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. Blanka Wiatrowska
2. Dorota Michalska-Hejduk
3. Zygmunt Dajdok

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr inż.	Department of Forest Botany, Faculty of Forestry, Poznań University of Life Sciences	17-01-2018
(2)	dr	Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Lodz	10-02-2018
(3)	dr	Department of Botany, Institute of Environmental Biology, University of Wrocław	10-02-2018

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

Polish name: Tawuła kutnerowata

Latin name: ***Spiraea tomentosa*** L.

English name: Steeplebush

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:

The Latin name was given according to The Plant List (2013 – B). The more commonly used synonyms, apart from those given below, are: *Drimopogon ferruginea* (Raf.) B.D. Jacks., *D. glomerata* (Raf.) B.D. Jacks., *D. parvifolia* (Raf.) B.D. Jacks., *D. rosea* (Raf.) B.D. Jacks., *D. tomentosa* (L.) B.D. Jacks., *Spiraea ferruginea* Raf., *S. glomerata* Raf., *S. parvifolia* Raf., *S. rosea* Raf. (The Plant List 2013 – B). The usual English names are given based on CABI (2017 – B), USDA (2018 – B).

Polish name (synonym I)	Polish name (synonym II)
–	–
Latin name (synonym I)	Latin name (synonym II)
Sorbaria aitchisonii (Hemsley) Hemsley ex Rehder	*Sorbaria tomentosa* (Lindley) Rehder
English name (synonym I)	English name (synonym II)
Hardhack	Meadowsweet

a03. **Area** under assessment:

Poland

acomm03. Comments:

–

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
X	alien, present in Poland in the environment, established

aconf01. Answer provided with a

low	medium	high	level of confidence
		X	

acomm04. Comments:

Steeplebush is a species established in Poland, which in specific environmental conditions tends to spread massively (Danielewicz 2006, Dajdok and Śliwiński 2009, Dajdok et al. 2011, Kujawa-Pawlaczyk 2009, Tokarska-Guzik et al. 2012 – P). The shrub is on the list of 17 invasive trees and shrubs (in the category of invasive species regionally), which in case of settling in valuable natural areas may threaten biodiversity. Steeplebush has been recognized as such a species in western Poland (Tokarska-Guzik and others 2012 – P), because the main areas of its occurrence in the country include Bory Dolnośląskie, Bory Niemodlińskie and Puszcza Drawska (Kujawa-Pawlaczyk 2009 – P, Dajdok et al. 2011 – B). The species is also cultivated in the Maria Curie-Skłodowska University Botanical Garden in Lublin (Employees of botanical garden ... 2018 – N).

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

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

acomm05. Comments:

The species has a strong impact on plant communities. The largest number of clusters (aggregations) of the shrub is observed on wet and swampy habitats, where in non-forest areas, e.g. on wet meadows (from *Molinion caeruleae*), on the outskirts of ditches, water

reservoirs, on roadsides and in illuminated forest communities, shrubs most often occur in the form of compact or intermittent fields (Wiatrowska and Danielewicz 2016b – P). The formation of compact patches by the steeplebush causes obscuring plant species and a strong impoverishment of plant communities as a result of competitive impacts and shading of the soil surface. The species is not very popular among deer (Wiatrowska 2015 – N), and the experiment carried out in the Daubaner Wald reserve in Germany showed that *S. tomentosa* sprouts are a completely unattractive source of food for farm animals, including sheep and goats (Burkart 2003 – P). Steeplebush flowers are rarely visited by insects, which is related to the fact that despite long and abundant flowering it is not a nectar plant (Wiatrowska 2011-2018 – A). Due to the large area of habitats occupied by it, the growth of its population may also affect the restriction of the food base for bees (Wiatrowska 2011-2018 – A). Until recently, insects feeding on leaves or sprouts of *Spiraea tomentosa* (Kott 2009 – P), have not been observed, although recently the larvae of *Earias clorana*, were observed at the base of inflorescences of the shrub, which was previously considered a monophagus of species of the *Salix* genus (Wiatrowska et al. 2018 – P). The spread of the species on pastures and hay meadows may cause a reduction of their area, and thus a decrease in their importance in agricultural production. In forest areas, where steeplebush is arable, there may be problems with natural and artificial renewal of the forest. The species was introduced into the natural environment in order to strengthen the banks of drainage ditches and water reservoirs (Bena 2012 – A). However, due to the fast growth rate of the steeplebush, as well as the expansion of the area occupied by it, its expansion along the ditches also increases the rate of overgrowth, which is associated with an increase in expenditure on their conservation (Wiatrowska 2011-2018 – A). The species is flammable. Old, dry shoots of plants are often the main cause of forest fires also in neighboring stands. This is a problem both for the renewal of trees and for the afforestation of post-agricultural areas (Danielewicz, 2006, Wiatrowska and Danielewicz 2016b – P), thus also affecting forest crops.

