Risk assessment

Rosa rugosa Thunb. ex Murray

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Risk assessment

Rosa rugosa Thunb. ex Murray

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This report was commissioned by the Invasive Alien Species Team of the Netherlands Food and Consumer Product Safety Authority.

1. Introduction

Exotic, invasive plant species have a negative impact on biodiversity, economy and/or public health. *Rosa rugosa* is a potential invasive alien plant species. For this reason the Invasive Alien Species Team of the Netherlands Food and Consumer Product Safety Authority has requested a risk assessment for *Rosa rugosa*.

The current risk assessment will focus on the situation in the Netherlands and discuss the following subjects:

- Probability of entry
- Probability of establishment in the Netherlands
- Probability of spread
- Identification of endangered areas based on the results of the three previous subjects
- Impact of *Rosa rugosa* in respect to ecological, economical and public health aspects
- Management options to eradicate the species
- Management options to control further spread and reduce impact.

This report is based on published literature, either in print or in the internet.

2. *Rosa rugosa*: description, ecology and history

2.1. Description

Rosa rugosa (Japanese Rose, rugosa rose) is a deciduous, multi-stemmed shrub, 1-2 m tall, belonging to the Rosaceae family. Twigs stout and covered with thin, straight sharp spines of various sizes; rhizomes woody with triangulate scale leaves; leaves alternate, compound, with (5-)7-9 leaflets, leaflets 2-5 x 1,5-3 cm, surface wrinkled, dark green, smooth above, pubescent, with sessile glands and slightly sticky underneath, leaflet margin crenate-serrate, involute, edge of teeth often deflexed; stipules densely pubescent, divergent; flowers usually solitary or few together, 5-merous, 6-10 cm in diameter, fragrant, bright purplish-pink, occasionally white (in *Rosa rugosa* var. *alba*), doubled flowers also occur in the wild, stamens 200-250 per flower, styles over 100, pedicel 5-25 mm; fruits large and slightly flattened, up to 2,5 cm wide, shiny, deep red and fleshy "rose-hips" (Weidema, 2006, Starfinger et al., 2008, van der Meijden, 2005, Bruun, 2005).

Rosa 'Hollandica' is a variety which is often mistaken for *Rosa rugosa*. Leaves of the variety are almost glabrous and have stalked glands on the lower side and the hip has glands whereas the hips of *Rosa rugosa* lacks these glands (van der Meijden, 2005).

2.2. Ecology

Rosa rugosa occurs naturally in eastern Asia from Ochotsk and southern Kamchatka to Korea and the northern parts of Japan and China. In its native area of distribution the species is found at coastal hillsides, sandy soils on sea shores and offshore islands; it occurs only below 100 m a.s.l. In this area it is found in dune scrub, dune grassland communities and shingle beaches, less frequently in tall-herbs meadows. These are the older development stages of dunes, where sand still occasionally covers the plants or where sand is stabilized. In the course of further succession these areas develop into dune forests, like those with pines (*Pinus thunbergii*).
In natural stands a shoot density of 10 per m^2 has been reported, but much higher densities are not an exception (Bruun, 2005; Starfinger et al., 2008).

Figure 1 Attractive purple flower.

Figure 2 Compound leaf with wrinkled surface.

3. Risk assessment

3.1. Entry

The first records of the species being introduced from Japan to Europe are from 1796, but only after 1845 the species became more abundant in Europe (Weidema, 2006). In the late 1800s and throughout the 20th Century the interest in utilising the species has grown.

Rosa rugosa has been planted worldwide as it is a harsh species, highly adaptable to local conditions, resistant to frost and tolerant of salt spray; moreover it tolerates moving sand layers as found in the dunes. It does not tolerate poorly drained sites. In Europe, it has been planted extensively as an ornamental species and for erosion control in coastal areas, more in particular for sand dune stabilization. As its growth can be very dense it is also used as living hedge, especially for the regulation of visitor movements in the dunes. In inland areas, *Rosa rugosa* is often planted along roadsides as it one of the few plants that tolerate wintertime salting of roads; moreover it is planted in flower beds by local authorities. In the Netherlands, it was planted during the second world-war to hide bunkers.

