



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. Agnieszka Popiela
2. Emilia Brzosko
3. Anna Gazda

acomment01.	Comments:		
	degree	affiliation	assessment date
	(1) prof. dr hab.	Department of Botany and Nature Conservation, Faculty of Biology, University of Szczecin	09-04-2018
	(2) prof. dr hab.	Institute of Biology, Faculty of Biology and Chemistry, University of Białystok	12-04-2018
	(3) dr hab. inż.	Department of Forest Biodiversity, Institute of Forest Ecology and Silviculture, Faculty of Forestry University of Agriculture in Krakow	07-04-2018

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

Polish name: Róża pomarszczona
Latin name: ***Rosa rugosa*** Thunb.
English name: Rugosa rose

acomm02.

Comments:

The Latin name is consistent with The Plant List (2013 – B), Polish name – with the Flowering plants and pteridophytes of Poland checklist (Mirek et al. 2002 – P), and Latin synonyms with CABI (2018 – B).

Other English common names of the species include: beach rose, beach tomato, potato rose, Ramanas, rugosa, rugose rose, saltspray rose, sea tomato, Sitka rose, Turkestan rose, wrinkled rose (Stace 1997 – P, CABI 2018 – B).

Polish name (synonym I)
róża fałdzistolista

Polish name (synonym II)
róża japońska

Latin name (synonym I)
Rosa ferox Lawrence

Latin name (synonym II)
Rosa pubescens Baker

English name (synonym I)
Japanese rose

English name (synonym II)
Ramanas rose

a03. Area under assessment:

Poland

acomm03.

Comments:

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

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

aconf01.

provided with a

low	medium	high X
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level of confidence

acomm04.

Comments:

Rosa rugosa is present throughout Poland, with particularly large populations in the western part of the country. It grows in synanthropic, semi-natural and natural habitats. The largest populations have been reported from Pomerania along the coastline, from Lower Silesia and the Opole region. There is a clear gap in the species range in the central part of the Carpathian Uplands. New data from the Kielce region indicate that the species is still in expansion and has not yet occupied the whole territory of Poland (Sobisz and Truchan 2008 – P, Popiela 2018 – A, Zajac 2018 – I). The species was classified as an invasive kenophyte by Tokarska-Guzik et al. (2012 – P). Bruun (2005 – P) reported that Poland is one of the regions in Europe with the largest populations of *R. rugosa*.

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

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

acomm05.

Comments:

The rugosa rose *Rosa rugosa* is a species with strong competitive properties and has a negative effect on the native flora and native plant communities. It eliminates native species from these communities by physical interactions and limiting access to light, and at the same time facilitates the invasion of other alien species (Bruun 2005, Vanderhoeven et al. 2005, Isserman 2008a, b, c – P and the literature cited therein). In addition, it may cause

the elimination of some pollinating insects associated with native species (Weidema 2006 – B). Thus, it causes a loss of biodiversity. First of all, the species displaces the natural flora of dune vegetation and sandy grasslands (Isermann 2008a, b, Tokarska-Guzik et al. 2012 – P). It alters the chemical composition of the substrate by enriching the upper layers of soil with nutrients, which promotes the invasion of other species that are alien to a given habitat (Essl 2006, Dassonville et al. 2008, Isserman 2008a – P). *R. rugosa* shrubs limit access to coastlines (Weidema 2006 – B). Light soil is a suitable substrate for this plant, which is an additional factor promoting its spread. The persistence of this species in cultivation and its naturalization in abandoned or neglected gardens are also important factors (Jorgensen and Kollmann 2009a – P). No negative impact of the species on human health has been reported, although hypersensitive individuals may be allergic to rose pollen or fragrance (Weidema 2006 – B).

