Appendix A

Harmonia^{+PL} – procedure for negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland

QUESTIONNAIRE

A0 | Context

Questions from this module identify the assessor and the biological, geographical & social context of the assessment.

a01. Name(s) of the assessor(s):

first name and family name

1. Zofia Sotek
2. Agnieszka Kompała-Bąba
3. Barbara Tokarska-Guzik

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr hab.	Department of Botany and Nature Conservation, Faculty of Biology, University of Szczecin	22-01-2018
(2)	dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	14-01-2018
(3)	prof. dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	01-02-2018

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

Polish name: Grubosz Helmsa

Latin name: ***Crassula helmsii*** (Kirk) Cockayne

English name: Australian swamp stonecrop

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:

Nomenclature accepted based on the Plant List (The Plant List 2013 – B).

Synonyms of the Latin name: *Bulliarda recurva* Hook. f., *Crassula helmsii* (Kirk) Berger, *Crassula recurva* (Hook. f.) Ostenf., *Tillaea helmsii* Kirk (The Plant List 2013 – B).

Synonyms of the English name: New Zealand pigmyweed, Australian stonecrop, swamp stonecrop (Minchin 2008 – B), Crassula, helms Crassula, New Zealand stonecrop (Minchin 2008, CABI 2017 – B, Stace 2010 – P). Many unacceptable names are still used in fishkeeping (CABI 2017 – B).

Polish name (synonym I)	Polish name (synonym II)
–	–
Latin name (synonym I)	Latin name (synonym II)
Tillaea helmsii	*Bulliarda recurva*
English name (synonym I)	English name (synonym II)
New Zealand pigmyweed	Australian stonecrop

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:

A species not yet recorded in Poland in the natural environment (Zając A. and Zając M. 2001 – P, Alien species in Poland 2009 – B, Tokarska-Guzik et al. 2012 – P, Popiela and Łysko 2018 – I). It occurs only in cultivation. It is possible to buy it in online stores, in which it is recommended for aquariums and home bodies and ponds. It is kept in small quantities in two botanical gardens (Botanical Garden employees... 2018 – N).

Crassula helmsii is a native species in Oceania: Australia (New South Wales, South Australia, Tasmania, Victoria, Western Australia) and New Zealand. It has also been found in the USA and North-East Asia (Webb et al. 1988 – P, Q-bank 2015 – B). In Europe, its occurrence has been recorded mainly in the western and central part (Tokarska-Guzik et al. 2015 – B).

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

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

acomm05. Comments:

In European countries, the plant colonizes inland wetlands, watercourses and reservoirs, river banks, canals and muddy banks of ponds, all habitats where it is capable of simplifying and replacing important vegetation types (OEPP/EPPO 2007 – I). In Poland, it may pose

a potential threat to several natural habitats where it capable of simplifying and replacing important vegetation types: 3130 – Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*, 3150 – Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation, 3260 – Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, 3270 – Rivers with muddy banks with Chenopodion rubri p.p. and *Bidention* p.p. vegetation (Tokarska-Guzik et al. 2012 – P). There is no data on the impact of *C. helmsii* on crop cultivation. By abundant occurrence it can inhibit the inflow of light and prevent the aeration of water reservoirs, which will have a negative impact on fish farming. Dense mats created by this species can be dangerous to domestic and farm animals and humans, as they can be confused with land surfaces (Sheppard et al. 2006, OEPP/EPPO 2007 – I). Overgrowing of water reservoirs lowers their recreational and aesthetic values, which may result in a decline in income from tourism (Robert et al. 2013 – P). Excessive development of *C. helmsii* limits the flow of water in irrigation channels and flood control systems (Kelly and Maguire 2009, Branquart et al. 2013 – B).

A1 | Introduction

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

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

	low
X	medium
	high

aconf02.	Answer provided with a	low	medium **X**	high	level of confidence

acomm06. Comments:

There is a likelihood of the spontaneous appearance of this species in Poland from neighbouring areas where it already occurs, from the West (Germany) and the South (Slovakia) (Hussner 2012 – P). Due to its pattern of local spread, mainly through vegetative reproduction (OEPP/EPPO 2007 – I), the likelihood of its spontaneous appearance in Poland is medium. *Crassula helmsii* in Western Europe also reproduces sexually however, most of the fruit lacks seeds, and the germination capacity is low (D'hondt et al. 2016 – P).