Many varieties of *Rosa rugosa* are available with commercial growers in the Netherlands. A well-know variety is *R. rugosa* var. *alba* with white flowers.

The probability of entry in the Netherlands is very high.

3.2. Establishment

The first records of naturalised Japanese Rose in Europe are from Germany in 1845 and Denmark in 1875. In Sweden the first observation was made in 1918, in Finland in 1919, in Norway in the 1940s, in Lithuania in 1937, while the first seashore locality was registered in 1928 in one of the Scandinavian countries (Nilsson, 1999 in: Weidema, 2006). In the Netherlands, the species was first found naturalised in 1926 (Leni Duistermaat, pers. comm. In: Weidema, 2006), and is now the third commonest rose species in the country (Bakker et al., 2011: 127).

From a study in Denmark, it is clear that establishment of *Rosa rugosa* is dependent on the availability of seed in coastal dune habitats, and that the species is able to establish in both active and fixed dunes once seeds have arrived (Kollmann et al., 2007). This implies that establishment in uninfested dune habitats may be prevented by controlling nearby seed sources.

Often seashore stands are descendants of shrubs planted in gardens of villas and summer cottages, while inland road-side plantings are important sources of naturalisation (Weidema, 2006).

Rosa rugosa is found naturalised in the following countries (Q-Bank, 2012); see Figure 4:

- Europe: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Former USSR, Germany, Ireland, Latvia, Lithuania, Netherlands, Norway, Poland, Romania, Sweden, United Kingdom
- Asia: Japan
- North America: Canada, USA.

Figure 5 shows the distribution in the Netherlands based on floristic inventories (FLORON & NHN, 2012). All over the northern and western parts of the coast *Rosa rugosa* is present.

The probability of establishment in the Netherlands is very high, and has already occurred.

3.3. Dispersal

Dispersal of *Rosa rugosa* is vegetatively by root suckers and fragmented rhizomes and generatively by fruits and seeds.

Heavy fruiting usually begins in the second year of establishment. The hips of Japanese Rose are extraordinarily buoyant and can float up to 40 weeks in both fresh water and seawater. After this the hips would disintegrate revealing the seeds inside. The seeds, however, are also buoyant for several weeks on their own, due to special tissues in the cell walls of the seeds. After such a period seeds remain viable. This shows that Japanese Rose is

Figure 3 Stem with various types of spines.

Figure 6 Hips in autumn.

Figure 5 Distribution in the Netherlands

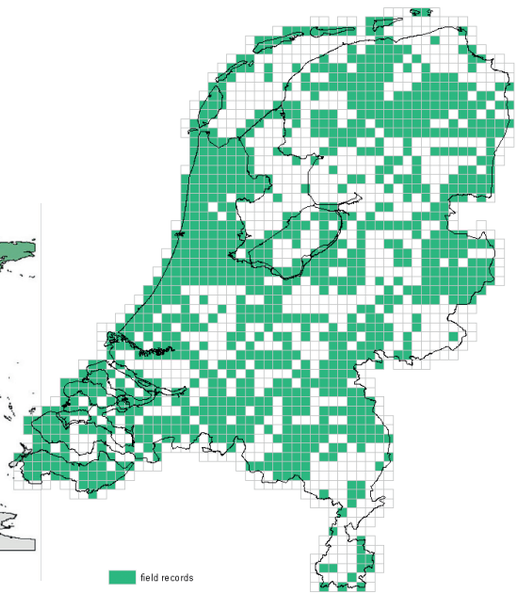
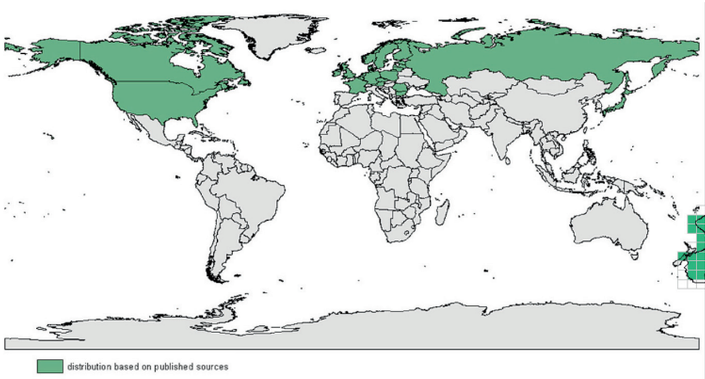