A1 | Introduction

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

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

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

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

acommm06.	Comments:
	<p>The species is established in Poland, which according to the methodology of risk assessment <i>Harmonia</i>^{PL} indicates a choice of answers: high probability and high level of confidence. The species is present throughout Poland and spreads spontaneously (Tokarska-Guzik et al. 2012 – P, Popiela 2018 – A, Zajac 2018 – I). Seeds are dispersed by birds and seawater. There are data indicating that some species of birds eat rose hips in coastal areas and most likely disperse seeds over large distances (Weidema 2006 – B). The seeds are resistant to seawater, and their germination is not reduced even after several weeks’ exposure to it. <i>R. rugosa</i> reproduces asexually through long and fast growing rhizomes. Fragments of rhizomes can be dispersed by water, which can contribute to the spread of the species (Bruun 2005, Weidema 2006 – B).</p> <p>Diaspores of <i>R. rugosa</i> can migrate to Poland from neighbouring countries, where this species is common and grown as an ornamental plant (Bruun 2005 – P). A particularly large number of diaspores can inflow along the Baltic coast – from the western side from Germany, and from the eastern side from Lithuania and Russia, where the species is common (Bruun 2005, Isserman 2008a – P). Other possible sources of spread are Scandinavian countries, from where diaspores can be dispersed over long distances by seawater and migratory birds (Bruun 2005, Isserman 2008 – P). Fruits and seeds can be dispersed by strong winds during late winter, when most fruits are dry (Kollmann et al. 2009 – P).</p>

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

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

aconf03.	Answer provided with a	low	medium	high X	level of confidence
acom07.	Comments: The species is established in Poland, which according to the methodology of risk assessment <i>Harmonia</i> ^{+PL} indicates a choice of answers: high probability and high level of confidence. The species has been present in Poland since the 19 th century (Tokarska-Guzik et al. 2012 – P) and spreads easily (Weidema 2006 – B). Fleshy fruits can be eaten by birds and mammals, whose droppings containing diaspores are later deposited outside the area of cultivation. Diaspores can be dispersed to some extent by unintentional human actions – by tourists penetrating the coast – local disturbances promoting the emergence of seedlings (Kollmann et al. 2007 – P).				

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

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

aconf04.	Answer provided with a	low	medium	high X	level of confidence
acom08.	Comments: The species is established in Poland, which according to the methodology of risk assessment <i>Harmonia</i> ^{+PL} indicates a choice of answers: high probability and high level of confidence. The species has been present in Poland since the 19 th century and spreads easily (Zajac and Zajac 2001, Tokarska-Guzik et al. 2012 – P, Popiela 2018 – A, Zajac 2018 – I). It is commercially available, cultivated, also as an ornamental plant (very popular for hedges), planted for soil stabilization, and as an edible plant and rootstock for the production of rose cultivars. Because of its attractive flowers and fruits, as well as ease of cultivation, the rugosa rose is often planted in home gardens and in landscaping urban green areas. The species is kept in the collections of arboreta and botanical gardens in Poland; 250 shrubs on a total acreage of 6000 m ² were reported from 21 of these institutions (Employees of botanical garden... 2018 – N). The species is widely available in garden shops, nurseries and online shops. Fruits rich in vitamin C are a valuable herbal raw material (literature available on the website Publikacje naukowe RÓŻA 2018 – I). In Poland before 1952 all rose hips and rose petals used for processing were harvested from the wild. Plantations were established later, and at the end of the 1960s they occupied an area of 1200 ha, and today organic plantations are increasingly common (WiOM 2016 – I). Despite the systematically growing demand for rose hips in Poland, species of fruiting roses (including the rugosa rose) are still not cultivated in our country on a large scale (the area of crops is currently estimated at approx.250 ha). Depending on the species or variety, from 2 000 to 2 500 shrubs can be planted per ha (Ogrodnictwo expert 2017 – I). The rugosa rose is planted to stabilize dunes, on roadsides and even on post-industrial wasteland. In 2004 <i>R. rugosa</i> was listed as an ecotone species, enriching the forest ecosystem and making it more attractive to forest animals and birds. Probably from that time approx. 0.3 million of seedlings were planted in Poland every year (Fundacja Polska Róża 2015 – I).				

