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. Katarzyna Bzdęga
2. Barbara Tokarska-Guzik
3. Bogdan Jackowiak

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	02-07-2018
(2)	prof. dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	11-07-2018
(3)	prof. dr hab.	Department of Plant Taxonomy, Institute of Environmental Biology, Faculty of Biology, Adam Mickiewicz University in Poznań	05-07-2018

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

Polish name: Ambrozja bylicolistna

Latin name: ***Ambrosia artemisiifolia*** L.

English name: Common ragweed

Współfinansowano w ramach projektu nr POIS.02.04.00-00-0100/16 pn. *Opracowanie zasad kontroli i zwalczania inwazyjnych gatunków obcych wraz z przeprowadzeniem pilotażowych działań i edukacją społeczną* ze środków Unii Europejskiej w ramach Programu Infrastruktura i Środowisko 2014-2020

acomm02. Comments

The Latin and Polish names are given based on the Flowering plants and pteridophytes of Poland – a checklist (Mirek et al. 2002 – P). The synonyms of the Latin name used are: *Ambrosia artemisiifolia* f. *artemisiifolia*, *Ambrosia artemisiifolia* subsp. *artemisiifolia*, *Ambrosia artemisiifolia* var. *artemisiifolia* and *Ambrosia artemisiifolia* var. *elatior* (L.) Descourt. The species is also described as: *Ambrosia chilensis* Hook. & Arn., *Ambrosia elata* Salisb., *Ambrosia elatior* L., *Ambrosia elatior* var. *elatior*, *Ambrosia glandulosa* Scheele, *Ambrosia monophylla* (Walter) Rydb., *Ambrosia paniculata* f. *paniculata*, *Ambrosia paniculata* var. *paniculata*, *Iva monophylla* Walter. (The Plant List 2013 – B). Unauthorized names are: *Ambrosia paniculata* Michx. and *Ambrosia peruviana* Cabrera, whereas the name *Ambrosia artemisiifolia* f. *gracilissima* D. Cîrțu & M. Cîrțu is considered controversial (The Plant List 2013 – B).

The following are synonyms of the English name (with the exception of those given beneath): bitterweed, blackweed, carrot weed, common ragweed, hayweed, hogweed, low ragweed, Roman wormwood, short ragweed, small ragweed, stammerwort, wild tansy (CABI 2018 – B).

Polish name (synonym I)	Polish name (synonym II)
–	–
Latin name (synonym I)	Latin name (synonym II)
Ambrosia artemisiifolia f. artemisiifolia	*Ambrosia artemisiifolia subsp. artemisiifolia*
English name (synonym I)	English name (synonym II)
Annual ragweed	Hayfever weed

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
X	alien, present in Poland in the environment, established

aconf01. Answer provided with a

low	medium	high
		X

level of confidence

acomm04. Comments:

Ambrosia artemisiifolia in Poland has the status of an established species of alien origin (kenophyte) (Tokarska-Guzik 2005 – P). It is an invasive species (Tokarska-Guzik et al. 2012 – P, Tokarska-Guzik et al. 2015 – I). The largest number of sites has been recorded so far in south-western Poland (Zając and Zając 2001 – P), also at individual sites, but including populations of hundreds of individuals, in the central, south-western, south-eastern and eastern parts of the country (Tokarska-Guzik et al. 2015 – I). Until recently, the species positions were scattered and not very numerous, however, the number of records is gradually increasing, among others in Upper Silesia (Chłopek et al. 2011, Tokarska-Guzik et al. 2011 – P) or in the Carpathians (Nobis and Nobis 2010, Jaźwa and Piątek 2015 – P). It is also turning up in Poznań, so far ephemerally (Jackowiak 1993, Jackowiak 2016, 2017 – P). There is no published data on the occurrence of the species in the Pomeranian and Masurian Lake District (Tokarska-Guzik et al. 2015 – I). In Poland, the species has been dynamically increasing its area in recent years (Tokarska-Guzik et al. 2011 – P, Tokarska-Guzik 2012-2017 – I), therefore it is worth remembering that its distribution requires systematic verification.