Figure 4 World distribution



very well adapted to dispersal by sea water (Jessen, 1958 in: Weidema, 2006). Seed dispersal by birds is a general phenomenon and is reported for several countries. It is eaten by European Greenfinch and thrushes (Bakker et al., 2011). Seed-eaters like finches disperse the plant by spilling seed while eating, whereas frugivorous birds like thrushes account for long distance dispersal of the seed. Seeds in the soil can remain viable for several years; dormancy is broken by a long cold period during at least five weeks (Essl, 2006).

Vegetative spread by root suckers is very efficient and can lead to stands covering a hectare. In dune sands it can profit from the mycorrhizae present by increased vegetative spread. Rhizomes from clones can extend 1-5 m to produce young shoots. Fragmented rhizomes can also be spread by water of by human intervention and these sprout and establish easily.

In a study in Denmark is was shown that dispersal and establishment was significantly higher close to the coastline, probably because propagules are deposited there by water and wind. Moreover, Japanese Rose occurrence was also correlated with the distance to roads, tracks and houses, hence related to human disturbance and slightly higher nutrient loads close to houses (Jørgensen & Kollmann, 2008). Also in Canada heavily colonized beaches were found adjacent to communities where extensive domestic planting and hedges of *Rosa rugosa* occurred and where escapes onto road-sides had occurred (Hill et al., 2010). Apart from coastal areas and road-sides, *Rosa rugosa* also invades ruderal sites (Starfinger et al., 2008).

By examination of aerial photographs of a coastal heath in Denmark one found that *Rosa rugosa* had spread from a few clones to a more or less contiguous area of 3.5 ha in less than 50 years (Didriksen, 1999 in: Bruun, 2005).

In Norway, Finland and Denmark it has been reported to occur on uninhabited isolated islands where human dispersal is unlikely. Dispersal of hips by

seawater is the most likely explanation (Weidema, 2006).

Within the past four decades, the distribution and local abundance of *Rosa rugosa* has increased markedly in the coastal areas of the Netherlands, Germany, Denmark, Norway, Sweden and Lithuania and it has colonized various habitat types due to its high reproductive capacity, seed dispersal by frugivorous birds, water and wind, and water transport of vegetative fragments (Kollmann et al., 2007).

The probability of spread by fruit and seed dispersal is high and the distance over which fruits can be spread in a short time by sea water is very large. Once established, colonization through vegetative reproduction by root suckers is intense, but limited in distance, in the order of 1 to a few m/year.

3.4. Endangered areas

In Denmark, coastal heath has been invaded by Japanese Rose (Didriksen, 1999 in: Bruun, 2005).

Beach and dune vegetation along the coast of the Netherlands are at risk. Both young and old dunes are characterised by open vegetation types, where *Rosa rugosa* is a serious threat.

3.5. Impact

It is often well-naturalised, forming extensive and dense thickets, which can smother native species, so reducing biodiversity and dominating amenity planting (Jukes et al., 2012).

Rosa rugosa forms extensive impenetrable thickets due to root and stem suckering. It displaces the natural flora of beach and dune vegetation and outcompetes early successional plant species in these habitats (Branquart et al., 2010). It reduces the number of native species, irrespective of the dune type in which the shrub is established, affecting both common and rare species (Isermann, 2009). The strong reduction of the species diversity is caused by the shading effect due to the high stand density. When local plant life is displaced the animal species that depend on these plants are also threatened (such as butterflies that lay the eggs only on certain seashore plants). A special problem is that *Rosa rugosa* has ecological demands comparable to those of *Rosa pimpinellifolia* and that especially young succession phases in dunes are affected (Weidema, 2006).

As indicated earlier, it has been found to colonize uninhabited, isolated islands affecting the pristine ecosystem. Besides, thickets of *Rosa rugosa* were seen starting dune formation, thereby altering the physical habitat substantially (Weidema, 2006).