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
	medium
X	high

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

acomm06. Comments:

Steeplebush is a species fully established in Poland – it has been present in the present-day Poland since the 19th century (in 1806 it was introduced from cultivation in the botanical garden in Kraków, whereas outside the cultivation it was recorded in Lower Silesian Wilderness and Niemodlińskie in the 1880s). The shrub produces a very large number of small and light seeds that are adapted to hydroochoria (spread with water). Even after periodic flooding, they maintain displacement and germination, which promotes the spread of the species along watercourses (Wiatrowska and Danielewicz 2016a – P). In autumn and winter, seeds that have fallen on snow or ice can also be moved along with gusts of wind (Danielewicz 2010 – A). A large population of this species is found in Germany, in Saxony, which is neighboring Poland (Kott 2009 – P, Dajdok et al. 2011 – B). The close distance between the areas occupied by steeplebush on both sides of the state border may favor the transfer of seeds between Polish and German populations, e.g. migrating birds (Wiatrowska

and Danielewicz 2016a – P), which are important vectors in the spreading of water-marsh plant seeds (Amezaga 2002, Soons et al. 2008 – P). Floating seeds are passively transmitted on their feathers, and small seeds that are often intact pass through the digestive tract (Figuerola 2003, Soons et al 2008 – P), which in the case of small, long floating on the surface of *Spiraea tomentosa* seeds may promote both their exo- and endozoochoric dispersion (Wiatrowska and Danielewicz 2016a – P).

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

	low
	medium
X	high

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

acomm07. Comments:

Currently, especially where the species occurs en masse, its seeds can be spread by humans e.g. on tire treads, on footwear and other items of clothing, on equipment used for maintenance of drainage ditches, as well as on forest management operations, especially during winter thinning (or other works) carried out in fragments of forests with a large proportion of steeplebush. The probability of accidentally transferring diasporas beyond this area and their precipitation in places favorable to the development of the shrub is, however, small due to the narrow ecological amplitude of the species (Wiatrowska 2011-2018 – A). For many years, the species has spread spontaneously, above all, to desiccated peat bogs, but there are reports of its appearance also on mineral soils (Kujawa-Pawlaczyk 2009 – P).

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	high **X**	level of confidence

acomm08. Comments:

The species is present in Poland. It was imported as an ornamental plant – the first listing from 1806 concerns cultivation in the botanical garden in Krakow. It was consciously introduced into the natural environment to strengthen the shores of fish ponds in Lower Silesia (Bena – N). The danger associated with the possibility of replanting and spreading from places of possible cultivation, such as gardens or green squares is small. Experience has shown that due to the specific habitat requirements of this species, its specimens die after a few years of replanting (Wiatrowska 2011-2018 – A). However, steeplebush is still used in horticulture, for planting parks, it is also introduced as part of forest management as a "biocenotic admixture" (Kujawa-Pawlaczyk 2009 – P). The species is available in the commercial offer.

