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. Władysław Danielewicz
2. Zofia Sotek
3. Barbara Sudnik-Wójcikowska

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr hab.	Department of Forest Botany, Faculty of Forestry, Poznań University of Life Sciences	24-03-2018
(2)	dr hab.	Department of Botany and Nature Conservation, Faculty of Biology, University of Szczecin	09-04-2018
(3)	dr hab.	Department of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw; Biological and Chemical Research Centre, University of Warsaw	16-04-2018

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

Polish name: Powojnik pnący

Latin name: ***Clematis vitalba*** L.

English name: Old man's beard

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 scientific name was adopted after The Plant List (2013 – B), and the Polish name after Mirek et al. (2002 – P). Apart from the synonyms listed below, another English common name, virgin's bower, is used (CABI 2017 – B).

Polish name (synonym I) –	Polish name (synonym II) –
Latin name (synonym I) –	Latin name (synonym II) –
English name (synonym I) Evergreen clematis	English name (synonym II) Traveller's joy

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 **X**	level of confidence

acomm04.	Comments: *Clematis vitalba* is regarded as an alien and established species in Poland (Mirek et al. 2002, Rutkowski 2006, Tokarska-Guzik et al. 2012, Popiela et al. 2015 – P), and was formerly treated as a native species with sites by the middle section of the Vistula river (Szafer et al. 1924 – P), or a species of uncertain status in flora (Boratyński 1974, Bugała 2000 – P). It is regarded as a native species almost all over Europe (with the exception of, e.g. Ireland, Norway and Sweden) (Raab-Straube 2014 – B). The closest sites of this species to Poland and regarded as natural are in Slovakia (Futak 1982 – P). *Clematis vitalba* has been grown for a long time in parks and gardens as an ornamental plant and naturalized outside of them (Rutkowski 2006 – P). *C. vitalba* is found in 17 botanical gardens and arboreta and is cultivated in 14 of them. Spontaneous dispersal of *C. vitalba* was reported from 9 institutions (Employees of botanical garden ... 2018 – N). It is listed among regional invasive plants that increase their area or number of sites occupied or are known from other countries for their strong invasive potential (Tokarska-Guzik et al. 2012 – P). In the natural environment in Poland it grows in various types of thickets (Szafer et al. 1988 – P) and is a species characteristic for the *Rhamno-Prunetea* class, and locally also for *Pruno-Ligustretum* association (Matuszkiewicz 2001 – P).

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
X	the domesticated animals domain
X	the human domain
X	the other domains

acomm05.	Comments:

Clematis vitalba reduces biodiversity – it is a highly competitive climber, and physically limits plants which it climbs on, shading them and reducing their viability. In this way it can lead to the decline of native species sharing the same site. It suppresses other plants growing in parks and gardens and in public green spaces within residential districts (Seneta 1994 – P, Danielewicz 1980-2017 – A). It occupies ruderal habitats, e.g. in urban areas, post-industrial areas, on the ruins of buildings, and excavation pits (Czekalski and Nowak 1988, Kidawska 2005 – P). It is a host for the alfalfa mosaic virus (Polak 1996 – P), wheat brown rust, and phytoplasma causing a serious grapevine disease (Angelini et al. 2004 – P). The plant is toxic and consumed in large amounts causes poisoning in grazing animals (Pieroni 1999 – P, CABI 2017 – B). Direct contact may cause irritation to human skin (Moore 1971 – P). Large populations of this species, e.g. along roads and railways and power lines, may disturb the operation of infrastructure.