3.5.1. Ecological impact

Dense thickets of *Rosa rugosa* have a direct negative impact on species diversity of dune plant communities: the number of species is seriously reduced, caused by a high density and inherent shade. This is evident in the affected areas in the dunes in the Netherlands. Especially young dune succession phases are affected. As *Rosa rugosa* occupies an ecological niche similar to that of *Rosa pimpinellifolia* and is a stronger competitor, the latter native rose is seriously threatened in *Rosa rugosa*-invaded dunes.

Rosa rugosa is known to form hybrids with native rose species. In Norway, spontaneous hybrids between *Rosa rugosa* and *Rosa majalis* are known (Lid & Lid, 2005 in: Weidema, 2006). *Rosa majalis* is a very rare species in the Netherlands (Bakker et al., 2011). In the UK, spontaneous hybrids are known with *Rosa canina* (= *R. x praegeri*), Rosa mollis Sm. (= *Rosa x mangii*) and *Rosa caesia* (Bruun, 2005).

The level of ecological impact in The Netherlands is high.

3.5.2. Economic impact

Japanese Rose has positive economic impact as ornamental with large and attractive flowers. It also serves economic purposes as a hedge, windbreak, in landscaping e.g. along highways and in cities and for erosion control (Weidema, 2006).

Figure 7 Infestation in the dunes in the Netherlands.

Figure 8 Attractive flowers and young fruits.

Rosa rugosa is used in breeding other cultivars of roses, viz. as rootstock.

Control and eradication programmes increase the cost of management of vulnerable nature conservation areas as well as amenity planting (Jukes et al., 2012).

The potential level of economic impact in the Netherlands is low.

3.5.3. Social impact
The species is often pictured in tourist guides and postcards as typical element of the dunes. Therefore, the general public may have difficulties in accepting that removal is necessary to provide room for native species. Education and raising awareness is needed (Weidema, 2006).

Dunes can become inaccessible due to the thickets *Rosa rugosa* can form, which can be both of positive and a negative impact (Essl, 2006).

Rosa rugosa has culinary uses in preserves, jelly and wine production. Furthermore, the floral scent is used in perfumes and in personal care articles. Extracts of the flowers or hips have also been used in herbal medicines and vitamin products (Weidema, 2006).

The potential level of social impact in the Netherlands is moderate.

4. Risk management

4.1. Prevention of deliberate plantings

It has been suggested to prohibit plantings in a strip of 50 km along the coast as to prevent undesired spread in dune plant communities (Essl, 2006). This is a first step in dealing with serious infestations in the dunes in the Netherlands.

The use of *Rosa rugosa* as rootstock for the cultivation of other roses is likely to continue and may present little problems.

4.2. Prevention of dispersal

From research it has been concluded that the dispersal and establishment of *Rosa rugosa* is seed-limited, meaning that uninfested areas can only be infested when seeds arrive. Seed set of colonies near vulnerable nature sites should be prevented, but in Europe there is no experience in this respect.

4.3. Eradication and control

Once control measures for this plant are initiated there is a need for continued dedication to the chosen approach. Therefore, it is only advisable to initiate measures if sufficient capacity is available to ensure successful eradication.

To control or eradicate shrubs, the following measures can be taken:

- Manual
- Mechanical
- Chemical
- Biological

Manual measures

The most efficient method for removing the species is to dig it up. There is a need to ensure that all rhizomes and roots have been removed. Furthermore, the procedure needs to be repeated until one is certain that all rhizome pieces have been found and removed (Weidema, 2006).

Mechanical measures

When plants are cut down, vigorous regrowth takes place. It has an adverse effect as it will only rejuvenate the plants.

Mechanical removal by a kind of caterpillar machines with a loading shovel has been used in Hanko district, Finland. The machines have taken a whole layer of sand away from the depth were the rhizomes were found. As a result, the above-ground shrubs and most of the rhizomes have been removed. Pieces of rhizomes have been left and these have been treated manually or with herbicides afterwards (Weidema, 2006).