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	high **X**	level of confidence

acomm09. Comments:

The range of European and American *Spiraea tomentosa* indicates that the steeplebush has no climatic barrier in Poland and can spread throughout the country. This species naturally occurs in North America – its dense area covers a wide belt along the eastern part of the continent from the provinces of Quebec and Ontario in the north – Canada, to the states of Louisiana, Mississippi and Georgia in the south of the United States (Gille 1950 – P, Flora of North America 2015, USDA – The Plants Database 2018 – B). Due to the vast area of natural occurrence in North America, and in particular its longitudinal extent along the Atlantic coasts, the climatic conditions at which the shrub grows are very diverse. On its northernmost positions there is a moderate cold climate, and in the southern positions – a subtropical climate. The steeplebush has tolerance for high temperatures, which confirms its inclusion in species that can be grown in 8 out of 10 plant growing zones in North America determined on the basis of the average annual minimum air temperature (Krüssmann 1986 – P). Simultaneous disjunction in the latitudinal range of the discussed species – the largest density of its population in the peroceanic zones and their distribution through a wide belt of the Great Plains, Rocky Mountains and Cordillera indicate that it gradually disappears under the influence of continental and mountain climate. One of the most important factors regulating its occurrence is also the annual amount of precipitation, because the distribution of shrub positions largely coincides with the area where the average annual precipitation exceeds 640 mm (Climate Prediction Center 2018 – B). The broad natural range of *Spiraea tomentosa* indicates that this species can occur in very different climatic conditions. Due to the climatic similarity (in the 94-100% range) of the area of Poland and at least part of the area within the range of the natural range of the species in North America, it should be noted that the climate requirements of this species are fully met within the country except for mountain areas (Wiatrowska 2011-2018 – A).

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:

In Poland, in the area of secondary occurrence of *Spiraea tomentosa*, its populations develop in similar habitat conditions as in the area within the original range. Due to the photophilia of this species (Stanton et al. 2010 – P), its compact populations are mainly observed in open areas, on wet and swampy habitats, e.g. over drained peatlands or wet meadows (Dajdok et al. 2011 – B, Podlaska 2011, 2014 – P, Wiatrowska 2016 – N, Wiatrowska and Danielewicz 2016b – P). In smaller clusters, the species also occurs in the overexposed forest communities, for example under mature pine stands or birchwood and alder forests (Dajdok et al. 2011 – B, Wiatrowska and Danielewicz 2016b – P). As the shrub tolerates alternating flooding and drought periods well, which adversely affect the development of many other woody species (Gille 1950 – P) and develops well in places where the level of groundwater and their availability are very variable, its expansion may favor m. in. disturbance of water conditions in various types of wetland habitats, related, for example, to a decrease in the level of groundwater (Wiatrowska 2015 – N), including those caused by the drainage of boggy forest areas. Taking into account the spectrum of habitats occupied by *Spiraea tomentosa* it can be concluded that there are optimal habitat conditions for this species in Poland.

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
X	very high

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

acomm11. Comments:

Dispersion from a single source (data type A): very large.
The species has a large generative potential and the ability to grow vegetatively. Every year, a mature specimen of a shrub develops about a million fine seeds with high germination capacity (93%), and its shoots, after contact with the soil surface, root down, which promotes rapid consolidation and growth of its already existing populations (Wiatrowska and Danielewicz 2013 – P, Wiatrowska 2015 – N). In autumn and winter, seeds that have fallen on snow or ice can also be moved along with gusts of wind (Danielewicz 2010 – A). Due to the fact that steeplebush often grows in near-water communities, its seeds float freely on the surface of the water and retain the ability to germinate after flooding for a long time, this species also spreads hydrochorically (Wiatrowska and Danielewicz 2016a – P). Along with the water, its diasporas can be transported over very long distances. In the case of seeds drifting on the surface of the water, the probability of their spreading by birds migrating between water reservoirs increases (Wiatrowska and Danielewicz 2016a – P), which promotes their transfer over a distance exceeding 50 km during the year.

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	high **X**	level of confidence

acomm12. Comments:

Due to high visual values of the plant, it is not possible to exclude the deliberate spread of the species by humans. The species is available in the commercial offer. Its large habitat requirements, however, limit the possibility of its cultivation. However, there are reports that the shrub was introduced as part of forest management as a "biocenotic admixture" (Kujawa-Pawlaczyk 2009 – P).