The species has been recorded so far in several regions of Europe, including England, Austria, Belgium, Denmark, France, Ireland, Germany, Italy, and the Baikal area (in Russia) (Dawson 1994, Stace 1997 – P, Huckle 2005, Afferni and Tavormina 2007, OEPP/EPPO 2007 – I, Minchin 2008, Branquart et al. 2013 – B). It has also been found in Spain (Dana et al. 2002 – I).

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

	low
X	medium
	high

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

acomm07. Comments:

The plant's diasporas can be introduced as a result of unintentional "contamination" with other farmed and sold plants (Environment Agency 2003 – P). The unintentional incorporation of diasporas by floating equipment is possible indicated (Leach and Dawson

	1999 – P), by transference between water bodies by anglers on equipment for fishing, waders, boats and boots (Dawson and Warman 1987, Leach and Dawson 1999, Watson 2001 – I).

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

	low
	medium
X	high

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

acomm08. Comments:

Crassula helmsii is cultivated and sold as an aquarium plant. This does not exclude its introduction into home ponds as an ornamental plant, from where it can enter the natural environment. This may be favoured by the ease with which it undergoes vegetative reproduction – even single fragments of stems with a length of 5 mm can generate new plants (Centre for Aquatic Plant Management 2004, OEPP/EPPO 2007 – I, CABI 2017 – B).

A2 | Establishment

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

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

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

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

acomm09. Comments:

The climatic conditions in Poland seem to be optimal for the establishment of *C. helmsii*. Summer temperatures in the area of the country are within tolerance limits for the species. They are slightly higher than in the United Kingdom, where the species shows expansion, but lower than in its natural range, because the average summer temperature is around 30° C (Huckle 2005 – I). On the other hand, winters in Poland are colder than in Great Britain. There is no data whether this species can survive in extreme conditions, such as the harsh winters that occur in the north-east and east of our country, where the influence of the continental climate is marked. It is known to tolerate temperature drops down to -6 ° C. According to the map of Poland's climatic similarity, which is included in the *Harmonia*$^{+PL}$ risk assessment procedure, almost the entire primary range of *C. helmsii* is within 0-45% and only in small areas does the similarity reach the highest range (90-100%). In the European secondary range, this similarity is varied, with predominantly 45-94% and 94-100% ranges. The climate of Poland is similar to the climate in Germany, where *C. helmsii* has been known for 20 years from North Rhine-Westphalia and continues to spread (Hussner 2007 – P), therefore it can be assumed that climatic conditions for the analyzed species are optimal in Poland.

a10. Poland provides habitat that is

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

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

acomm10. Comments:

Within the natural range, the species occurs in marshy places and grows around stagnant or slow flowing waters, both inland and along the coast (Laundon 1961, Dawson 1989, Sainty and Jacobs 2003 – P). The area of Poland is rich in habitats (e.g. wetlands, water reservoirs and their shores), which *C. helmsii* can potentially colonize. This type of habitat also occurs in Europe, e.g. in the United Kingdom (Leach and Dawson 1999 – P). The species is associated with soft sediments and probably with areas rich in iron (Dawson and Warman 1987 – P). It tolerates habitats with low content of nutrients. It also tolerates shade for prolonged periods Kelly and Maguire 2009 – I), however, intense sunshine (Hussner 2009 – P) affect this plant negatively. Aquatic populations can grow in oligotrophic and acidic conditions, as well as eutrophic and alkaline lakes and streams (GISD 2015 – B).

A3 | Spread

Questions from this module assess the risk of *the species* to overcoming dispersal barriers and (new) environmental barriers within Poland. This would lead to spread, in which vacant patches of suitable habitat become increasingly occupied from (an) already-established population(s) within Poland.

Note that spread is considered to be different from range expansions that stem from new introductions (covered by the Introduction module).

a11. The capacity of the species to disperse within Poland by natural means, **with no human assistance**, is:

	very low
	low
	medium
X	high
	very high

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

acomm11. Comments:

The species has not yet been found in the natural environment in Poland, but if it achieved entry, the rate of its expansion could be similar to that in other European countries (data type B). Based on data from the British Isles, the number of species localities doubles every two years, the most recent data confirms around 1000 localities (Watson 2001, Dadds and Bell 2008, BSBI 2010, Lockton 2010 – I). In Belgium, in the years 1982 – 2009, 26 squares (area 1 km^2) were noted, in which the species occurred in one to several ponds; in 2009-2010, this number increased by a further 8 squares and continues to grow. In Wallonia, where the species was recorded in three ponds, the distance between sites was about 7 km (Robert et al 2013 – P).