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

aconf05.	Answer provided with a	low	medium	high X	level of confidence
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acom09. Comments:
Rosa rugosa has been present in Poland since the 19th century and is spreading fast (Tokarska-Guzik 2005 – P, Weidema 2006 – B, Zajac 2018 – I). The climate in Poland is optimal for the dispersal of the species. *Rosa rugosa* is present in all climatic regions of Poland (Zajac and Zajac 2001 – P). Tolerance to a wide range of climatic conditions is reflected in the presence of *R. rugosa* from Scandinavia to Mediterranean countries – between the latitudes 46° N and 68° N (Bruun 2005 – P). *Rosa rugosa* is a frost-resistant species, tolerant to drought, salinity, periodic flooding, and survives covered with sand (Kollmann et al. 2011, Bruun 2005 – P).

a10. Poland provides **habitat** that is

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

aconf06.	Answer provided with a	low	medium	high X	level of confidence
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acom10. Comments:
 The primary range of the species covers northern Japan, the Korean Peninsula, north-east China and the far eastern regions of Russia (Kamchatka, Kuril Islands, Sakhalin, Habarov Region and Primorye) (Bruun 2005, Kurtto 2009 – P). In these regions *R. rugosa* always occurs near the coastline: on stable dunes, rocky shores, rarely on multi-species meadows near the coastline. In Europe, including Poland, it occupies a wider range of habitats. In its secondary range it occurs on various types of dunes, rocky beaches, cliffs, sandy grasslands, on forest margins, along roads and railway tracks, on landfill sites and in other anthropogenic habitats (Bruun 2005 and the literature cited therein, Bruun 2006, Isermann 2008a, b, Kollmann et al. 2009a, b, Stace and Crawley 2015 – P, Weidema 2006, CABI 2018 – B). In Poland, very favourable conditions for the species are on grey dunes along the sea coast, and in non-forest habitats, on light soils, in the mountains on debris. The species has a low tolerance to calcareous soils (Popiela 2018 – A, Zajac 2018 – I).

A3 | Spread

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

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

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

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

aconf07. Answer provided with a

low	medium	high X
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 level of confidence

acommm11. Comments:

Dispersal from a single source (data type A):
Rosa rugosa spreads through sexual (accessory fruit, seeds) and asexual reproduction (underground rhizomes). Kollmann et al. (2009b – P) estimated the annual growth of the clone at 0.42 m. The important vector of long-distance dispersal of seeds are migratory birds (Bruun 2005, Isermann 2008a – P).

Expansion of populations (data type B):
 The rapid spread of *R. rugosa* in the British Isles has been documented, especially on the coastline, where both the number of sites and the size of existing sites have increased significantly in the last four decades (Bruun 2005, Kollmann et al. 2007 – P). Bruun (2005 – P) compared data reported by Graham and Primavesi (1993 – P) and Preston et al. (2002 – P) and concluded that over one decade the number of 10x10 km squares in which the species was found increased almost three-fold, from 333 to 947. In Germany, within less than 50 years, several clones of *Rosa rugosa* colonized an area of about 3.5 ha (Didriksen 1999 – P). Kollmann et al. (2009b – P) investigated the spread of *R. rugosa* in Denmark and found that in 2004 it covered 0.33% of the study area. Considering the rate of growth of existing patches (0.42 m/year), they predicted that if the current environmental conditions persist and no actions are taken, *R. rugosa* will colonize 3.9% of the area by 2034. If new patches are formed, the cover rate of the species will increase to 9.5%.