A4a | Impact on the environmental domain

Questions from this module qualify the consequences of *the species* on wild animals and plants, habitats and ecosystems.

Impacts are linked to the conservation concern of targets. Native species that are of conservation concern refer to keystone species, protected and/or threatened species. See, for example, Red Lists, protected species lists, or

Annex II of the 92/43/EWG Directive. Ecosystems that are of conservation concern refer to natural systems that are the habitat of many threatened species. These include natural forests, dry grasslands, natural rock outcrops, sand dunes, heathlands, peat bogs, marshes, rivers & ponds that have natural banks, and estuaries (Annex I of the 92/43/EWG Directive).

Native species population declines are considered at a local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as (near) extinction. Similarly, limited ecosystem change is considered as transient and easily reversible; severe change is considered as persistent and hardly reversible.

a13. The effect of *the species* on native species, through **predation, parasitism or herbivory is**:

X	inapplicable
	low
	medium
	high

aconf09.	Answer provided with a	low	medium	high	level of confidence

acomm13. Comments:

The species is a plant, it does not affect native species through predation, parasitism or herbivorousness.

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

	low
	medium
X	high

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

acomm14. Comments:

Spiraea tomentosa is characterized by a large generative potential and the ability to grow vegetatively. One specimen of the shrub develops about 1 million seeds in the course of the growing season, and its shoots, after contact with the soil surface, easily rooting, which favors the rapid concentration of already existing populations (Wiatrowska and Danielewicz 2013 – P, Wiatrowska 2015 – N). Due to the fact that under mature individuals of the species, there are appropriate conditions for germination of its seeds, this species develops compact, nearly monogeneous fields relatively quickly and by changing the microhabitat conditions (e.g. shading of the soil surface and release of chemical substances to the environment that inhibit the development of other plants, the so-called allelopathy), hinders the restoration of other woody species (Wiatrowska 2011-2018 – A). *Spiraea tomentosa* has the ability to quickly overgrow the space previously occupied by natural or semi-natural communities and to eliminate the majority of peat bog species. Competitiveness of the species with regard to native species is so large that it can radically change both the original species composition and the structure of the community (Dajdok et al 2011 – B).

The endangered species are primarily protected species of peatlands, among others:
- Davall's segde *Carex davalliana*,
- brown beakrush *Rhynchospora fusca*,
- pod grass *Scheuchzeria palustris*,
- sundews *Drosera spp.*,
- marsh clubmoss *Lycopodiella inundata*,
- numerous species of orchids connected with peat bogs,
- species of peat moss *Sphagnum spp*.

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

X	no / very low
	low

	medium
	high
	very high

aconf11.	Answer provided with a	low	medium	high **X**	level of confidence

acomm15. Comments:

Until now, *Spiraea tomentosa* has not been found to affect other native plant species through hybridization (Dajdok et al 2011 – B). In Poland, there are two native species of *Spiraea*: *Spiraea salicifolia* and *S. media*. *Spiraea salicifolia* grows in the Sandomierz Wilderness and in the Lublin region, while *S. media* in Bieszczady and Pieniny (Seneta and Dolatowski 2009 – P). Because the natural range of the native species of *Spiraea* covers areas in the south-east of Poland, and currently known populations of *S. tomentosa* are found in western Poland, crossing of these species is unlikely (Wiatrowska 2011-2018 – A) and there are currently no studies in this area.

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

	very low
	low
	medium
X	high
	very high

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

acomm16. Comments:

Spiraea tomentosa may be the vector of '*Candidatus* Phytoplasma asteris' (yellow disease phytoplasmas) (CABI 2017 – B) – belonging to the group of phytoplasmas with a very wide host spectrum. These phytoplasmas mainly infect dicotyledonous plants, but some strains may also attack monocots and woody plants (CABI 2017 – B). The species is therefore a vector of one pathogen, which may also threaten native species of special care.