The ability to spread without human involvement can also be assessed on the basis of the assessment of species biological mobility (data type C). *Crassula helmsii* in the secondary range spreads locally mainly through vegetative reproduction. New plants can be formed from small fragments of 5 mm (Center for Aquatic Plant Management 2004 – P) and do not have a dormant period (EPPO 2007 – I). They easily spread through water and along with mud. The species diasporas can also be dispersed by animals (De Vries et al. 2012 – P).

In autumn, the plants form short stems with very short internodes (the so-called turions) that are carried with water (Dawson 1994 – P). In addition, the parent plants produce roots and lateral stems from many nodes, especially when subjected to some form of stress. The species may also reproduce sexually, however, most fruits lack seeds and the germination capacity is low (D'hondt et al. 2016 – P). To sum up, the ability of the species to spread without human assistance was assessed as high due to the presence of appropriate habitats

	in Poland, as well as the presence of vectors that may facilitate the spread of the species in the habitat.

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 has not yet been found in Poland in the natural environment (Zając A. and Zając M. 2001 – P, Popiela and Łysko 2018 – I). *Crassula helmisii* can spread as a "fugitive" from backyard ponds, where it can be introduced by man as an ornamental plant. This may be favoured by the ease of vegetative reproduction in the species (see question a11), as well as the possibility of spread of the species diasporas by moving them from pond to pond by anglers on fishing equipment, on waders, on boats, on shoes (Dawson and Warman 1987, Leach and Dawson 1999 – P, Watson 2001 – I). There is therefore a risk that the species can spread over a considerable distance.

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:

Crassula helmsii is a plant, it does not affect native species through predation, parasitism or herbivory.

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

	low
	medium
X	high

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

acomm14. Comments:

Although the influence of *C. helmsii* on the native flora is not easy to predict, it can be expected that this plant will, as in the United Kingdom, compete with native plant species. The species is capable of covering a significant part of the surface of a reservoir and competing effectively with other species (Dawson and Warman 1987 – P, Environment Agency 2003, Habitas 2009 – I). In studies conducted in the north-west of England, a decrease in the germination rate of native species was found (Langdon et al. 2004 – P).

Smaller plants such as *Callitriche spp.* appear to be suppressed by *C. helmsii*, which is also likely to reduce the number of green *Charophyceae* algae, and is also a threat to one of the rarest plants in Britain – *Damasonium alisma* (Watson 2001 – I). Similar phenomena may therefore occur in the case of excessive spread of *C. helmsii* in Polish water reservoirs. It will probably also negatively affect the breeding places of various animal species. The ability to conduct CAM photosynthesis (CO2 collected and accumulated at night, and released during the day to carry out photosynthesis) and its lack of dormancy throughout the year also increases the chances of its competition with other species (Keeley 1998 – P, EPPO 2006, USDA 2013 – I, CABI 2017 – B). In Poland, the species due to its biology and ecology may pose a potential threat to less competitive species of natural habitats Natura 2000: 3130 – Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*, 3150 – Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* – type vegetation, 3260 – Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, 3270 – Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation (Tokarska-Guzik et al. 2012 – P). In the light of these facts presented about the secondary range of *C. helmsii*, despite some climatic differences (see question a09), it can be expected with an average degree of certainty that also in Poland, this plant, through competition, will have a major impact on native species.

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 **X**	high	level of confidence

acomm15. Comments:

There are no data on interbreeding of *C. helmsii* with other species. There are currently no localities of the *C. helmsii* or other species of the genus *Crassula* that occur in nature in Poland, hence there is no possibility of interbreeding with them in natural conditions. There are also no data on the possibility of interbreeding of *C. helmsii* with native species.

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

X	very low
	low
	medium
	high
	very high

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

acomm16. Comments:

Little is known about the pathogens / parasites (fungi) which are enemies of *Crassula helmisii* in Europe and in its natural range (Gassmann et al. 2006 – P). It is unlikely that it

will transmit pathogens or parasites to native species. Risk analysis associated with the impact of the species on native species by transferring pathogens or harmful parasites to these species carried out in other European countries has not shown such an impact (Robert et al. 2013 – P).

