C (CABI 2017 - B). The species will not survive during prolonged periods of frost (Langeland et al. 2008 - P).

**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 <b>X</b>	level of confidence
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acomment12. Comments:  
The species spreads mainly due to its intentional introduction as an water or aquarium plant in many parts of the world, and as a plant introduced by unintentional humans actions: in the ballast of ships, as a contaminant in transported materials (a mix of seeds for birds, imported ornament plants) (CABI 2017 – B). However, it does not belong to species preferred by aquarists in Poland. They rather prefer other species or varieties, such as *Alternanthera sessilis* var. *rubra*. The studies on lakes with heated water show that they can be the centre of invasion for many alien species of plants and animals which had been introduced by humans, and then they escaped from breeding or were intentionally released to the environment (Najberek and Solarz 2008 – I). This species can adapt to various habitat conditions and can propagate vegetatively even from very small fragments (CABI 2017 – B). It is also likely to spread in lakes or rivers, places of doing water sports, or recreational or fishery areas. Parts of plants are transported by water equipment or anglers (Rothlisberger et al. 2008 – I; EPPO 2015; CABI 2017 – B).



There are no wild stands of *A. philoxeroides* population in Central Europe (including Poland), from where the species can disperse to new areas due to human impact. However, due to many reported possibilities of its dispersal by human actions in combination with biological nature of the species, we can assess the frequency of dispersal as medium (assuming occurrence of the species in Poland).

**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:  
This species is not a parasitic plant. It also does not affect native species through predation, parasitism or herbivory (OEPP/EPPO 2016 – P).

**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	level of confidence
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acomm14. Comments:  
The available data on the species ecology, the native and introduced range demonstrate that the species can successfully compete with other plants in aquatic and terrestrial habitats (CABI 2017 – B). *Alternanthera philoxeroides* grows vigorously covering the surface and limiting, inter alia, gaseous exchange of co-occurring plants (Pan et al. 2006 - P). This species can produce a large biomass of leaves and consequently, effectively compete with other species for resources which leads to decline of biodiversity (Bassett et al. 2012b –P). In the literature, there are described cases of negative feedback between biomass of dominant species and reduced diversity of species (Richardson et al. 2012; Wu et al. 2016 - P). Taking into account the likelihood of species spread in Poland, in potentially favourable habitats (artificial reservoirs with heated water), the species could limit the native species which do not belong to the species of "special concern". The problem could arise in the far future providing that *A. philoxeroides* starts occupying "cooler" habitats.

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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a15. Comments:  
Nowadays, in Poland there are no locations of *Alternanthera philoxeroides* population or wild populations. So, they cannot interbreed with that species in natural conditions.

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

<input type="checkbox"/>	very low
<input checked="" type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf12.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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a16. Comments:  
There are no data on the impact of this species on native species by hosting pathogens or parasites that are harmful to them. This species can be a host for some pathogens (fungi, nematodes, viruses, snails) (Najberek 2018– N). The list of the most hazardous pests according to the European and Mediterranean Plant Protection Organization (EPPO) includes the above mentioned *Pseudomonas syringae* pv. *actinidiae* (Najberek 2018– N; EPPO 2017 – P). The species was not placed on OIE list (OIE 2012).

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

<input type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input checked="" type="checkbox"/>	High

aconf13.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
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a17. Comments:  
And, there are no data on the species impact on the ecosystem integrity by affecting its abiotic properties. The published data indicate that the species introduced to aquatic habitats can disturb the chemical composition of the water body and negatively impact the cycle of nitrogen in the water body (Bassett et al. 2010; Zuo et al. 2012 - P). The species forms dense mats that reduce oxygen content in water (EPPO 2015 – P). Its intensive growth in water bodies may impede light penetration with adverse effects on the growth of native species in it (Bassett et al. 2011a; Chatterjee and Dewanji 2014 – P). Plants of the species decay much faster compared to other species, affecting the modification of processes occurring in the ecosystem, which facilitates the entry of other invasive species or creates the appropriate conditions for the expansion of *A. philoxeroides* (Basset et al. 2011a - P). The species also has the effect of reducing the amount of dissolved oxygen (Quimby and Kay 1976 - P).



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

<input type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input checked="" type="checkbox"/>	High

aconf14.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
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acommm18. Comments:  
 In Poland, there are no data on the species impact on the ecosystem integrity by affecting its biotic properties. In the initial stage of establishment, the species will mainly inhabit thermal reservoirs and watercourses to which heated water from the power plant is discharged. However, there are not too many in Poland Information on the species impact on the ecosystem integrity by affecting its biotic properties within the introduced range shows that the species can significantly reduce the native species of plants and animals, and in extreme cases, can eliminate them completely (Guo and Wang 2009; Telesnicki et al. 2011; Bassett et al. 2011b, 2012a,b; Zho et al. 2012 – P; CABI 2017 – B).