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 **X**	high	level of confidence

acomm17. Comments:

Spiraea tomentosa transforming non-forest communities (peat bogs, wet meadows, pastures) into long-lasting, dense thickets, changes the light conditions prevailing in the ecosystem. The expansion of the bush can therefore affect the microclimate conditions, such as the availability of light or temperature of the soil surface. The negative consequences of changes in the habitat conditions, as well as the species composition of marshland meadows under the control of *Spiraea tomentosa* have attracted the attention of Balkenhol et al. (2018 – P) in the work on spiders.

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:

The influence of steeplebush on biotic factors of the ecosystem is very important due to its influence on the structure and functioning of the entire biocenosis. The species has a strong impact on plant communities. The largest number of aggregations of the shrub is observed on wet and swampy habitats, mainly on non-forested areas, e.g. on wet meadows (from *Molionion caeruleae*), on the outskirts of ditches, water bodies and roads and in illuminated forest communities where the species often develops compact or intermittent fields (Wiatrowska and Danielewicz 2016b – P). Expansion of *Spiraea tomentosa* and its tendency to strongly densify the population causes crowding out of native plant species and strong depletion of species of plant communities as a result of competitive impacts. Despite large production of biomass, the expansion of steeplebush does not affect a variety of the feeding base of large animals, as this species is less popular with deer (Wiatrowska 2011-2018 – A). Furthermore, transformation of wet meadows or open peatlands into permanent and hard-to-reach thickets may affect the functioning of animals (even large mammals, Dajdok et al. 2011 – B). The shrub flowers are rarely visited by insects. Despite the long and rich flowering, it is not a nectar plant, which in connection with the large area of habitats occupied by it can affect the limitation of the bee's food base (Wiatrowska 2011-2018 – A). A small number of damages of leaves, shoots and flower buds by insects may indicate that this species is also not an attractive host for phytophagous species (Kott 2009 – P), although recently moth larvae have been observed at the base of inflorescences of this species: *Earias clorana*, previously considered a monophagus of *Salix* willow species. It was found that although feeding on a new host plant does not significantly affect the survival of larvae, host change has an adverse effect on some of their growth parameters and may adversely affect the condition of the entire insect population (Wiatrowska et al. 2018 – P).

A4b | Impact on the cultivated plants domain

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

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

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

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm19. Comments:

Lack of such impact, the species is a non-parasitic plant.

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

	inapplicable
	very low
	low
X	medium

	high
	very high

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

acomm20. Comments:

At present, the species does not show any competition for cultivated species such as cereals or root crops. However, *Spiraea tomentosa* enters the meadows that can be used as pastures (Gille 1950 – P). Due to its high competitive potential associated with high seed production, rapid growth and regeneration after damage to its above-ground structure, this species also creates problems with natural and artificial renewal of the forest – within forest crops (Wiatrowska 2015 – N). Considering the above, it should be noted that the probability of competition is low – the impact will affect less than 1/3 of crops being invaded, and the effect may be high – in the worst case, the condition of plants or single crop is reduced by over 20%.

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

	inapplicable
X	no / very low
	low
	medium
	high
	very high

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

acomm21. Comments:

The species does not crossbreed with native species but can cross with related species of the *Spiraea* genus – which have a decorative meaning. Because there is no research on crossbreeding native species, such research should be undertaken.

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

	very low
	low
X	medium
	high
	very high

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

acomm22. Comments:

This species does not affect the cultivation of cereals or root crops, its mass occurrence in meadows may, however, reduce the share of meadow plants and hinder grazing of animals, and in forest crops, slow down or prevent the growth and development of seedlings (Wiatrowska 2011-2018 – A). Due to its flammability, the species can affect the integrity of forest crops (Danielewicz 2006 – P). Considering the above, it should be confirmed that the probability of disturbance of crop integrity is low – the impact will affect less than 1/3 of crop plants being invaded, and the effect may be high – in the worst case the condition of plants or single crop yield is reduced by more than 20%.

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

	very low
X	low
	medium
	high
	very high

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

acomm23. Comments:

Spiraea tomentosa may be a vector of '*Candidatus* Phytoplasma asteris' (yellow disease phytoplasmas) (CABI 2017 – B) – belonging to the group of phytoplasmas with a very wide spectrum of hosts. These phytoplasmas mainly infect dicotyledonous plants, but some strains may also attack monocot and tree species (CABI 2017 – B). However, this phytoplasma is not on the EPPO lists.