For a dune area in the Netherlands, a similar measure is planned: areas of up to 1500 m^2 are dug out to a depth of 1 m and all the sand is sieved to remove any rhizome fragments (Gemeente Den Haag, 2011).

Chemical measures

In the Netherlands it is proposed to cut or mow the existing *Rosa rugosa* with machinery located on the paths or roads in order to reduce impact on the native vegetation. The cut shrubs are brushed with Garlon, a product with triclopyr as active ingredient. Garlon will be banned from use in the Netherlands by November 2012, therefore another systemic herbicide should be used (de Vries, 2011; Landschap Noord Holland, 2012).

Biological measures

Grazing has been suggested to control *Rosa rugosa* infestations; grazing, however, provokes vigorous regrowth by rhizomes, and very heavy grazing is necessary, often altering the plant community in an adverse direction. Grazing by sheep is generally not a good option through eutrophication and damage by tread. Goats are the only animals that seem to be able to graze *Rosa rugosa* enough to control it efficiently (Starfinger et al., 2008; Weidema, 2006).

4.4.Conclusions

Rosa rugosa is widely found in the countries at the North Sea and at the Baltic Sea and is in all these countries displaying invasive behaviour. Entry in the Netherlands occurred over 100 years

ago; subsequent naturalisation occurred many years later. The risk of further dispersal and establishment is high as it can spread easily and rapidly by fruits and seed which are dispersed by birds and by water.

Impact on the plant communities in the dunes is high as *Rosa rugosa* forms dense thickets which displace native plants and alter the physical environment by enhancing sand stabilization and dune formation.

Eradication will be a major challenge; leaving infestations in place will unavoidable lead to an increase in the surface covered by *Rosa rugosa*, as has been seen in many coastal areas in Europe. In this respect digging up the plants and sieving the sand seems the best option, but monitoring and sustained treatment of these areas is a prerequisite.

It is advisable to prevent further planting of *Rosa rugosa* particularly in areas near the coast, as these plantings have been the centres of infection in the past.

5. References

Bakker, P.A., Maes, N.C.M. & Kruijer, J.D., 2011. De wilde rozen (Rosa L.) van Nederland. Gorteria 35 (1-4): 1-173.

Branquart, E., Vanderhoeven, S., Van Landuyt, W., Van Rossum, F. & Verloove, F., 2010. *Rosa rugosa* - Rugosa rose. Invasive species in Belgium. http://ias.biodiversity.be/species/show/92 [Accessed 27 March 2012]

Bruun, H.H., 2005. *Rosa rugosa* Thunb. Ex Murray. Biological Fora of the British Isles. Journal of Ecology 93: 441-470.

De Vries, H., 2011. Bestrijding rimpelroosje. http://www.landschapnoordholland.nl/sites/default/files/bestrijding%20Rimpelroos.pdf [Accessed 3 April 2012]

Dickerson, J. and Miller, C., 2002. Rugosa rose – *Rosa rugosa* Thunb. Plant Fact Sheet NRCS-USDA. http://plants.usda.gov/factsheet/pdf/fs_roru.pdf 2 pp. [Accessed: 27 March 2012]

Essl, F., 2006. *Rosa rugosa*. Factsheet from DAISIE (Delivering Alien Invasive Species Inventories in Europe). http://www.europe-aliens.org/pdf/Rosa_rugosa.pdf. [Accessed 2 April 2012]

FLORON, Stichting & Nationaal Herbarium Nederland (NHN), 2012. FlorBase. http://www.floron.nl [data not online accessible]

Gemeente Den Haag, 2011. Westduinpark. Aanvraag Waterwetvergunning. http://www.hhdelfland.nl/contents/vergaderagenda/382/D955101V2051434.pdf [Accessed 3 April 2012].

Hill, N., Beveridge, L., Flynn, A. & Garbary, D.J., 2010. *Rosa rugosa* as an Invader of Coastal Sand Dunes of Cape Breton Island and Mainland of Nova Scotia. Canadian Field-Naturalist. 124(2): 151-158.