### 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:

<input type="checkbox"/>	Inapplicable
<input checked="" type="checkbox"/>	very low
<input type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf15.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acommm19. Comments:  
*Alternanthera philoxeroides* is not a parasite.

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

<input type="checkbox"/>	Inapplicable
<input type="checkbox"/>	very low
<input checked="" type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf16.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
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acommm20. Comments:  
 In Poland, there are no data on the species impact on cultivated plants through competition. According to data related to the introduced range (the USA, North Carolina, and Australia - North South Wales), the species can considerably reduce crops of rice,

wheat, rye or lettuce (OEPP/EPPO 2016 – P). The species was also reported to compete effectively with vegetable crops (e.g. carrot) (OEPP/EPPO 2016 – P). In a scenario where the species establishes in Poland, it could create a hazard to root plants, some vegetables or crops.

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

<input type="checkbox"/>	Inapplicable
<input checked="" type="checkbox"/>	no / very low
<input type="checkbox"/>	Low
<input type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf17.	Answer provided with a	low	medium	high	level of confidence
				<input checked="" type="checkbox"/>	

a21. Comments:  
In a scenario where the species spreads in Poland, it cannot interbreed with related species including cultivated plants, because other species from *Alternanthera* genus do not occur in Poland.

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

<input type="checkbox"/>	very low
<input type="checkbox"/>	Low
<input checked="" type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf18.	Answer provided with a	low	medium	high	level of confidence
			<input checked="" type="checkbox"/>		

a22. Comments:  
*Alternanthera philoxeroides* does not occur in Poland and cannot affect the integrity of cultivation system. It is known to significantly reduce yields for crops (rice, wheat, sweet potatoes, lettuce, or rye) within the introduced range (the USA - North Carolina, Sri Lanka) (Shen et al. 2005; van Oosterhout 2007; OEPP/EPPO 2016 – P). In a scenario where the species spreads in Poland, by analogy they should affect plant crops through a drop in yields.

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

<input type="checkbox"/>	very low
<input type="checkbox"/>	Low
<input checked="" type="checkbox"/>	Medium
<input type="checkbox"/>	High
<input type="checkbox"/>	very high

aconf19.	Answer provided with a	low	medium	high	level of confidence
			<input checked="" type="checkbox"/>		

a23. Comments:  
*Alternanthera philoxeroides* does not currently occur in Poland, and the nearest reported locations are in France and Italy. The available data indicate that, for the considered scenario, this species is likely to occur in Poland and can be a host to *Pseudomonas syringae* pv. *actinidae* (EPPO 2009 – I; Najberek 2018 – N). This species may threaten plantations of the *Actinidia* genus causing a bacterial cancer disease that causes spalls of the gummy

substance from underneath the bark This species has been included on the list of pests (EPPO A2) recommended for regulations (EPPO 2017 – P).

### 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:  
*Alternanthera philoxeroides* is a plant and it cannot affect individual animal health or animal production, through predation or parasitism.

**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 <b>X</b>	high
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 level of confidence

acomm25. Comments:  
In Poland, this species does not currently affect individual animal health or animal production, by having properties that are hazardous upon contact. In a scenario where the species appears in Poland, animals can face an increased risk for skin lesions or liver diseases after consuming the plant (Schooler 2012 – P). There are also cases of cattle death after consuming the species. However, there were probably other factors contributing to death of animals (Van Oosterhout 2007; Schooler 2012 – P).  
The intensive development of the species may also have a negative impact on the fish farming, as decaying shoots may deteriorate the water quality causing fish mortality (Zhang et al. 1993 - P; CABI 2017 - B). The species can absorb heavy metals and be a problem in countries where it is used as food (CABI 2017 - B). It has also been detected that the species may create suitable habitats for the development of snails and mosquitoes, which may have a negative impact on cattle breeding as well as food production (Global Invasive Species Database 2018 - B).

**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:  
The species does not participate in any way, as an indirect host, in the developmental cycles of pathogens and animal parasites

### 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

acomm27. Comments:  
This 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

acomm28. Comments:  
In a scenario where the species spreads in Poland, it does not affect human health, by having properties that are hazardous upon direct contact. The literature data mainly refer to animals (OEPP/EPP0 2016; van Oosterhout 2007 – P).

**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

acomm29. Comments:  
The plants are neither hosts nor vectors for pathogens/parasites to human targets.