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:

Clematis vitalba is regarded as a native species in countries neighbouring Poland – in Ukraine and Slovakia, in the Czech Republic and Germany, but also in all of western and southern Europe (CABI 2017 – B), but not all its sites there are natural. The self-propelled expansion of *C. vitalba* following its introduction outside the area of Poland is therefore difficult to explain. It seems quite likely that the species was not introduced to Poland as a result of self-propelled expansion from neighbouring countries. *Clematis vitalba* has been grown in Poland since the 16th century (Syreniusz 1613, Kluk 1786 – P). It has been reported as an easily naturalized plant in Poland by Waga (1847 – P) and Łapczyński (1889 – P) [after Tokarska-Guzik 2005-P]. Previous observations have demonstrated that the species in Poland has achieved a strong capacity for spontaneous expansion because of sexual reproduction through achenes with silky appendages easily dispersed by wind and a strong growth allowing climbing on supports, mainly trees, up to a height of 30 m, at a rate about 3 m per year. Diaspores can also easily spread along watercourses (CABI 2017 – B). According to the *Harmonia*$^{+PL}$ Procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland, it should be assumed that the probability of the species to expand into Poland's natural environments as a result of self-propelled (spontaneous) expansion is high, with a high level of confidence.

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:

Propagules of *Clematis vitalba* (whole plants, rooted fragments of shoots, achenes) may be unintentionally dispersed during earthworks on sites occupied by this species and transported with soil to other places. In this way, *C. vitalba* invades different types of landfills or waste disposal sites, which is important if they are located in the vicinity of valuable natural areas. The expansion of this climber is facilitated by maintaining and enlarging the area of ruderal habitats. Achenes of *C. vitalba* growing on roadsides can be dispersed by vehicles (von der Lippe et al. 2013 – 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:

Although the species is currently not often introduced to gardens, and non-invasive varieties of large flowered clematis are more popular as ornamental plants (Marczyński 2008 – P), some authors recommend growing *C. vitalba* in mid-field woodlots (Karg and Bałazy 2011 – P). *Clematis vitalba* is sold in garden shops (also online), from where it reaches private gardens in an uncontrolled way. It can escape from private gardens to the natural environment. In addition, clippings from large plants can be intentionally dumped by humans, e.g. on waste heaps whose location is significant for the dispersal of the species. Although the probability of introducing the species is currently medium, the final score is overestimated in the *Harmonia*$^{+PL}$ procedure.

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 native range of *Clematis vitalba* covers a large area, from central and southern Europe and north-west Africa to south-west Asia, and a variety of climatic conditions (CABI 2017 – B). It is believed that the distribution of *Clematis vitalba* is determined by the mean temperature of July 16-19^{o}C (Fitter 1978 – P, after Cabi 2017 – B). In Poland it is regarded as an established species (Tokarska-Guzik et al. 2012 – P). It occurs mainly in the western and southern parts of the country, although it is suitable for cultivation throughout Poland, except the mountains (Bojarczuk et al. 1980 – P). It is assumed that low temperature is a factor limiting the spread of *Clematis vitalba* (Atkinson 1984 – P), and this could explain the very limited number of its sites in the north-eastern part of Poland, as well as high in the mountains.

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, as in other Central European countries (Ellenberg et al. 1991 – P), *C. vitalba* grows on dry, moderately poor (mesotrophic), mineral-humic soils with pH from neutral to alkaline (Zarzycki et al. 2002 – P). According to Atkinson (1984 – P), *Clematis vitalba* does not seem to be particularly sensitive to soil pH or nutrient deficiency. In the middle section of the Vistula valley it usually grows on warmer and drier sites (Boratyński 1974 – P). It also grows in ruderal habitats, so it is regarded as an urbanophilic plant (Kidawska 2005 – P), i.e. with a preference for urban environments. According to Zarzycki et al. (2002 – P), *Clematis vitalba*'s indicator value for light is 4 (moderate light), and 5 for temperature (the warmest regions and micro-habitats, thermally privileged areas).

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
X	medium
	high
	very high

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

acomm11. Comments:

Dispersal from a single source (Data type A). *Clematis vitalba* produces small fruits (achenes) with feathery appendages easily spread by the wind up to a 100 m distance (Vittoz and Engler 2007 – P) or dispersed by water (CABI 2017 – B). Fruits can also be dispersed by attachment to animals. Then it is possible to assess the capacity of the species to disperse within Poland by natural means, on the medium level (500 m up to 5 km for the year). Germination of seeds does not require special environmental conditions and is usually quite effective (Tylkowski 2016 – P).