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

	low
X	medium
	high

aconf13. Answer provided with a

low	medium	high
	X	

level of confidence

acomm17. Comments:

Until now there are no data on the impact of *C. helmsii* on the integrity of the ecosystem through disturbance of abiotic factors in Poland. The species, due to CAM photosynthesis, can assimilate CO2 for about 20 hours during the day (CABI 2017 – B), therefore, aquarists recommended it as an "oxygenating" plant for aquariums. If we accept the scenario that it would spread across the country, it would most probably inhabit wet habitats, i.e. banks or drained aquatic habitats oxbow lakes and natural eutrophic water reservoirs. Available data on the biology and ecology of the species shows that in the case of massive development it can modify conditions in the water by limiting the access of light and poor oxygenation (Branquart et al. 2013 – B, Robert et al. 2013 – P). Increasing the abundance in nutrients in the habitat may result in the suppression of plant species and animals that are adapted to less nutrient rich habitats. Therefore, assuming that *C. helmsii* will settle and spread in our country, its influence on the integrity of the ecosystem through disturbing its abiotic factors will probably be medium. This means that, in the worst case scenario, this species can cause difficult to reverse changes in processes occurring in habitats that do not belong to special care habitats, or easily reversible changes in processes occurring in special care habitats.

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

	low
	medium
X	high

aconf14. Answer provided with a

low	medium	high
		X

level of confidence

acomm18. Comments:

Crassula helmsii can interfere with the integrity of the ecosystem by disrupting its biotic factors, as it is a highly competitive plant and, consequently, can lead to the elimination of some species of plants occupied by it. Research in England showed a significant reduction in diatom (*Synedra delicatissima*) populations caused by *C. helmsii*. Because freshwater algae provide food for many invertebrates, this can have a serious impact on freshwater invertebrate populations (OEPP/EPPO 2007 – I), and thus the species can affect the ecosystem by (cascade) impact on the trophic network. The invasion of *C. helmsii* in eastern England prevented pied avocet chicks (*Avoceta curvirostra*) from feeding (Martin 2015 – P). As a result of intensive development of *C. helmsii*, changes in the distribution of organic matter could significantly contribute to reducing the oxygen content in water, and thus to a decrease in the number of fish, amphibians, or invertebrates living in the water (USDA 2013 – I, CABI 2017 – B). In Poland, the species may pose a potential threat to Natura 2000 natural habitats 3130, 3150, 3260 and 3270 (Tokarska-Guzik et al. 2012 – P). Assuming that this species would colonise throughout Poland, its impact on the biotic disturbance of ecosystems would probably be large. In the worst case, *C. helmsii* would cause scarcely reversible changes in the processes occurring in habitats requiring special care.

A4b | Impact on the cultivated plants domain

Questions from this module qualify the consequences of *the species* for cultivated plants (e.g. crops, pastures, horticultural stock).

For the questions from this module, consequence is considered 'low' when presence of *the species* in (or on) a population of target plants is sporadic and/or causes little damage. Harm is considered 'medium' when *the organism's* development causes local yield (or plant) losses below 20%, and 'high' when losses range >20%.

a19. The effect of *the species* on cultivated plant targets through **herbivory or parasitism** is:

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm19. Comments:

The plant is not a parasite.

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:

Crassula helmsii has no effect on the cultivation of plant species that are economically important. Neither has such an effect been found in analyzing this risk in other countries where this species occurs (EPPO 2006 – I).

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 **X**	high	level of confidence

acomm21. Comments:

No data are available on species interbreeding with related species (Robert et al. 2013 – P).

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: In available literature data, there is no information on the impact of the species on crops by disturbing the integrity of their cultivation system.

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

X	very low
	low
	medium
	high
	very high

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

acomm23.	Comments: There are no data on *C. helmsii* pathogens and parasites (Robert et al. 2013 – 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:

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm24.	Comments: The species is a plant.

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

	very low
X	low
	medium
	high
	very high

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

acomm25.	Comments: There are no data on the impact of the species on the health of an individual animal or animal production by having properties that pose a danger during direct contact. However, dense mats created by this species can be dangerous to domestic and farm animals, as they can be confused with a dry land surface although no such cases have been reported so far (Sheppard et al. 2006 – P, OEPP/EPPO 2007 – I). Massive spreading over the surface of shallow water reservoirs in which fish farming is carried out, could affect them negatively, because dense mats would inhibit the flow of light and would not allow for the aeration of the water body.

