



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. Barbara Sudnik-Wójcikowska
2. Tadeusz Korniak
3. Bogdan Jackowiak

acomment01.	Comments:	degree	affiliation	assessment date
	(1)	dr hab	Dep. of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw; Biological and Chemical Research Centre, University of Warsaw	16-01-2018
	(2)	prof. dr hab	Department of Botany and Nature Protection, Faculty of Biology and Biotechnology, University of Warmia and Mazury in Olsztyn	22-01-2018
	(3)	prof. dr hab	Department of Plant Taxonomy, Institute of Environmental Biology, Faculty of Biology, Adam Mickiewicz University in Poznań	26-01-2018

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

Polish name: —*)

Latin name: ***Spartina anglica*** C.E.Hubb

English name: Common cordgrass

acomm02.

Comments:

Latin names are provided in The Plant List (2013 – B). Other synonyms: *Spartina ×townsendii* var. *anglica* (C.E.Hubb.) Lambinon & Maquet

English name: syn.: common cord-grass, English cord-grass, salt marsh-grass.

Spartina anglica is a fertile cross breed of North American *S. alterniflora* with the native European species *S. maritima*. However, its formation at the end of the nineteenth century in England was preceded by the emergence of a sterile cross breed – *Spartina × townsendii* grass (Ayres and Strong 2001 – P, Nehring and Adersen 2006 – B).

*) Notice: In the study on naming the species of Polish flora (Mirek et al. 2002 - P) there is a generic name "spartyna", however there is no name of the species. Thus, we recommend a Polish name: Spartyna angielska.

Polish name (synonym I)

Spartyna angielska

Polish name (synonym II)

–

Latin name (synonym I)

Spartina × townsendii sensu lato

Latin name (synonym II)

Spartina townsendii var. *anglica*

English name (synonym I)

English cord-grass

English name (synonym II)

Salt marsh-grass

a03. Area under assessment:

Poland

acomm03.

Comments:

–

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

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

aconf01.

Answer provided with a

low

medium

high

X

level of confidence

acomm04.

Comments:

There is no data on the occurrence of the species in Poland, both in natural and anthropogenic habitats. The fact that *Spartina anglica* is commonly grown in Polish botanical gardens has not been confirmed (Botanical Gardens employees... 2018 - N). The possibility of cultivating the species in facilities related to the Plant Breeding and Acclimatization Institute (IHAR) seemed quite unlikely, except for the Branch in Bydgoszcz, where there is also the IHAR Botanical Garden specializing in growing grass. However, it turned out (Sudnik-Wójcikowska, Korniak 2018 - A) that the species has never been cultivated there. Similarly, there was no information on the cultivation of *S. anglica* at IHAR in Radzików (Department of Grasses, Legumes and Energy Plants)(IHAR employees– N).

The species is not grown in private gardens. Due to the small ornamental qualities, specific requirements and being listed as invasive species – it is not sold in garden centers (companies). Some companies sell grass called Spartyna or Spartina. However, this applies to the species *Spartina pectinata* – prairie grass.

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

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

<input type="checkbox"/>	the human domain
<input checked="" type="checkbox"/>	the other domains

acommm05. Comments:

In Western Europe, in places where the species was planted or occurs spontaneously, it undoubtedly affects the natural environment (and indirectly also animal husbandry), e.g. in the Netherlands it overgrows seaside pastures or fish ponds, and by entering dunes and beaches, it affects people by restricting recreation - sharp, stiff leaves can hurt tourists, anglers and fishermen. Within the secondary range, where it occurs en masse, it can hinder the flow of water in the sewers, cause mechanical damage or shallowing.

In Poland, there is currently no such influence on the spheres. *Spartina anglica* is an obligatory halophyte - it requires high salinity and tides. If the species could cross the Danish straits and appear on our coast, its real impact in conditions of low salinity of the Baltic Sea, would only concern a narrow coastal belt, and its local impact on the following spheres would only be considered on a small scale. Impact on nature – by displacing other halophytes, which are heliotropic species or by transferring the *Claviceps purpurea*. Our halophilic meadows could be endangered by the overgrowing spartina (meadows, which are protected as nature reserves – in case of too low salinity, halophilic species require constant human intervention, e.g. by grazing). We don't know if spartina would grow on such meadows! Impact on grass cultivation (grains, pasture grass) – here the role of spartina as vector to *Claviceps purpurea* would be possible (also on small scale). Impact on animal husbandry– ergot, i.e. an endospore form of *Claviceps purpurea*, is poisonous to animals and humans. More important is the impact of spartina caused by overgrowing halophilic coastal pastures. In fact, grazing on our halophilic meadows, due to their low salinity, is carried out in order to maintain these meadows. Extremely low salinity of the ground (and additionally local drainage) will cause very poor competitiveness of spartina. Impact on humans – may hinder recreation, but perhaps the scale would be minimal. Impact on infrastructure – it may hinder the flow in some areas.