Approximation (data type C):
 A single accessory fruit (hypanthium) of *Rosa rugosa* contains from 20 to 120 real fruits (approx. 60 on average). The total number of seeds produced per unit area of shrubbery is from 600 to 1300 seeds /m² (Brunn 2005 – P). Fleshy rose hips are eagerly eaten by birds and mammals, which promotes their dispersal on a local scale, while migratory birds can transport diaspores over long distances (Bruun 2005, Isermann 2008a – P). Diaspores can also be dispersed by water, e.g. along a coastline (Isermann 2008a – P) or by strong winds during late winter, when most fruits are dry (Kollmann et al. 2009 – P). Vegetative fragments can also be dispersed by water (Kollmann et al. 2007 – P). *Rosa rugosa* has a high capacity for asexual reproduction through the growth of underground rhizomes (Isermann 2008a, Tsuda et al. 1999 – P). One reason for the successful expansion of the species is the high potential of seeds for germination (up to 98%) and high survival rate of seedlings (Kollmann et al. 2007 – P). Kollmann et al. (2007 – P) in their experimental study found no seedlings on the control plots, which suggests the small importance of seed fall and the seed bank in the survival of the population and spread of the species. One of the reasons may be that fruits and seeds are eaten by rodents. On the other hand, their experiments with sowing stratified seeds showed that: (i) the seeds germinate better on white dunes and heaths, especially those locally disturbed, and the survival rate of seedlings is highest on heaths, and the lowest on grey dunes; (ii) the survival of seedlings is higher on soils with increased availability of Ca, K, Mg, Na and C: N, while it decreases with increasing cover rate of lichens and bare substrate; (iii) the mortality of seedlings is increased during drought; (iv) herbivores have no effect on the survival of seedlings.

The increase in the number of sites differs in individual regions of Poland. Analyses of data from the Polish Carpathians collected from the second half of the 20th century demonstrated that a long period of "domestication" (only single specimens growing in the wild were recorded) was followed by a rapid self-seeding stage, and in the last few years *Rosa rugosa* shrubs have increasingly been often found on roadsides and at the margins of forest communities (Marciniuk et al. 2015 – P).

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

	low
	medium
X	high

aconf08.	Answer provided with a	low	medium	high X	level of confidence
acomm12.	Comments: The species is used as an ornamental plant and for the stabilization of dunes (Herbich 2004 – P). It is still planted in urban green areas, on roadsides, and is grown in home gardens. The plantations of <i>R. rugosa</i> are popular and established for harvesting petals and fruits used in the food, pharmaceutical, perfumery and herbal industries (Cendrowski et al. 2012 – P, Fundacja Polska Róża 2015, Publikacje naukowe RÓŻA 2018 – I). The species is widely available in garden shops, nurseries and online shops (e.g., Poradnik ogrodnicy 2018, Ogrodinfo.pl 2018 – I). It is used as a rootstock for other cultivated roses (Bruun 2006 – P). In Poland before 1952 all rose hips and rose petals used for processing were harvested from the wild. Plantations were established later, and at the end of the 1960s they occupied an area of 1200 ha, and today organic plantations are increasingly common (Fundacja Polska Róża 2015, WiOM 2016 – I). Despite the systematically growing demand for rose hips in Poland, species of fruiting roses (including the rugosa rose) are still not cultivated in our country on a large scale (the area of crops is currently estimated at approx.250 ha). Depending on the species or variety, from 2 000 to 2 500 shrubs can be planted per ha (Ogrodnictwo expert 2017 – I). <i>Rosa rugosa</i> is grown in the collections of many botanical gardens and arboreta (cf. Q a08). Disposal of achenes after the use of the fleshy part of hypanthium may to some extent contribute to the dispersal of the species. Seeds may be accidentally dispersed during the extraction of gravel or sand for construction, or by tourists penetrating, e.g. coastlines. The persistence of this species in cultivation and its naturalization in abandoned gardens are also important factors.				

A4a | Impact on the environmental domain

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

Impacts are linked to the conservation concern of targets. Native species that are of conservation concern refer to keystone species, protected and/or threatened species. See, for example, Red Lists, protected species lists, or Annex II of the 92/43/EWG Directive. Ecosystems that are of conservation concern refer to natural systems that are the habitat of many threatened species. These include natural forests, dry grasslands, natural rock outcrops, sand dunes, heathlands, peat bogs, marshes, rivers & ponds that have natural banks, and estuaries (Annex I of the 92/43/EWG Directive).