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm26.	Comments: The plant is not a host or a vector of pathogens / animal parasites (Najberek 2018 – N).

A4d | Impact on the human domain

Questions from this module qualify the consequences of *the organism* on humans. It deals with human health, being defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (definition adopted from the World Health Organization).

a27. The effect of *the species* on human health through **parasitism** is:

X	inapplicable
	very low
	low
	medium
	high
	vert high

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

acomm27.	Comments: The plant 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 **X**	high	level of confidence

acomm28.	Comments: Until now there are no data in the literature on the impact of the species on human health as the result of any properties that might pose a danger during direct contact. The species, as the result of intensive vegetative reproduction, can form dense mats, which can be mistaken for land (low probability), which may pose a threat to human health although no such cases have been reported so far (OEPP/EPPO 2007 – I).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm29.	Comments: The published data on the risk assessment of *C. helmsii* in other European countries shows that this species has no impact on human health as a result of the transmission of pathogens and parasites that are harmful to humans (Robert et al. 2013 – P).

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 **X**	high	level of confidence

acomm30.	Comments: In Poland, there are currently no data on the harmful impact of the species on infrastructure. Assuming that the species appears and spreads in Poland, based on the biology and ecology of the species, it can be concluded that it could block the flow of water in channels and drainage ditches (Dawson 1989 – P), which would increase the risk of flooding (OEPP/EPPO 2007, Kelly and Maguire 2009 – I, Branquart et al. 2013 – B). Recreational reservoirs with the mass occurrence of *C. helmsii* will at least partly lose their current function (Shepperd et al 2006 – P). The decay of accumulated necromass will worsen the aesthetic value of the area, this will be reflected in the reduction in the value of the property.

A5a | Impact on ecosystem services

Questions from this module qualify the consequences of *the organism* on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the

overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of *the species*.

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

The species should not affect the supply services, as it is not a plant parasite. It is also not a host or vector of animal pathogens/parasites. However, it can massively cover the edges and surfaces of shallow water reservoirs creating a dense mat, thus it can probably contribute to small economic losses in fish farming as a result of their weakened development, and in extreme cases lead to fish mortality. The accumulation of necromass undergoing anaerobic decomposition will significantly deteriorate the water quality. This will have particular significance in the case of water bodies used as a source of drink water and consumption.

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	high **X**	level of confidence

acomm32. Comments:

In Poland, there are currently no data on the impact of the species on regulatory services. Knowing the biology and ecology of the species, as well as based on data from other European countries, it may be assumed that if the species occurred in Poland, it could negatively affect the chemistry of water, reduce the oxygen level in the reservoir by limiting the water cycle in the ecosystem and by increasing the rate of decomposition of organic matter (Robert et al. 2013, Newman 2014 – P). It would also adversely affect the trophic network of the ecosystem. The moderately negative rating is also increased by the possibility of the species contributing to the enhancement of flood risk and related costs of removing the effects of flooding and the impact on the quality of soils flooded with such flood waters.

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

Generally, the species does not affect cultural services related to cultural and artistic resources, the spiritual sphere and religiosity, science and education. Assuming that this

species would spread to Poland, it is clear from the data concerning its biology and ecology that the overgrowing of a water reservoir by *C. helmsii* could seriously affect the recreational and aesthetic value of that reservoir (Sheppard et al. 2006 – P, OEPP/EPPO 2007 – I, 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 **X**	high	level of confidence

acomm34. Comments:

Climate changes that lead to global warming may cause climatic conditions to become similar to those currently prevailing in those European countries where the plant is in expansion, for example in Great Britain or Belgium (compare question a09). This would moderately increase the probability of the species entering the natural habitats of Poland, especially into areas with more mild climatic conditions.

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:

If climate changes are heading towards global warming, it can be expected that after *C. helmsii's* entry into Poland, the establishment of the species will increase moderately, because milder winters will have a significant impact on its survival through the winter in the natural environment. This will probably also favour vegetative reproduction. This species may also start to reproduce sexually; however this form of reproduction, as in Western Europe, may continue to have little significance (D'hondt et al. 2016 – P, compare question a06).

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:

As a result of global warming, the spread of *C. helmsii* may moderately increase. Favourable conditions for the development of the plant will probably allow it to reproduce more intensively. The plant has a huge potential to spread from small fragments and is characterized by a high growth rate (Dawson and Warman 1987 – P). The species may also be unknowingly moved for some distance from pond to pond by anglers on fishing equipment, waders, boats, shoes and by animals (Dawson and Warman 1987 – P, CABI 2017 – B).