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

aconf02.	Answer provided with a	low	medium	high	level of confidence
			<input checked="" type="checkbox"/>		

acommm06. Comments:

Species of hybrid, polytopic origin, i.e. its origin, probably occurred many times, off the coast of Great Britain (1870), (Gray et al. 1991, Eno et al. 1997 - P) and on the Bay of Biscay (1870). It is an obligatory halophyte. Widespread on the shores of Great Britain and Ireland. Planted or alone wandering along the coast of the North Sea (France, Belgium, the Netherlands, Germany, Denmark, Sweden; Nehring and Adersen 2006 – B, Nehring and Hesse 2008 – P, CABI 2018 – B), reaching the Danich straits east, which it did not cross, at least in the first decade of the 21st century. It seems that too low salinity of the Baltic Sea (North Sea 34 ‰, Danish Straits 20 ‰, Baltic 2-7 ‰), ice retention and excessive wave exposure are a barrier, and in the present conditions they hinder further expansion east. However, if the species appeared spontaneously in our country (seeds, fragments of rhizomes transferred by birds or sea currents), the areas around the Szczecin Lagoon would probably be the most vulnerable.

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

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

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

acomment07. Comments:
 The species is a spontaneous cross breed. One of the parent species – *Spartina alterniflora* comes from the North America, and its diaspores have been accidentally dragged by ballast water (Nehring and Adersen 2006 – B). The cross breed established quite quickly on the coast of Great Britain around 1870. In the first half of the 20th century and later, it was planted for strengthening of the sea coast in Western Europe but also regardless of man, or due to man's unintentional actions, it spread east (where it reached the east banks of Kattegat, Ferm 2007 – P). The main barrier seems to be the decrease in the salinity of the Baltic Sea, which decreases along with the distance from Denmark Straits, as well as climatic differences. So far, there is no information that the species reached Poland (although it is possible that diasporas were accidentally transported, for example with aquatic birds or sailing). The probability that the species will be introduced into the natural environment as "stowaways", dragged along with ballast water or with other materials is low.

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

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

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

acomment08. Comments:
 In its current range, in Western Europe already in the first half of the 20th century, mainly in the 1920s and 1930s (Nehring and Hesse 2008 - P, CABI 2018 - B), but even in the 1970s, the species was planted for stabilization and strengthening of the coast (currently, these activities are discontinued and the species removed). There was and there still isn't a need to do this in Poland. On the contrary, salty coastal meadows constitute a very small part of our coast and are under protection. There is no information that *Spartina anglica* has ever been intentionally planted in Poland.

A2 | Establishment

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

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

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

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

acom09.

Comments:

In the European part of the spontaneous range, the species occurs under conditions of moderate humid climate with strong Atlantic influences. Our climate is transitional between Atlantic and continental. Among various climatic factors, the time of ice retention, temperatures in the germination and fructification period may also be important. However, it should be noted that in recent years differences between the oceanic climate of Western Europe and the oceanic climate of north-western Poland are less visible. It seems, however, that it is not so much the climate itself, as it is mostly the habitat conditions (sufficient salinity of waters and ground, not very strong waving) that decide on the widening of the range of spartina (Nehring and Adsersen 2006 – B).

a10. Poland provides **habitat** that is

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

aconf06.

Answer provided with a

low	medium	high
	X	

level of confidence

acom10.

Comments:

In its homeland and current range of occurrence, the species is limited to coastal saline and moderately saline habitats. The sea coasts, sludgy shallowing areas, estuaries and muddy coastal swamps are the main habitat of this species (Tutin 1980 - P, Nehring and Hesse 2008 – P, CABI 2018, RAFTS 2018 – B). Near the Denmark Straits, where the North Sea passes into the Baltic Sea, the level of salt in sea waters changes substantially (North Sea - 31-35 ‰, Kattegat and Skagerrat - 20 ‰, Polish Baltic coast 2-7 ‰). In the past, during the holocene Littorina Sea, the Danish straits were much deeper, the water exchange was easier and salinity of the Baltic Sea was greater. Today the sea is fresher – less salty (mesohaline). It seems that this is one of the most important factors preventing the occurrence of *S. anglica* in Poland. Information is already available (but concerns the United States) that the species tolerates salinity between 5-40 ‰ (Aberle 1990 - P). Thus, maybe with time its occurrence at the Baltic Sea is not excluded, but it will probably be less competitive. It is worth noting that even where conditions for the occurrence of *S. anglica* are, in principle, optimal (e.g. southern England), it happens that, for some obscure reasons, the plant dies en masse.