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

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

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

aconf09.	Answer provided with a	low	medium	high	level of confidence
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acomm13.	Comments: <i>Rosa rugosa</i> is a non-parasitic plant species and does not cause such effects.				
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a14. The effect of *the species* on native species, through **competition** is:

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

aconf10.	Answer provided with a	low	medium	high X	level of confidence
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acomment14. Comments:
Rosa rugosa has a negative effect on native flora and fauna by decreasing the number of native species sharing the same habitats. *Rosa rugosa* has strong competitive properties. Its growth causes deterioration of light conditions and has a physical impact, and as a consequence causes loss of species richness of native plants, and even their complete elimination and the formation of monoculture patches (Bruun 2005, 2006, Stace and Crawly 2015 – P). *Rosa rugosa* displaces native species from white and grey dunes – both common and rare/protected: typical dune species, such as the thyme-leaf sandwort *Arenaria serpyllifolia*, the red fescue *Festuca rubra* ssp. *arenaria*, the European beach grass *Ammophila arenaria*, the sand ryegrass *Leymus arenarius*, the sea sandwort *Honckenya peploides*, the sea holly *Eryngium maritimum*, and the wild pansy *Viola tricolor*, and decreases the share of mosses and lichens (Popiela 2018 – A). The thickets with *Rosa rugosa* are usually very dense and poor in species. Because *Rosa rugosa* displaces native plant species, it also creates a threat to animals associated with them, e.g. butterflies (Weidema 2006 – B).

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 X	high	level of confidence
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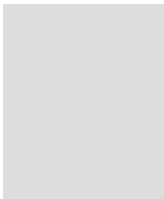
acomment15. Comments:
 In its primary range *Rosa rugosa* interbreeds with local rose species (Bruun 2005 – P). There are documented cases of *R. rugosa* interbreeding with native species in the secondary range, both in America and Europe. In North America it creates hybrids with *Rosa carolina* L. (= *R. ×koehneana* Rehder) and *Rosa palustris* Marsh. (= *R. ×spaethiana* Graebner). In the British Isles it interbreeds with polyploid *R. canina*, *R. mollis* and *R. caesia* (Eigner and Wissemann 1999, Stace 1997 – P). Numerous sterile hybrids have been created in horticulture, some of which have been identified in Europe as non-established (ergasiophytes): e.g., a hybrid with *Rosa majalis* Herrm. (= *R. ×majorugosa* Palmén & Häme, a hybrid with *Rosa nitida* Willd. (= *R. ×rugotida* Darthuis) and with *Rosa multiflora* (Bruun 2005 – P). Potentially it can create hybrids with all diploid and polyploid species of the *Rosa* genus that are characterised by regular meiosis (Bruun 2005 – P). In cultivation it can interbreed with many taxa of the *Rosa* genus. Because *R. rugosa* is not a species of special concern, there is no risk of the loss of genetic coherence. In addition, the reproductive potential of hybrids is not always high, which limits their spread (Bruun 2005 – P).

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

- verylow
- low
- medium
- high
- very high

aconf12.	Answer provided with a	low	medium	high X	level of confidence
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acomment16. Comments:
 In the primary range, many species of insects, viruses, bacteria and fungi damaging various parts of *Rosa rugosa* plants have been identified (Bruun 2006 – P). Some insects are



associated only with *Rosa rugosa*. Pathogens attacking *R. rugosa* in its native range have been reported primarily from cultivation; it is not known whether they attack natural populations. Most insects feeding on *R. rugosa* in its primary range do not occur in Europe. It is also believed that *R. rugosa* in Europe is resistant to bacteria, fungi and insects recorded on other species of roses. The above data suggest that *R. rugosa* does not have a significant impact on native species by hosting pathogens or parasites.

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

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

aconf13.

Answer provided with a

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

level of confidence

acomment17.

Comments:

The thickets of *Rosa rugosa* may initiate the formation of dunes, and then alter abiotic properties of the ecosystem (Weidema 2006 – B). *R. rugosa* alters the physical and chemical composition of the substrate by enriching the upper soil layers with nutrients (chemical elements supporting life), which promotes the invasion of other species that are alien to a given habitat (Essl 2006, Dassonville et al. 2008, Isserman 2008a – P). By limiting access to light it contributes to the decline of native plant species, and thus the elimination of pollinating insects (Bruun 2005, Vanderhoeven et al. 2005, Isserman 2008a, b – P and the literature cited therein, Weidema 2009 – B). Change to the structural and chemical composition of soil can affect soil-dwelling organisms.

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

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

aconf14.

Answer provided with a

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

level of confidence

acomment18.