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	high **X**	level of confidence

acomm37. Comments:

Global warming, including milder winters, may affect the plant's ability to survive the unfavourable period season and at the same time bring about faster and increased growth. This may result in a moderate increase in the negative impact of *C. helmsii* on the natural environment. Presumably, it will manifest itself, among other ways, by overgrowing shallow water reservoirs and drainage ditches, lowering the natural values of protected areas, increasing the intensity of competition in relation to species of native plants and having a negative impact on freshwater fish farms. It may pose a threat to Natura 2000 habitats 3130, 3150, 3270, 3260 (Tokarska-Guzik et al. 2012 – P).

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 **X**	high	level of confidence

acomm38. Comments:

As a result of climate change, the impact of *C. helmsii* on arable crops or crop production in Poland is unlikely to change, because in countries where this plant grows, there were no reports on its influence on arable crops.

a39. IMPACT ON THE DOMESTICATED ANIMALS DOMAIN – Due to climate change, the consequences of *the species* on domesticated animals and animal production in Poland will:

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm39. Comments:

Climate change (warming) may cause the massive spread of *C. helmsii* in some habitats, which may have a negative impact on fish farms in these areas, as oxygen and light conditions deteriorate. Dense mats created by this species in water reservoirs could be dangerous for domestic and farm animals, as they might be confused with the dry land surface (Sheppard et al. 2006 – P, OEPP/EPPO 2007 – I), but this will not have a significant impact on large numbers of animals.

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
X	increase moderately
	increase significantly

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

acomm40. Comments:

Changes in climatic conditions towards a warmer climate can contribute to the faster spread of *C. helmsii* and increase its rate of growth, however, this will not have a direct impact on humans, but indirectly, due to losses in fish farming, it will reduce species diversity, and will also contribute to the decline in the recreational value of water bodies. The above arguments justify the degree of assessment that the impact will "increase moderately".

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
X	increase significantly

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

acomm41. Comments:

As a result of climate warming, the species is likely to be massively present in some water reservoirs, ponds, canals, drainage ditches, including those used for recreation. It could lead to the loss of their function.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.67	0.50
Establishment (questions: a09-a10)	1.00	0.75
Spread (questions: a11-a12)	0.63	0.50
Environmental impact (questions: a13-a18)	0.50	0.60
Cultivated plants impact (questions: a19-a23)	0.00	0.70
Domesticated animals impact (questions: a24-a26)	0.00	0.50
Human impact (questions: a27-a29)	0.25	0.50
Other impact (questions: a30)	0.50	0.50
Invasion (questions: a06-a12)	0.76	0.58
Negative impact (questions: a13-a30)	0.50	0.56
Overall risk score	0.38	
Category of invasiveness	potentially 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:

Until now, there has not been any occurrence of *C. helmsii* n the "wild state" in Poland. In some countries of Central and Western Europe, the species has invasive or potentially invasive status, however, in most countries spontaneous presence or lack of such data has not been found (Tokarska-Guzik et al. 2015 – I). Potentially it could occur in all European countries (Minchin 2008 – B).

From the risk assessment for Poland, the swamp stonecrop was classified as a "potentially invasive alien species" whose total negative impact falls under the category "average". The highest scores (0.50) were obtained in the 'Impact on the natural environment' module (questions a13-a18) and impact on other objects (question 30). This result is likely to be associated with its strong competitiveness in relation to other co-occurring species, the lack of natural enemies in the secondary range and the negative impact on the integrity of settled ecosystems (a high impact leading to biotic and medium abiotic factors) and with the deterioration or the loss of recreational function of bodies as a result of mass occurrence of the species

The ease of vegetative reproduction and the ability to spread are arguments for the recognition of *C. helmsii* as a species with a high invasiveness potential, which in the case of getting into the natural environment in Poland, might allow it to rapidly reach the status of an established species, especially since our country is rich in potential habitats for this plant. The current climate in Poland, as well as the predicted climate warming, especially at the simultaneous increase in humidity, may contribute to the spread of the species.

Due to the fact that this species has not yet been found in Poland in the "wild state" inclusion in the EU list, and early action (education of the public, prohibition of sale) may effectively prevent the introduction of the plant to water reservoirs, and thus its spreading into semi-natural habitats (Tokarska-Guzik et al. 2015 – I).

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