Too long lagoons, anaerobic (oxygen-poor) substrate, toxic level of sulphides may all be the cause of that (Nehring and Adsersen 2006 – B). Perhaps the level of Baltic pollution may further complicate the spread of spartina.

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
- high
- very high

aconf07. Answer provided with a

low	medium X	high
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 level of confidence

acommm11. Comments:
 Data on the biological estimation of species mobility (type C): In the optimum range on the coastal wetlands in the intertidal zone (foreshores, marches) the species intensively reproduces vegetatively (rhizomes) and generatively, although a small part of caryopses germinate (Nehring and Adsersen 2006 - B , Nehring and Hesse 2008 - P, CABI 2018, JNCC 2018, RAFTS 2018 - B). Diaspores are transmitted by animals and water (on its surface caryopses may stay for several weeks). There is no such habitat on our coast (the tidal range varies from 1 to 2 cm, the salinity is small 2-7‰). A distant counterpart of marches in Poland are salty coastal meadows, which are, however, a very small percentage of our coast, dominated by dunes or cliffs. Salty meadows in Poland are usually protected as nature reserves. They occur in Wolin and Uznam, in the region of Kołobrzeg (disappearing) and over the Bay of Puck (the farther east the tides and salinity are slightly smaller). Rare occurrence of salty meadows, low salinity and tides very much limit the spread of the species without human intervention.
 It is quite difficult to assume that obligatory halophyte will be found throughout the country. There is no data on species mobility in our conditions, although it will probably be weaker (we assumed that it would be "low") than in the optimal range. Further research should show how much the species is competitive in conditions of low salinity.

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

X	low
	medium
	high

aconf08. Answer provided with a

low	medium	high X
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 level of confidence

acommm12. Comments:
 There is no reason why a species should be propagated (spread) in Poland. Salty coastal meadows that are rare on our coast are mostly under protection as nature reserves. There is no need to introduce (especially alien) species for strengthening the sea shore, stabilizing swampy ground, etc.
 As the query showed (Botanical Garden employees... 2018 - N), *Spartina anglica* is not grown in our botanical gardens. As mentioned in p. A04, it is also absent in facilities at the Plant Breeding and Acclimatization Institute (IHAR), even in the Botanical Garden in Bydgoszcz, which specializes in growing grass (Botanical Garden employees... 2018 - N). Therefore, it is not possible to estimate the frequency of moving an individual or its diaspores through human activities at a distance greater than 50 km. However, if the species were found in Poland, it can be assumed that its frequency of spreading with human participation (intentional or unintentional) will be low, due to the poor representation of proper habitats on the coast, especially in the interior of the country. It is different in Western Europe, where intentionally planted *S. anglica*, with time started "living its own life", contrary to human intentions, spreading excessively (the role of sea currents, shipping, aquatic birds, Nehring and Adsersen 2006 - B). It is worth noting, however, that even in very favorable conditions for the species, on the North Sea, it happens that, for some obscure reasons, entire populations die.

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:

- inapplicable
- low
- medium
- high

aconf09. Answer provided with a

low	medium	high
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 level of confidence

acommm13. Comments:
The species is not a parasitic plant.

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

- low
- medium
- high

aconf10. Answer provided with a

low	medium	high X
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 level of confidence

acommm14. Comments:
If the species was spread all over the country (which is unlikely, because it is an obligatory halophyte), its impact through competition would be medium or even relatively large - it is an impressive perennial with an extensive, strong system of rhizomes. The competition would mainly concern light and food resources (Nehring and Adsersen 2006, GISD 2018, JNCC 2018 - B). In particular, weakly competitive and extremely heliotropic halophytes from the communities of salty meadows and sub-halophilic reed beds would be at risk.

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

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

aconf11. Answer provided with a

low	medium	high X
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 level of confidence

acommm15. Comments:
In Poland, there are no native or introduced species of the *Spartina* genus with which the species could interbreed. There is no data on the formation of intergeneric hybrids in literature (apart from the only information about the possibility of interbreeding with rice, Chung 2006 - P).