Comments:

Rosa rugosa has negative effects on the biotic properties of ecosystems because it competes with native species of flora and fauna associated with them. Growing shrubs of the rugosa rose limit the abundance, and even completely eliminate native plant species and form monoculture patches (Bruun 2005, Vanderhoeven et al. 2005, Isserman 2008a, b, c – P). This may lead to the disappearance of phytocoenoses, including those associated with coastal and inland dunes. Reduced diversity of insect species pollinating native plants has been reported. *R. rugosa* also increases the share of species representing the *Bombus* genus, *Apis mellifera* and other pollinators (Bruun 2005, Vanderhoeven et al. 2005, Essl 2008, Isserman 2008a and b – P and literature cited therein, Weidema 2009 – B). This may alter relations within food webs.

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
- verylow
- low
- medium
- high
- very high

aconf15. Answer provided with a

low	medium	high X
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 level of confidence

acomm19. Comments:
Rosa rugosa is a non-parasitic plant species.

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

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

aconf16. Answer provided with a

low	medium X	high
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 level of confidence

acomm20. Comments:
Cases of negative impact of *R. rugosa* on cultivated plants have not been reported. It seems that the occupied habitats do not facilitate the spread of the species to crops. Regular agrotechnical treatments limit the probability of the spread of the species in crops. It is possible, however, that *R. rugosa* can compete for pollinators with some cultivated plants (e.g. orchard plants).

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

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

aconf17. Answer provided with a

low	medium X	high
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 level of confidence

acomm21. Comments:
Plants cultivated in Poland belong to taxonomic groups other than *Rosa rugosa*, and this creates an important barrier for its interbreeding with cultivated plant taxa. In its native range *R. rugosa* interbreeds with local rose species (Bruun 2005 – P). There are documented cases of *R. rugosa* interbreeding with native species in the secondary range, both in America and Europe. In the British Isles it interbreeds with polyploid *R. canina*, *R. mollis* and *R. caesia* (Eigner and Wissemann 1999, Stace 1997 – P). Potentially, it can create hybrids with all diploid and polyploid species of the *Rosa* genus that are characterised by regular meiosis (Bruun 2005 – P). In cultivation it can interbreed with many taxa of the *Rosa* genus. *R. rugosa*, especially its hybrid *R. ×hollandica*, and is used as a rootstock for cultivated rose varieties. Cultivars and hybrids of *R. rugosa* and several other rose species have been described. The species is popular among rose growers for its resistance to frost and pathogens, as well as variability. In total more than 50 cultivars are grown in Europe and North America, and nearly 40 cultivars of this species are described in China (Burnie et al. 2005 – P).

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

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

aconf18.	Answer provided with a	low	medium	high	level of confidence
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a22.22. Comments:
The invasion of *R. rugosa* to crops has not been reported so the species has no effect on the cultivation system's integrity. Potential impact on food webs has been indicated by competing for pollinators with cultivated plants.

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

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

aconf19.	Answer provided with a	low	medium	high	level of confidence
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a23.23. Comments:
The number of species of insects, viruses, bacteria and fungi hosted by *Rosa rugosa* is greater in its primary range than in the secondary range (Bruun 2006 – P). Some insects are associated only with *Rosa rugosa*. Pathogens attacking *R. rugosa* in its native range have been reported primarily from cultivations. Most insects feeding on *R. rugosa* in its primary range do not occur in Europe. It is also believed that *R. rugosa* in Europe is resistant to bacteria, fungi and insects recorded on other species of roses. In addition, pathogens are transferred from native rose species to *R. rugosa* rather than the opposite way (Bruun 2006 – P). Because cultivated plants belong to taxonomic groups other than *R. rugosa*, the probability of transmitting pathogens by *R. rugosa* to cultivated plants is low. However, such impact cannot be ruled out because there are no relevant data available.

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:

<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

aconf20.	Answer provided with a	low	medium	high	level of confidence
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acomm24.

Comments:

Rosa rugosa is a plant species and has no impact on individual animal health or animal production through predation or parasitism.

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

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

aconf21.