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 **X**	medium	high	level of confidence

acomm12.	Comments: The species is available in garden shops but there are no data on the frequency of its use as an ornamental plant in Poland. The frequency of accidental dispersal of diaspores (fruits, fragments of stems) is not very high. Because there is a real possibility of intentional and unintentional dispersal of diaspores by humans, we adopted the 'medium' score with a low level of confidence.

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: *Clematis vitalba* is a non-parasitic plant species.

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

	low
	medium
X	high

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

acomm14.	Comments: No detailed studies have been carried out on the effect of *Clematis vitalba* on native flora in Poland. The spread of the species has been reported, for example, in riparian forests growing on the slopes of river valleys and in gorges, e.g. in the Odra valley, in the area of the "Bielinek nad Odrą" nature reserve (Celiński and Filipek 1958, Jermaczek and Pawlaczyk 1999, Danielewicz 2008 – P), and on moraine slopes, e.g. in Wielkopolska National Park (Szulczewski 1963, Danielewicz and Maliński 1995, Żukowski et al. 1995 – P). In the Vistula valley, *C. vitalba* colonizes thickets and xerothermic grasslands (Boratyński 1974 – P). It can be expected that this species will compete with native plant species, like in other areas of its occurrence. *Clematis vitalba* is a fast-growing vine (up to 3 m per year) (CABI 2017 – B), and in large populations can create a dense canopy. In this case it can quickly shade and restrict the growth of other plant species, and cause the decline of some of them. This lush heavy vine climbing on other plants can cause mechanical damage (CABI 2017 – B). The scale of the threat can be illustrated by the case of forest reserves in New Zealand, where

	the spread of *C. vitalba* 70 years after its first occurrence in well-established forest communities caused serious disturbance to forest structure and loss of native biodiversity, because of inhibited recruitment of native species (Ogle et al. 2000 – P).

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

X	no / very low
	low
	medium
	high
	very high

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

acomm15.	Comments:
	No hybrids of *C. vitalba* with native *Clematis* species – the Alpine clematis *C. alpina* or the erect clematis *C. recta* have been reported.

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

	very low
	low
X	medium
	high
	very high

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

acomm16.	Comments:
	Clematis vitalba is an intermediate host of brown leaf rust on wheat *Puccinia recondita* f. sp. *tritici*, whose definitive hosts include wild grasses (Tratwal et al. 2017 – P) and cultivated grasses, e.g. the common wheat *Triticum aestivum,* and the rivet wheat *T. turgidum*, an ephemerophyte (alien species, accidentally introduced, transiently present and not established in Polish flora) (Collins 1996 – P).

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

	low
	medium
X	high

aconf13.	Answer provided with a	low	medium **X**	high	level of confidence

acomm17.	Comments:
	Clematis vitalba, because of its vigorous growth, can restrict the access of other plants to nutrients accumulated in the soil, but most of all to light, which results in reduced photosynthetic efficiency. *C. vitalba* most rapidly colonizes disturbed habitats, but also poses a threat to Natura 2000 habitats, so it should be considered that in the worst case it can cause difficult to reverse changes in habitats of special concern.

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:

Because of its strong competitive properties *Clematis vitalba* can have a negative effect on ecosystem integrity by disturbing its biotic properties. *C. vitalba* is a fast-growing plant and can restrict the growth of other species and compromise their development (cf. Q a14). *C. vitalba* may limit the number of these species (especially those which are shade-intolerant), and in extreme cases cause their decline in the occupied habitat. This plant mainly colonizes anthropogenic habitats, especially ruderal ones. However, it also poses a threat to Natura 2000 habitats, especially to habitat type 6210 – steppic grasslands (*Festuco-Brometea*), 9170 – *Galio-Carpinetum* oak-hornbeam forests (*Galio-Carpinetum*, *Tilio-Carpinetum*), and 91F0 – riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ficario-Ulmetum*) (Tokarska-Guzik et al.2012 – P). If *C. vitalba* spreads throughout Poland in a short time, its disturbing effect on the biotic properties of ecosystems will probably be significant. In the worst case *C. vitalba* can cause difficult to reverse changes in processes taking place in habitats of special concern.