A4c | Impact on the domesticated animals domain

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

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm24. Comments:

The species is a plant; lack of the above mentioned impact.

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

X	very low
	low
	medium
	high
	very high

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

acomm25. Comments:

So far, the species has not been found to exhibit properties that pose a danger to animals during direct contact. According to observations, the shrub is not an attractive source of deer food (Wiatrowska 2011-2018 – A), nor farm animals (Burkart 2003 – P). This may be due to high concentration of phenolic compounds and tannins, the concentration of which reduces the attractiveness of the plant for phytophagous species (Wiatrowska et al 2018 – P), probably also reducing the taste of the plant (Wiatrowska 2011-2018 – A).

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: *Spiraea tomentosa* is not a host or a vector of animal pathogens / 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:

X	inapplicable
	very low
	low
	medium
	high
	vert high

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

acomm27.	Comments: Lack of such impact, the species is a plant.

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

X	very low
	low
	medium
	high
	very high

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

acomm28.	Comments: Both in the area of natural occurrence as well as in the range of the secondary range of *Spiraea tomentosa* no cases of its negative impact on human health have been found.

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 species is a plant, it does not carry harmful pathogens or parasites 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
X	high
	very high

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

acomm30. Comments:

The species was introduced into the natural environment due to its ability to strengthen the banks of fish ponds and ditches (Bena 2012 – A). Currently, its uncontrolled growth accelerates overgrowth of drainage ditches, reducing flow, which is associated with the need to increase expenditure on maintaining their patency. In addition, the *Spiraea tomentosa* thickets can develop on the causeway of ponds or fire-fighting tanks, making it difficult to maintain them properly. Overgrowing of forest dirt roads is also observed (Wiatrowska 2011-2018 – A). Because the species is flammable – old, dry shoots of plants are often the main cause of forest fires also in neighboring stands. This is a problem both for the renewal of trees and for the afforestation of post-agricultural areas (Danielewicz 2006, Wiatrowska and Danielewicz 2016b – 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
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31.	Comments: *Spiraea tomentosa* in the case of expansion into hay meadows may reduce the production of biomass, and in the case of pastures – at least temporarily reduce their area. In addition, the growth of its population in forest crops may slow down the renewal process and, as a consequence, prolong the waiting period for obtaining wood raw material (Wiatrowska 2011-2018 – A). Due to the flammability and fire hazard for forest crops, it can have a negative impact on raw materials of organic origin – mainly on wood and wood raw materials.

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32.	Comments: Steeplebush produces numerous, quickly dying stems (Wiatrowska 2015 – N), which due to the flammability of its above-ground structure may affect the rate of spread of fires. However, the extensive root system can be a factor counteracting soil erosion – however, this fact does not reduce its negative impact on regulatory services. The growth of the bush population may affect numerous biological processes due to its incorporation in the network of trophic links. The shrub has become a new host plant for native insect species, e.g. *Earias chlorana* (Wiatrowska et al. 2018 – P), which may have a stimulating or limiting effect on the development of its population and indirectly affect other moth species (Wiatrowska 2011-2018 – A). The growth of a species, which flowers do not produce nectar and which displaces nectar native plants, can reduce the insects' food base and the chance of pollination in native species. Preliminary studies show that falling leaves and shrub seeds affect the chemical properties of soils due to their allelopathic properties (Wiatrowska 2011-2018 – A). In addition, the change in the nature of habitats, for example in wet meadows overgrown with steeplebush, causes changes in the species composition of other groups of organisms – e.g. spiders (Balkenhol and others 2018 – P).

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm33.	Comments: The species does not affect cultural services, such as science or education. Its ornamental qualities may encourage the cultivation of the shrub due to its interesting habit, large ornamental inflorescences and a nice autumn color of the leaves.