Answer provided with a

low	medium	high X
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level of confidence

acomm25.

Comments:

Rosa rugosa has no negative effect on individual animal health or animal production by having properties that are hazardous upon contact. Nevertheless, prickly stems may create problems to moving animals and cause injury, but the probability of production animals coming into contact with the plants is low.

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

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

aconf22.

Answer provided with a

low	medium	high
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level of confidence

acomm26.

Comments:

Rosa rugosa is a plant species and is not a vector of animal parasites or pathogens.

A4d | Impact on the human domain

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

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

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

aconf23.

Answer provided with a

low	medium	high
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level of confidence

acomm27.

Comments:

Rosa rugosa is an autotrophic plant.

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

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

aconf24.	Answer provided with a	low	medium	high X	level of confidence
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acomment28. Comments:
Negative effects of the species on human health have not been reported, although hypersensitive individuals may be allergic to rose pollen or fragrance (Weidema 2006 – B). *Rosa rugosa* does not produce chemicals that are hazardous to humans upon direct contact. Prickly stems can cause minor injuries, but they do not pose a hazard to human health or life.

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

aconf25.	Answer provided with a	low	medium	high	level of confidence
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acomment29. Comments:
Pathogens associated with the species are not hazardous 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:

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

aconf26.	Answer provided with a	low	medium	high X	level of confidence
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acomment30. Comments:
Rosa rugosa has no negative effect on infrastructure (Weidema 2006 – B).

A5a | Impact on ecosystem services

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

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

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf27. Answer provided with a

low	medium	high X
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 level of confidence

acomm31. Comments:
Rosa rugosa is an important plant for the food, pharmaceutical, perfumery, herbal and horticultural industries (e.g. Bruun 2006, Cendrowski et al. 2012 – P, Fundacja Polska Róża 2015, WiOM 2016 – I). Herbal raw materials obtained from *R. rugosa* are recommended because of their high content of vitamins, especially vitamin C. Rose hips contain antioxidants. They are recommended during convalescence, as a remedy for weakness, fatigue, stress, cold, and for pregnant women. Flavonoids produce a gentle diuretic effect, promote the flow of bile, have antioxidant properties and strengthen capillary walls. Galactolipid (GOPO) contained in the fruit has anti-inflammatory and anti-rheumatic activity. Fresh accessory fruits have a protective effect on the gastric mucosa and antiulcer properties. Rose hip products are used as adjuvants in the treatment of various liver, kidney and gastrointestinal disorders (Lamer-Zarawska et al. 2007 – P).

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf28. Answer provided with a

low	medium X	high
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 level of confidence

acomm32. Comments:
Rosa rugosa, by changing the physical and chemical properties of the substrate and competition, may limit the growth of plant species associated with coastal dune communities (cf. Q a17 and a18). It is a melliferous plant, with flowers very attractive to pollinators. The presence of *R. rugosa* shrubs can positively influence effective the pollination of various plants, both cultivated and wild, because of beneficial effects on insect assemblages. There are, however, reports on its negative impact related to the effective competition of *R. rugosa* for pollinators (cf. Q a18). *R. rugosa* has an impact on regulation services: it forms windbreaks (sheltering from extreme winds), prevents soil erosion and stabilizes dunes. It is widely planted on roadsides (it is resistant to salt used in winter for melting snow and ice). *R. rugosa* is used for plantings protecting soil erosion. It is recommended for the stabilization of waste heaps (Weidema 2006 – B). The effect of species on regulation and maintenance services was indicated as neutral due to its both positive and negative influence.