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:

Clematis vitalba is a non-parasitic plant species.

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:

Clematis vitalba is a minor weed of cultivated plants, but by competing for light and nutrients it can have a negative effect on plants cultivated in gardens, urban greenery, e.g. parks,

cemeteries and small public green spaces, especially in unmanaged areas (Seneta 1994, Bugała 2000 – P). It climbs other plants and covers them, restricting access to light. It strongly inhibits the growth of young plants. *C. vitalba* has a similar effect on forest vegetation (Danielewicz 1980-2017 – A).

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

	inapplicable
X	no / very low
	low
	medium
	high
	very high

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

acomm21. Comments:

No data are available regarding the interbreeding of *C. vitalba* with cultivated species that are related to it. Spontaneous hybrids have not been reported. However, *C. vitalba* has been artificially hybridized with other species to produce garden varieties such as *C. 'jouiniana'* (*C. vitalba* × *C. davidiana* or *C. vitalba* × *C. heracleifolia*) and *C. 'Paul Farges'* ('summer snow') (*C. vitalba* × *C. potanini*) (CABI 2017 – B).

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

	very low
X	low
	medium
	high
	very high

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

acomm22. Comments:

No data are available on the effect of *C. vitalba* on plants cultivated in Poland through disturbance of the cultivation system's integrity. In other European countries *C. vitalba* damages small trees and hedges, and it is treated as a weed in vineyards (Clay and Dixon 2000 – P) and in pine plantations (CABI 2017 – B). If the species further spreads in Poland, it may cause a similar threat, e.g. in plantations of fruit shrubs, as well as in parks and cemeteries. *C. vitalba* can also have a negative effect on plant collections (e.g. in botanical gardens), where its expansion could lead to the impoverishment of local flora.

Assuming that species is present on the whole territory of Poland, it has been predicted that in the worst case the influence of *Clematis vitalba* will affect less than 1/3 of plant target populations; the condition of plants or yield of cultivated populations can be reduced by c 5-20%.

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

	very low
	low
X	medium
	high
	very high

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

acomm23. Comments:

Clematis vitalba is a host for the alfalfa mosaic virus (Polak 1996 – P) and brown leaf rust on wheat (Collins 1996 – P). It can also be infected with the powdery mildew *Sphaerotheca pannosa*, which often attacks fruit trees, cultivated vegetables, etc. *C. vitalba* is also a host for phytoplasma causing a serious grapevine disease called flavescence dorée (FD) (Angelini et al. 2004 – P). Infected *C. vitalba* plants growing near or in vineyards are particularly dangerous, because there is a high probability of pathogen transmission and spreading the disease to grapevines. The pathogen is listed at EPPO A2 List of pests recommended for regulation as quarantine pests).

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:

Clematis vitalba is a non-parasitic plant species.

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
X	medium
	high
	very high

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

acomm25. Comments:

Clematis vitalba contains toxins, e.g. protoanemonin (Pieroni 1999 – P). This substance is dangerous to animals in large quantities and can cause poisoning and sometimes death. However, the toxicity of plants varies seasonally, so limited and controlled grazing is allowed (CABI 2017 – B).

Assuming that the species is spreading throughout Poland, the probability of contact with farm and home animals will be medium (i.e. 1-100 cases per 100 000 animals per year). Also the effect, i.e. symptoms and duration of the disease, is estimated as medium. Therefore, the effect of the species is assessed as “medium”.