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

- very low
- low

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

aconf12.	Answer provided with a	low	medium	high X	level of confidence
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acomment16. Comments:
Pathogens of *Spartina anglica* are: *Claviceps purpurea* (American line G3 *Claviceps purpurea*; Preece et al. 1994, Reybould et al. 1998, Nehring et al. 2012 – P, CABI 2018 – B), ascomycota, which causes a disease called ergot, and *Fusarium heterosporum*, ascomycota, which is a highly specialized endospore (ergot) hyperparasite of *Claviceps purpurea* (both species of fungi are not on the EPPO list; EPPO Standards 2017 - I). Among the two pathogens, *Claviceps purpurea* attacking the grass is the more dangerous one. In Western Europe, the mass appearance of ergot on *S. anglica* took place in 1985-1995 (Raybould et al. 1998 – P). If *S. anglica* appeared on the coast / in Poland, it is not possible to rule out the transfer of *Claviceps purpurea* to adjoining halophilic and sub-halophilic grass, e.g. *Phragmites australis* and *Puccinellia distans*. The minor, it seems, would be the influence of spartina on non-halophilic communities.

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

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

aconf13.	Answer provided with a	low	medium X	high	level of confidence
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acomment17. Comments:
Until now, we have not found the impact of the species on abiotic factors. If we assume that *Spartina anglica* has spread on our coast / country for some reason, its impact on abiotic conditions would result from an extensive system of rhizomes and roots (mechanical and chemical). The changes would probably include obstructing the flow of waters, excessive terrestrialization or siltation and shallowing, and impoverishment of soils, changes in the lighting conditions.

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

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

aconf14.	Answer provided with a	low	medium X	high	level of confidence
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acomment18. Comments:
When assessing the impact of the species on biotic factors and integrity of the ecosystem with which it is associated and assuming that it occurs throughout the country (which is impossible, because it is an obligatory halophyte!), the following should be considered: - plant size, - durability (perennial grass), – growing in tufts and/or clumps (compact system of strong rhizomes and roots), - intensive vegetative and generative reproduction, - photosynthesis C4 (Nehring and Adersen 2006 - B, Nehring and Hesse 2008 - P, CABI 2018 - B). Consequently, biotic factors will be disturbed due to jamming, shadowing, competition for resources and changes in water relations, where *Spartina* would be stronger, i.e. on salty ground. As a result, native species of halophilic meadows will be displaced (in Western Europe, for example, the *Suaeda*, *Salicornia* genera), there is a reconstruction of phytocoenoses species composition (mainly communities of the *Glauco-Puccinellietalia* order), the nature of the community changes (“monoculture”, “*Spartina* reed bed”). Some invertebrates and birds start to withdraw. The integrity of the ecosystem is unstable.

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 X	level of confidence
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acomm19. Comments:
The species is a non-parasitic plant.

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

aconf16.	Answer provided with a	low	medium	high X	level of confidence
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acomm20. Comments:
Assuming that the species is spread in Poland, its impact on crops would be limited due to completely different habitats - it is not competitive.

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 X	level of confidence
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acomm21. Comments:
There are no native *Spartina* species in the flora of Poland, so in this sense the species has no impact on the cultivation of plants important from an economic point of view.
(Notice: in China interbreeding with rice species was confirmed, Chung 2006 – P).

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

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

aconf18. Answer provided with a

low	medium	high X
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 level of confidence

acommm22. Comments:
The species does not penetrate the crops, it does not infest them, it does not occupy similar habitats - so it does not affect the integrity of crops.

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

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

aconf19. Answer provided with a

low	medium	high X
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 level of confidence

acommm23. Comments:
The species is the host of *Claviceps purpurea* – line G3 *Claviceps purpurea* (Nehring et al. 2012 – P), hazardous to crops, as well as to farmed animals and humans. In Western Europe, in the years 1985-1995, the occurrence of *Claviceps purpurea* on *Spartina anglica* inflorescences was noted. However, habitats occupied by crops and species are mutually exclusive and are unlikely to be close enough. On the other hand, assuming that the species is spread throughout the country, the probability of infecting crops with fungi will probably increase. If moreover, we take into account not only field crops but also meadows, then there is also a possibility of infecting the meadow grass. Monitoring fungal growth at the earliest stage possible will then be indicated.
It should be added, however, that *Claviceps purpurea* is not on the EPPO list (EPPO Standards 2017 - I) and therefore (according to the instructions) the impact on crops should be assessed as small.