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf29. Answer provided with a

low	medium	high X
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 level of confidence

acom33. Comments:
Rosa rugosa has a significantly positive effect due to its aesthetic features; it is an inspiration in culture, art and design. Its colourful and fragrant flowers are particularly appealing – they draw attention and lure many insect species, but the plant also has vivid fruits. *R. rugosa* has important organoleptic qualities and medicinal properties – some parts of the plant are edible, and the plant has been known and used for a long time in phytotherapy. Single shrubs and groups of the rugosa rose may increase the aesthetic quality of landscape and have a positive effect on recreational functions. On the other hand, large spreading prickly shrubs of *R. rugosa* can limit access to attractive tourist areas (Weidema 2009 – B), because compact patches of the plant are difficult to penetrate for humans (Stace and Crawly 2015 – P). Hill et al. (2010 – P) estimated that 45% of beaches by the Gulf of St. Lawrence (Nova Scotia, USA) are occupied by *R. rugosa*, and the species covers 8.8% of their surface area. Thickets formed by *R. rugosa* may reduce the quality of the coastal landscape (by eliminating typical dune plant communities) and inland landscapes (overgrowing/elimination of xerothermic grasslands (Herbich 2004 – P).

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	high X
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 level of confidence

acom34. Comments:
 The species is already present in Poland (Adamowski and Bomanowska 2008, Tokarska-Guzik et al. 2012, Bomanowska et al. 2014, Eichmann and Afranowicz-Ciepelak 2014, Czyryca 2017 – P, Popiela 2018 – A, Zajęc 2018 – I) in a wide spectrum of climatic conditions (Bruun 2005, Richardson and Rejmanek 2011– P). It is resistant to drought and frost (Weidema 2009 – B). Therefore, the effect of climate change in the predicted range is insignificant.

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	high X
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 level of confidence

acomm35. Comments:
The species is established in Poland and present throughout the country (Adamowski and Bomanowska 2008, Zajac and Zajac 2001, Tokarska-Guzik et al. 2012, Bomanowska et al. 2014, Eichmann and Afranowicz-Ciepelak 2014, Czyryca 2017 – P) in a wide range of climatic conditions; it is resistant to drought and frost (Bruun 2005 – P, Weidema 2009 – B). In Poland it reproduces from seeds and vegetative parts of the plant (Brzosko et al. 2016 – P). Therefore, the effect of climate change in the predicted range is insignificant.

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	high X
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 level of confidence

acomm36. Comments:
The species is established in Poland and present throughout the country (Zajac and Zajac 2001, Tokarska-Guzik et al. 2012 – P) in a wide range of climatic conditions; it is resistant to drought and frost (Bruun 2005 – P, Weidema 2009 – B). In Poland it reproduces from seeds and vegetative parts of the plant (Brzosko et al. 2016 – P). Therefore, it can be assumed that climate change will not increase its dispersal and reproductive success.

a37. IMPACT ON THE ENVIRONMENTAL DOMAIN – Due to climate change, the consequences of *the species* on wild animals and plants, habitats and ecosystems in Poland will:

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf33. Answer provided with a

low	medium	high X
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 level of confidence

acomm37. Comments:
The present climate in Poland is optimal for the development of *R. rugosa*. The impact of the species on the environmental domain will probably not change due to climate change.

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 X	high
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 level of confidence

acomm38. Comments:
 The present climate in Poland is optimal for the development of *R. rugosa*. So far, no significant impact of the species on cultivated plants has been reported. It is assumed that the expected climate change will not affect the species and thus cultivated plants (no direct data related to this are available).

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf35. Answer provided with a

low	medium	high X
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 level of confidence

acomm39. Comments:
 The present climate in Poland is optimal for the development of *R. rugosa*. No impact of the species on animal production has been reported. There is no reason to believe that climate change will affect domesticated animals and animal production.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf36. Answer provided with a

low	medium	high X
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 level of confidence

acomm40. Comments:
 The species is established in Poland and present throughout the country (Zajac and Zajac 2001, Tokarska-Guzik et al. 2012 – P). The climate change in the predicted range will not change the impact of the species on humans.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf37. Answer provided with a

low	medium	high X
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 level of confidence

acomm41. Comments:
R. rugosa has no negative impact on infrastructure (Weidema 2006 – B). Climate change is not expected to change the impact of species in other domains.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.88	1.00
Environmental impact (questions: a13-a18)	0.60	0.80
Cultivated plants impact (questions: a19-a23)	0.05	0.60
Domesticated animals impact (questions: a24-a26)	0.00	1.00
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	0.96	1.00
Impact (questions: a13-a30)	0.60	0.88
Overall risk score	0.58	
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:

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Data sources

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