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:

There have been no reports on *C. vitalba* hosting pathogens or parasites that are harmful to animals

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:

C. vitalba is a non-parasitic plant species.

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

	very low
X	low
	medium
	high
	very high

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

acomm28. Comments:

Direct contact with the plant may cause skin irritation in humans (Moore 1971 – P).

Assuming that the species is spreading throughout Poland, the probability of contact with people is medium (1-100 cases per 100 000 people per year), and the effect is low (medical consultations are rare, the disease does not cause absenteeism from work, there are no permanent disabilities, and the level of stress is low). Thus the effect of the species is assessed as “low”.

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:

There have been no reports on *C. vitalba* hosting pathogens or parasites that are harmful to humans.

A4e | Impact on other domains

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

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

	very low
X	low
	medium
	high
	very high

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

acomm30. Comments:

Very large plants can damage elements of infrastructure used as supports, e.g. fences, pergolas, lightning protection systems, or overhead power lines (Danielewicz 1980-2017 – A). Large populations of *C. vitalba* along roads and railways may interfere with the operation of this infrastructure.

Assuming that the species is spreading throughout Poland, the probability of a negative impact on infrastructure is medium (over 1 but not more than 100 incidents per 100 000 structures per year), and the effect is small (completely reversible). Thus the effect of the species is assessed as “low”.

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
X	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

Clematis vitalba hosts pathogens harmful not only for other species of wild plants, but also for cultivated plants, including fruit trees and shrubs, and vegetables. In addition, its abundant growth, limiting access to light, contributes to the weaker development of other plant species. Because of this *C. vitalba* can have a negative effect on yield. Toxins contained in plants can cause poisoning in animals if consumed in excess, but this does not exclude the possibility of limited and controlled grazing, since the toxicity of plants varies seasonally. *C. vitalba* also has a positive effect on provisioning services. Because of its antibacterial and antifungal properties it is used in natural medicine (Khan et al. 2001 – P). Leaf extracts are a component of homeopathic medicines used, e.g. for the treatment of urinary tract diseases (CABI 2017 – B). Charred wood of *C. vitalba* can be used as a matrix for bone regeneration in the treatment of fractures (Colville et al. 1979 – P). In some European countries, e.g. Italy, young shoots of the plant are eaten after brief boiling to inactivate toxins (Pieroni et al. 2002 – P). Considering the above aspects, it was assessed that the impact of the species is "neutral" with a high level of confidence, since the negative effects are offset by positive effects.

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

No available data regarding this aspect. *Clematis vitalba* probably does not have a significant effect on regulation services. There have been no reports on the significant effect of *C. vitalba* on abiotic properties of the ecosystem, disturbing the nutrient cycle or causing marked soil erosion. However, if the species spreads throughout Poland and forms large populations, it may change abiotic properties, and in particular deteriorate light conditions. As a result, plants growing under the canopy of *C. vitalba* will be shaded. *Clematis vitalba* can probably restrict the pollination and dispersal of seeds produced by suppressed plants sharing the same habitat. Because of the form of growth (climber), it is sometimes recommended for planting near noise barriers (Borowski 2012 – P). It improves the performance of noise barriers, and absorbs dust and gaseous pollutants.

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

	significantly negative
	moderately negative
	neutral
X	moderately positive
	significantly positive

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

acomm33. Comments:

C. vitalba is used in gardens as an ornamental plant for covering fences, pergolas, walls etc. (Bugała 2000 – P). When covering noise barriers it has a positive effect on regulation services (Q a32), but also performs aesthetic functions.

A5b | Effect of climate change on the risk assessment of the negative impact of *the species*

Below, each of the Harmonia^{+PL} modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest taking into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes in atmospheric variables listed in its 2013 report on the physical science basis may be used for this purpose. The global temperature is expected to rise by 1 to 2°C by 2046-2065.