A4c | Impact on the domesticated animals domain

Questions from this module qualify the consequences of *the organism* on domesticated animals (e.g. production animals, companion animals). It deals with both the well-being of individual animals and the productivity of animal populations.

a24. The effect of *the species* on individual animal health or animal production, through **predation or parasitism** is:

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

aconf20. Answer provided with a

low	medium	high
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 level of confidence

acomm24. Comments:
The species is a plant.

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

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

aconf21. Answer provided with a

low	medium	high
		X

 level of confidence

acomm25. Comments:
Direct contact with spartina, even if it has been frequent in Poland, does not directly threaten the livestock. The species does not show any features that would pose a threat to animals. In Western Europe *Spartina anglica* is even used to some extent as feed for cattle and sheep (Nehring and Adersen 2006 - B), however, it seems that it is less willingly eaten than other halophilous grasses, such as, for example, *Puccinellia maritima* (there were even sporadic reports from Great Britain that a freshly mown spartina can cause digestive problems in cattle, Ranwell 1967 -P).
It is worth noting that spartina does not play a role in the transmission of pathogens to animals, but it is also a host of *Claviceps purpurea*, which spores can be poisonous for animals.
There are also reports of oyster farmers (this is not applicable to our country) about unfavorable influence of the species on oyster farms (Reise 1998 - P).

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

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

aconf22. Answer provided with a

low	medium	high

 level of confidence

acomm26. Comments:
Until now there is no information in literature on the transmission of parasites and pathogens to livestock.

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:

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

- high
- vert high

aconf23. Answer provided with a

low	medium	high
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 level of confidence

acommm27. Comments:
The species is not a parasitic organism.

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 X
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 level of confidence

acommm28. Comments:
Even if the species were abundant, direct contact with it is not hazardous to humans, except that the plant has stiff, prickly leaves that may hinder walking and swimming (Nehring and Adersen 2006 - B).

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

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

aconf25. Answer provided with a

low	medium	high
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 level of confidence

acommm29. Comments:
The species does not carry parasites and pathogens harmful to humans.

A4e | Impact on other domains

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

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

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

aconf26. Answer provided with a

low	medium	high X
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 level of confidence

acommm30. Comments:
Due to the foregoing reasons (low salinity, lack of tides), the occurrence of the species on our coast, and thus the impact on the infrastructure, are very unlikely. Assuming that the species would spread in Poland (but with no chance of mass occurrence), its impact on the infrastructure will not be big. However, where *Spartina anglica* occurs en

masse, in salt pans of Western Europe, as well as in China (An et al. 2007 – P) and Australia (Shimeta et al. 2016 – P), it may impede the flow of water in sewers, cause mechanical damage or shallowing.

A5a | Impact on ecosystem services

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

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

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

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

acommm31. Comments:
The species does not occur in Poland, therefore it has no impact on the supply services. In Western Europe and China, where *Sparina anglica* occurs en masse, it is considered a source of biomass, biofuel, raw material for the production of paper, and even health-promoting products (Chung 1993, 2006 - P, Minchin 2008 - I). It is used as feed (cattle, sheep, horses, geese, ducks), fish food and green manure (Nehring and Adsersen 2006, GISD 2018 -B).

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

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

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

acommm32. Comments:
The species does not occur in Poland, so it has no impact on regulatory services (neutral). In Western Europe, where *Spartina anglica* occurs en masse, it can counteract erosion, slightly soften tides and waves (the species itself reacts poorly to these phenomena), can accelerate land drying, affect water flow (flood risk!), water self-purification processes or soil recultivation (Nehring and Adsersen 2006 – B, Nehring and Hesse 2008 – P, CABI 2018, JNCC 2018, RAFTS 2018 –B).

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

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

aconf29.	Answer provided with a	low	medium	high X	level of confidence
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acomm33. Comments:
The species does not occur in Poland, therefore it has no impact on cultural services (science, education, spiritual sphere and artistic resources).
Assuming its spread, we cannot rule out the "cultural" effects: the elimination of native species, e.g. of symbolic or healing importance, deterioration of landscape values, etc.