Isermann, M., 2009. Expansion of *Rosa rugosa* in coastal dunes. Bulletin of the European Dry Grassland Group 2: 14-15. http://www.edgg.org/publ/bulletin/Bulletin%20EDGG%202.pdf

Jørgensen, R.H. & Kollmann, J., 2008. Invasion of coastal dunes by the alien shrub *Rosa rugosa* is associated with roads, tracks and houses. Flora 204: 289-297.

Jukes, A., Ames, V., Wade M. and McKee, K., 2012. Japanese Rose. https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=117 2 pp. [Accessed: 27 March 2012]

Kollmann, J., Frederiksen, L., Vestergaard, P. & Bruun, H.H., 2007. Limiting factors for seedling emergence and establishment of the invasive non-native *Rosa rugosa* in a coastal dune system. Biological Invasions 9: 31-42.

Landschap Noord Holland, 2012. Maatregelen. http://www.landschapnoordholland.nl/maatregelen. [Accessed 3 April 2012]

Q-Bank, 2012. Rosa rugose. [record from database on invasive plants]. http://www.q-bank.eu/Plants/BioloMICS.aspx?Table=Plants%20-%20Species&Rec=72&Fields=All [Accessed: 27 March 2012]

Starfinger, U., Kowarik, I., Isermann, M. & Klingenstein, F., 2008. *Rosa rugosa* Thunb. (Rosaceae), Kartoffel-Rose. http://www.floraweb.de/neoflora/handbuch/rosarugosa.pdf [Accessed 2 April 2012].

van der Meijden, 2005. Heukels' Flora van Nederland. 23e druk. Wolters-Noordhoff, Groningen/Houten. 685 pp.

Weidema, I., 2006. NOBANIS – Invasive Alien Species Fact Sheet – *Rosa rugosa*. From: Online Database of the North European and Baltic Network on Invasive Alien Species – NOBANIS 13 pp. www.nobanis.org [Accessed: 27 March 2012].

Annex 1

Risk assessment scores using the ISEIA protocol

The following risk assessments is based on E. Branquart (Editor), 2009. Guidelines for environmental impact assessment and list classification of non-native organisms in Belgium. version 2.6 dated 7-12-2009, commonly referred to as the ISEIA - Invasive Species Environmental Impact Assessment - protocol. These guidelines are published at: http://ias.biodiversity.be/documents/ISEIA_protocol.pdf.

This protocol aims to assess environmental risks only and do not take into consideration the direct impact of non-native species on human interests.

In Belgium, the ISEIA protocol has also been adopted and *Rosa rugosa* obtained a total score of 12.

The risk categories are scored as follows:
Score 1: risk is low
Score 2: risk is medium
Score 3: risk is high

The different scores are detailed for every type of risk in the ISEIA protocol.

Risk	Risk category
Dispersion potential or invasiveness	3
Colonization of high conservation value habitats	2
Adverse impacts on native species	3
Alteration of ecosystem functions	2

Dispersion potential or invasiveness: *Rosa rugosa* fruits can be dispersed by sea over considerable distances in a short lapse of time. Uninhabited islands have been infested in this way. Once established the rhizomes assure that the species spreads further and sustain the colonization process. Seeds remain viable for several years and form a seed soil bank. The score for this category is high (score 3).

Colonization of high conservation value habitats: In countries at the Nordic and Baltic Seas, infestations occur in the various dune plant communities from the shoreline land inward to stabilized sand dunes. Some of these vegetation types are vulnerable and rare and are seriously altered by *Rosa rugosa*, hence the risk is high. As the vegetation types of the dunes are restricted to narrow strips along the coast of the Netherlands, the overall risk is assessed to be medium (score 2).

Adverse impacts on native species: From experiences documented in affected areas it is clear that native plant species are displaced, both common and rare species. Of the rarer species particularly *Rosa pimpinellifolia*, but also *Salix repens* are outcompeted by *Rosa rugosa*. The adverse impact on native species therefore is high (score 3).

Alteration of ecosystem functions: It is documented that *Rosa rugosa* thickets cause sand fixation in the dunes limiting ecosystem dynamics. Effects on soil nutrient levels are ambiguous and have not been discussed in the present report. The risk of this category is assessed to be medium (score 2).