Note that the answers to these questions are not used in the calculation of the overall risk score, but can be but can be considered when decisions are made about management of *the species*.

a34. INTRODUCTION – Due to climate change, the probability for *the species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation in Poland will:

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm34. Comments:

Clematis vitalba is already well-established in almost all regions of Poland, except the north-eastern part of the country. Because of climate warming the species may increase its range and occur in areas located at higher altitudes – it is believed that the spread of *C. vitalba* is limited by lower temperatures at higher altitudes (CABI 2017 – B). The spread of *C. vitalba* towards regions located further north-east is possible.

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
X	not change
	increase moderately
	increase significantly

aconf31.	Answer provided with a	low	medium	high **X**	level of confidence

acomm35. Comments:

Clematis vitalba is already established in Polish flora, but it will be able to become established more successfully in areas of a slightly harsher climate (higher mountain elevations, north-east of Poland).

a36. SPREAD – Due to climate change, the probability for *the species* to overcome barriers that have prevented its spread in Poland will:

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

aconf32.	Answer provided with a	low	medium **X**	high	level of confidence

acomm36.	Comments:

It is expected that because of climate warming *C. vitalba* will also spread to the areas of north-eastern Poland and the mountains, and it will be more common in the rest of the country than today.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm37.	Comments:

The expected climate change may moderately increase the impact of *C. vitalba* on wild plants, animals, habitats and ecosystems in areas where the spread of this species will continue. This impact will be mainly manifested by mechanical damage to plants used as supports, overgrowing land, and restricting access to light and other resources.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm38.	Comments:

The expected climate change will probably not change the impact of *C. vitalba* on cultivated plants and plant production.

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 **X**	high	level of confidence

acomm39.	Comments:

The expected climate change will not change the impact of *C. vitalba* on 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
X	not change

	increase moderately
	increase significantly

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

acomm40.	Comments: *Clematis vitalba* has no significant impact on the human domain, and the expected climate change will not change its impact 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
X	not change
	increase moderately
	increase significantly

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

acomm41.	Comments: The expected climate change will probably not change the impact of *C. vitalba* on other domains (direct data related to this are unavailable). There might be some difficulties related to traffic, or the need to eradicate large specimens growing in parks, gardens, hedges, and in roadside bushes.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.50	0.50
Environmental impact (questions: a13-a18)	0.70	0.60
Cultivated plants impact (questions: a19-a23)	0.25	0.70
Domesticated animals impact (questions: a24-a26)	0.50	0.50
Human impact (questions: a27-a29)	0.25	0.50
Other impact (questions: a30)	0.25	0.50
Invasion (questions: a06-a12)	0.83	0.83
Impact (questions: a13-a30)	0.70	0.56
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 is regularly repeated.

acomm42.	Comments:

Clematis vitalba has the status of a native plant species in countries neighbouring Poland, and in western and southern Europe. In Poland it is regarded as an alien and established species, and in the Polish climate it has achieved a strong potential for spontaneous expansion.

As a result of the conducted risk assessment procedure *C. vitalba* was classified as a moderately invasive alien species in Poland. The highest score (0.70) was allocated in the module 'Impact on the environmental domain' (Questions a13-a18). This score is very likely to be attributed to the strong competitiveness of *C. vitalba* in relation to other co-occurring plant species and a negative impact on ecosystem integrity (predicted significant impact leading to the disturbance of biotic and abiotic properties, assuming that the species spreads throughout Poland and forms large populations). *Clematis vitalba* also scored high (in the range of 0.50-1.00) in the module related to introduction and spread (Questions a06-a12).

Because the ease of sexual reproduction, the capacity to disperse, and the availability of suitable habitats *C. vitalba* should be regarded as a highly invasive species. Therefore, this plant species should be strictly controlled and eradicated, wherever possible, from the natural environment, especially from the most valuable natural areas. Preventive actions, including education of the public and relevant services to explain the scale and effects of the invasiveness of this species and sources of its introduction are necessary to limit the further spread of *C. vitalba.*

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