## A4e | Impact on other domains

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

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

- very low
- Low
- Medium
- High
- very high

aconf26. Answer provided with a 

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

acomm30. Comments:  
Nowadays, there are no reported cases of the species occurrence in water bodies or other water courses in Poland. In a scenario where the species established in Poland (mainly thermal water bodies, sometimes post-industrial water-bodies), it can form dense mats impeding water flow and affecting the operation of hydrological equipment by increasing sedimentation, flood risk, and damaging the structure (van Oosterhout 2007 – P; CABI 2017– B).  
This assessment is based on information available for the introduced range of the analysed species (Shi and Fu 2017 – P).

## A5a | Impact on ecosystem services

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

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

- significantly negative
- moderately negative
- Neutral
- moderately positive
- significantly positive

aconf27. Answer provided with a 

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

acomm31. Comments:  
The available information on biology and habitat conditions of the species indicate that it can affect provisioning services (supply of food, materials and energy) (CABI 2017 – B). Its intensive growth can have an adverse effect on fish production because decomposed shoots can deteriorate water quality and fish death (Zhang et al. 1993 – P; CABI 2017 – B). This species can absorb heavy metals and it can create a problem in

countries where this plant is used as food (CABI 2017 – B). This species can also form favourable habitats for snails and mosquitoes which can have impacts on livestock and food production (Global Invasive Species Database 2018 – B). In some countries (China), it is used for animal breeding and fish feeding (Li et al. 2013 - P). The latter is important because food is anti-bacterial, anti-viral and protects fish against diseases (Wang and Zhao 2010 – P). The species was also found to have a positive impact on increased amount of produced milk and cattle mass (Wang and Chen 1986 – P). In a scenario where the species spreads in Poland, its impact on provisioning services should be assessed as neutral.

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

- significantly negative
- moderately negative
- Neutral
- moderately positive
- significantly positive

aconf28. Answer provided with a 

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

acomm32. Comments:  
 The method of growing and dense population can impair the operation of hydraulic equipment. However, due to this biological aspect the species growth can result in an increased flood risk. This assessment is based on information available for the introduced range of the analysed species (Shi and Fu 2017 – P).  
 These plants decompose much faster than other species, and modify processes in the ecosystem, which facilitate introduction of other invasive species and form the favourable conditions for expansion of *A. philoxeroides* (Basset et al. 2011b - P). Moreover, the species decreases dissolved oxygen (Quimby and Kay 1976 – P).

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

- significantly negative
- moderately negative
- Neutral
- moderately positive
- significantly positive

aconf29. Answer provided with a 

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

acomm33. Comments:  
 According to available data on biology of the species, it tends to grow intensively and become the dominant species when introduced into the habitat (water body). In a scenario where the species is introduced in Poland due to climatic changes, it will dominate aquatic and waterside habitats. It will have negative impact on animals. Consequently, their biological diversity will be reduced and aesthetic values of aquatic and waterside ecosystems will degrade (CABI 2017 – B; EPPO 2015; OEPP/EPPO 2016 – P). There is some risk that the species introduced in Poland can form habitats favourable for the growth of some organisms, such as mosquitoes, that reduced aesthetic values of such objects (Schooler 2012 – P).

## 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
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 level of confidence

acommm34. Comments:  
The presented assessment is based on the assumption that warm water bodies are favourable conditions for the species establishment and expansion. Global warming can also cause warming of natural and artificial water bodies (Lu et al. 2013; EPPO 2015 – P). The species tolerance for unfavourable conditions, such as drought, lower air temperature etc. increases the threat. Thermal and anthropogenic water bodies used for cooling, as well as watercourses into which heated waters are discharged can be particularly exposed to hazard. Although there are very few of them in Poland.

**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 <b>X</b>	high
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 level of confidence

acommm35. Comments:  
Assuming the species occurrence in Poland due to global warming, it is likely to establish, that is, increase its population in already occupied locations. According to EPPO report (2015 – P), the species is likely to occur and establish in Poland. However, its local occurrence will refer to sites with thermal or anthropogenic reservoirs used for cooling water from power plants. Despite the information that it very adaptable to various conditions, large temperature fluctuations will prevent its permanent establishment (Shi and Fu 2017 and literature cited therein – 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
- increase moderately
- increase significantly

aconf32. Answer provided with a 

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

acomm36.