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
X	not change
	increase moderately
	increase significantly

aconf30.	Answer provided with a	low	medium	high **X**	level of confidence

acomm34. Comments:

Currently, the species is established only in western Poland. However, its current range is not related to the climatic barrier, but to the history of its introduction to the crop and its specific soil requirements, which limit its expanding to the larger patches of arid and fresh habitats surrounding it (Wiatrowska and Danielewicz 2016b – P). The wide, natural range of the bush in North America, stretched from its sites in the northern reaches of the cold temperate zone in Canada, to sites located in the warm subtropical climate zone in the South of the United States (USDA – The Plants Database 2018 – B), indicates that in Poland already there are no climatic barriers to the spread of this species, and the expected climate change will probably have no impact on its colonization potential (Wiatrowska 2011-2018 – A).

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	high **X**	level of confidence

acomm35. Comments:

Spiraea tomentosa is already established in Poland. There are no barriers in the country that prevent the plant from surviving or limiting its reproduction.

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	high **X**	level of confidence

acomm36. Comments:

In Poland, except for mountainous areas, there are no climatic barriers to the spread of *Spiraea tomentosa*. It may be assumed that, with the exception of higher mountainous

	areas, there are no climatic barriers for spreading of the shrub in the country. Climate warming will not affect overcoming of geographical barriers on the lowlands, but it can also enable colonization of wetland habitats in the foothills and in the mountains.

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
X	not change
	increase moderately
	increase significantly

aconf33.	Answer provided with a	low	medium	high **X**	level of confidence

acomm37.	Comments: Steeplebush is already established in Poland. Climate warming may enable the colonization of wetland ecosystems in the foothills and in the mountains.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm38.	Comments: Currently, the species has no significant impact on the cultivation of plants, and the expected climate change should not result in changes in this area.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm39.	Comments: Currently, the species has a small impact on animal husbandry, although it indirectly affects the production of feed in hay meadows and the reduction of the area of pasture, which can overgrow. Predicted climate changes should not result in significant changes in this area.

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

	decrease significantly
	decrease moderately
X	not change

	increase moderately
	increase significantly

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

acomm40. Comments:

The species has no impact on humans and the expected climate change should not result in significant changes in this area.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

Spiraea tomentosa is currently established in Poland and there is no climate barrier for it, it can potentially spread throughout the country. The impact of the species on other objects (e.g. on roadside ditches, roadsides, dams of ponds) may increase, but it will not be directly related to climate change.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.75	1.00
Environmental impact (questions: a13-a18)	0.65	0.90
Cultivated plants impact (questions: a19-a23)	0.25	1.00
Domesticated animals impact (questions: a24-a26)	0.00	1.00
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.75	1.00
Invasion (questions: a06-a12)	0.92	1.00
Impact (questions: a13-a30)	0.75	0.98
Overall risk score	0.69	
Category of invasiveness	moderately invasive alien species	

A6 | Comments

This assessment is based on information available at the time of its completion. It has to be taken into account. However, that biological invasions are, by definition, very dynamic and unpredictable. This unpredictability includes assessing the consequences of introductions of new alien species and detecting their negative impact. As a result, the assessment of the species may change in time. For this reason it is recommended that it regularly repeated.

acomm42. Comments:

In the risk assessment, the *Spiraea tomentosa* steeplebush was considered a "medium invasive foreign species" with a value of 0.75 "negative impact". The maximum grade (1.0) was obtained in the modules "Introduction" (a06-a08) and "Settlement" (a09-a10). It obtained high grades in the modules "Spreading" (0.75, questions: a11-a12), "Impact on other objects" (0.75, question a30) and "Impact on the natural environment" (0.65; questions a13-a18). At the same time, the species obtained a low value in the module "Impact on crops cultivation" (0.25, questions: a19-a23), and in modules "Impact on animal husbandry" (questions: a24-a26), "Impact on people" (questions: a27-a29), the species has a value of 0.00.

Due to the fact that the species is domesticated in Poland and is highly capable of spreading, activities limiting the negative impact of the species on naturally valuable areas and undertaking research leading to the development of effective control methods should be recommended. So far, the methods of combating steeplebush, such as trimming and plucking have been tried. Cutting the bush proved to be effective for a few years, from 4 to 5 times a year (Kujawa-Pawlaczyk 2014 – P).

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