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
- increase moderately
- increase significantly

aconf30.	Answer provided with a	low	medium X	high	level of confidence
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acomm34. Comments:
Low salinity of the Baltic Sea does not promote the occurrence of this species. The authors (Nehring 2003, Loebel et al. 2006, Nehring and Hesse 2008 - P, CABI 2018 - B) suggest that under global warming conditions higher water temperatures in winter and warmer springs may favor widening the range of the species, mainly to the north, but we cannot rule out that it will also spread east. Assuming that in the future the average annual temperature will increase by 1-2 ° C, it may be necessary to expect an increase in the evaporation of the Baltic Sea, and, as a result, a slightly higher salt concentration. It could also favor spartina's journey further east.

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 X	high	level of confidence
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acomm35. Comments:
Assuming an increase in the average annual temperature (e.g. by 1-2 ° C), the following should be taken into account: higher water temperatures (in winter), shorter ice retention

will support the survival of the species; b) long, warm autumn will cause longer flowering, more maturing caryopsis (notice: low soil temperatures during this time inhibit flowering and reduce the number of caryopsis); c) warm spring favors the germination of caryopsis (which has already been confirmed in Western Europe, Loebel et al 2006 - P). As a result, the chances of survival and the effectiveness of generative reproduction will increase; species at least locally (on the coast) can be established.

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 X	high
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 level of confidence

acomm36. Comments:
If *Spartina anglica*, in the situation of global climate change, reaches our coast and spreads here, then its further spread beyond the coastal areas deep into the country is quite unlikely. The species is an obligatory halophyte - a salty substrate seems indispensable.

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 X	high
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 level of confidence

acomm37. Comments:
It is quite likely that climate change will change the range and incidence of *Spartina anglica*. If the species reaches the Polish coast of the Baltic Sea, it will not find too many suitable habitats here. Nevertheless, it may play a more important role on the habitats of halophilic meadows and sub-halophilic reed beds, displacing native species of halophilic plants. In particular, it would be dangerous to transform different phytocoenoses into monocultures. The impact on water birds is more difficult to assess more clearly – the majority of them will probably retreat, but some of them can find conditions that are right for them. On the other hand, it seems very unlikely that the *S. anglica* will migrate inland, into salt-free 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 X
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 level of confidence

acomm38.

Comments:

In the conditions of climate change, the impact on field crops will be visible, perhaps, to a minimal extent. However, the nature of extensively used halophilic and sub-halophilic meadows on the coast may change. With regards to plant production in Poland, this is unlikely to have any meaning.

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 X	high	level of confidence
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acomm39.

Comments:

It seems that in the conditions of climate change, the species will not have a major impact on animal production in Poland. On the coast, where it may appear on salty meadows, it could be used as a fodder plant, but probably the quality of fodder will be worse (it is known that in Western Europe, *Spartina anglica* is less eagerly eaten by animals than other halophyte grasses, e.g. *Puccinellia maritima*).

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 X	high	level of confidence
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acomm40.

Comments:

If, as a result of climate change, the species begins to appear more often on our coast, entering salty meadows, and perhaps partly also the beaches, it may hinder recreation, tourism, limit the possibility of communing with nature (bird-watching, tourism). It seems, however, that in our conditions (type of coast) the scale of these changes will be small and they do not directly concern human health.

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 X	high	level of confidence
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acomm40.

Comments:

Species entering salty meadows, but also partly the beaches, may impede recreation, tourism, limit the possibility of communing with nature (bird-watching, tourism). It seems, however, that in our conditions (type of coast) the scale of these changes will be small.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.17	0.83
Establishment (questions: a09-a10)	0.25	0.75
Spread (questions: a11-a12)	0.13	0.75
Environmental impact (questions: a13-a18)	0.45	0.80
Cultivated plants impact (questions: a19-a23)	0.05	1.00
Domesticated animals impact (questions: a24-a26)	0.25	1.00
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.25	1.00
Invasion (questions: a06-a12)	0.18	0.78
Negative impact (questions: a13-a30)	0.45	0.96
Overall risk score	0.08	
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.

acom42.

Comments:

Based on points awarded, *Spartina anglica* has the status of a "minimally invasive alien species" (it is located near the upper range value - not far from a "mid-invasive alien species").

So far spartina has not been seen in the natural environment of Poland, mainly due to the very small share of salty coastal meadows in the Polish coastal landscape and due to the low level of salinity of the ground. However, further spread cannot be ruled out with the participation of birds, sea currents or shipping.

Import and trade of this species is now, at least locally, banned pursuant to the Ordinance of the Ministry of Environment dated 9 September 2011 (P).. There is rather no danger that it will be consciously imported in order to strengthen and stabilize the Polish coastal area of the Baltic Sea.

Data sources

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