Comments:

It is difficult to assess the likelihood of *Alternanthera philoxeroides* overcoming barriers due to climatic changes that prevented its spread in Poland. However, the species is likely to spread spontaneously through vegetative reproduction and through unintentional humans actions (water bodies used for recreational purposes or as fishery areas). Artificial reservoirs with heated water can be a centre of the species further introduction into habitats with lower temperature. However, large temperature fluctuation can prevent the spread of *A. philoxeroides* in Poland (Zhao et al. 2015 - 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
- increase moderately
- increase significantly

aconf33.

Answer provided with a

low	medium	high
	<b>X</b>	

level of confidence

acomm37.

Comments:

It is difficult to assess the likelihood of *Alternanthera philoxeroides* impact on wild plants and animals, habitats and ecosystems in Poland. Data on introduced range show that this effect is considerable (Weber et al. 2012; Sorte et al. 2013; Zhang et al. 2015 - P). In a scenario where the species establishes in Poland, it is likely to occupy thermal body waters and some artificial reservoirs for industrial purposes. After some time, the species could affect the native species of plants animals and both aquatic and waterside ecosystems, and consequently spread to other cooler habitats.

**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	high
	<b>X</b>	

level of confidence

acomm38.

Comments:

It is difficult to assess the likelihood of *Alternanthera philoxeroides* impact on cultivated plants or plant production in Poland. In a scenario where the species establishes and spreads in Poland, it could affect cultivated plants (rye, wheat, maize). The species was also reported to compete effectively with forage crops of *Trifolium* genus (OEPP/EPPO 2016 – P).

**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	high
	<b>X</b>	

level of confidence



acomm39.

Comments:

It is difficult to assess the likelihood of *Alternanthera philoxeroides* impact on farm and domestic animals and animal production in Poland. However, there is some risk that farm or domestic animals could suffer from some skin lesions, liver diseases or light sensitivity after eating this species. The mass development of the species may also cause changes in physical and chemical parameters prevailing in water bodies and adversely affect the fish farming (OEPP/EPP0 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
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level of confidence

acomm40.

Comments:

It is difficult to assess the likelihood of *Alternanthera philoxeroides* impact on human domain in Poland. There is some risk the species can form favourable conditions for massive growth of mosquitoes (CABI 2017 – B). However, such conditions are also created by native water species, so the impact on human domain will not change.

**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
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level of confidence

acomm41.

Comments:

It is difficult to assess the likelihood of *Alternanthera philoxeroides* impact on other domains in Poland. However, the intensive growth of the species can block hydrotechnical equipment, ditches and irrigation channels and increase the flood risk (van Oosterhout 2007 – P; CABI 2017 – B).

## Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.00	0.67
Establishment (questions: a09-a10)	0.25	1.00
Spread (questions: a11-a12)	0.50	0.75
Environmental impact (questions: a13-a18)	0.65	0.70
Cultivated plants impact (questions: a19-a23)	0.25	0.70
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)	0.25	0.81
Impact (questions: a13-a30)	0.65	0.78
Overall risk score	0.16	
Category of invasiveness	medium 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 Poland, there are no reported cases of occurrence of wild *Alternanthera philoxeroides*, or its presence in botanical gardens (Tokarska-Guzik et al. 2012 - P; Botanical Garden employees...2018 - N). In some EU countries, the species is classified as invasive or potentially invasive (a region of France in the Mediterranean Basin, Italy - Florence, Lazio) (OEPP/EPPO 2016 – P). Its spontaneous occurrence has not been observed in the majority of countries even though the favourable climatic and habitat conditions for its establishment are in the Mediterranean Basin (Julien et al. 2015 - P). In other countries (Poland, Slovakia, Hungary), the species could occur in thermal reservoirs having the suitable habitat conditions.

The species has been included on the updated list of invasive alien species of Union concern adopted by the Commission Regulation (EU) 2016/1141 pursuant to Regulation of the European Parliament and of the Council (Commission Implementing Regulation 2017 – P). According to the current state of knowledge on the species spread, its spontaneous distribution or caused by human action as well as climatic conditions do not pose a threat to native flora. The completed risk assessment for Poland specifies alligator weed as "medium invasive alien species". The proper preventive measures (public education, prohibited sale) should be implemented in Poland according to Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 – P to prevent effectively the species migration to Poland, its introduction to water bodies and spread to semi-natural habitats. The total negative impact on the natural environment is within the "large" category. It obtained 0.65 points in the category "Impact on environmental domain" (questions a13-a18). This score is likely to be related to the species capability of competing with native species and adverse impact on the integrity of established ecosystems (moderate effect with reference to disturbed abiotic and biotic factors). Moreover, the species can negatively affect other hydrotechnical equipment "Impact on other domains" (0.50) and deteriorates their aesthetical qualities by forming dense mats.

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