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:

Ambrosia artemisiifolia is an alien species and often invasive in many regions of the world, including Europe (CABI 2018 – B). Currently, it is considered one of the most harmful in Europe (Essl et al. 2015 – P). It occurs mainly in open and disturbed habitats, including in fields (in various crops), orchards, gardens, on fallows, unused pastures, also on roadsides, along watercourses and on various wasteland (Basset and Crompton 1975, Weber and Gut 2005, Fărcăşescu and Lauer 2007, Montagnani et al. 2017 – P, CABI 2018 – B). It also penetrates grasslands and floodplains and overgrows river banks (Csiky and Purger 2007, Tokarska-Guzik et al. 2015 – I). However, the impact of common ragweed on natural ecosystems has not been sufficiently researched and determined (EFSA 2010 – I), and positions of scientists on this issue differ. Most share the view that the species does not pose a threat to natural ecosystems, because its emergence is associated with disturbances and any harmful impact on the biodiversity of protected plant communities is unlikely (Martin and Lambinon 2008 – P). Although in Europe, the impact of *A. artemisiifolia* on biodiversity has been considered low and, as assessed by impact assessment, as "no impact" (Blackburn et al. 2014 – P), the species can colonize valuable natural habitats, such as dry meadows, communities of tall herbs and open forests (Bullock et al. 2012, Tokarska-Guzik 2012-2017 – I, Essl et al. 2015 – P). There have also been cases of its occurrence in protected areas, among others in Germany (Alberternst et al. 2006) and Poland (Bomanowska et al. 2014, Sołtys-Lelek and Wiśniowski 2015 – P). Common ragweed, introduced into new areas, may act not only as a pioneer species, but also poses a serious threat to the natural environment as it effectively competes with native plant species for space, nutrients, light and water (Béres et al. 2002 – P), which leads to negative changes in habitats and a reduction of biodiversity (CABI 2018 – B). It may cause a decline in species diversity in communities of segetal weeds (Bullock et al. 2012 – P). The species also has a negative impact on the cultivation of plants. Through the creation of dense compact populations, it reduces the quality and efficiency of multiplication of the cultivated plants, which in turn leads to yield losses, in the case of maize, up to 73% (Varga et al. 2000, 2002 – P). In addition, *Ambrosia artemisiifolia* acts allelopathically on plants (by releasing chemical substances), which limit the germination of seeds and the subsequent growth of the seedlings (Béres et al. 1998, Brückner 1998, Brückner et al. 2003, Hodişan et al. 2009 – P). The species is also a host to many pathogens and insects which are pests, among others, of cultivated plants (CABI 2018 – B). *Ambrosia artemisiifolia* affects the physicochemical and biological properties of soil (Foster et al. 1980, Li et al. 2014, Qin et al. 2014 – P). Its presence changes the amount of the available resources of nitrogen, organic carbon, phosphorus and potassium (Foster et al. 1980, Li et al. 2014 – P) and leads, among other consequences, to an increase in the number of sulphate reducing bacteria (Li et al. 2014 – P). The ability of *A. artemisiifolia* to support mycorrhiza (the co-existance of fungi with its roots) leads to an increase in tolerance of the species to abiotic and biotic stresses, improves the condition and growth of the plants, and thus can facilitate the colonization of new habitats by the plants (Fumanal et al. 2006b, Essl et al. 2015 – P).

It has a negative impact on farm animals, including cattle and horses, triggering allergic reactions (Laan et al. 2007 – P), and also reduces the quality of animal products, among others milk (Spencer 1957 – P). *Ambrosia* pollen is a particularly strong allergen (Smith 1984, Lewis et al. 2000 – P). The amount of pollen produced by one plant was estimated to be several billion grains in one season (Fumanal et al. 2007a – P), while as few as 5-10 pollen grains in 1 m^3 are considered harmful (Jäger 1991, Bosquet et al. 2001, Kozłowska et al. 2007, Boehme et al. 2009 – P). Human contact with *A. artemisiifolia* may cause allergic respiratory problems (Deschamps 1995 – P), allergic diseases and reactions (asthma, conjunctivitis, rhinitis, hay fever), and its pollen is highly sensitizing (Déchamp 1999, Moller

et al. 2002 – P). As a result, public areas such as gardens, parks, recreational areas, roadsides and railways are also made dangerous by invasions of the species. (CABI 2018 – 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:

	low
	medium
X	high

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

acomm06. Comments:

Ambrosia artemisiifolia is categorized as a strongly invasive and troublesome plant in many countries (Tokarska-Guzik et al. 2012 – P, Tokarska-Guzik et al. 2015 – I). The species is already widespread in Poland, but it can still migrate in from the border areas, from the Czech Republic, Slovakia, Ukraine as well as from Germany, along communication routes, canals and ditches and is mainly spread by seed dispersion in strong wind and moving water (Bullock et al. 2012, Tokarska-Guzik et al. 2015 – I). Although the seeds are relatively heavy, they can easily float on water for a long time (Moskalenko 2001, Fumanal et al. 2007b – P) and in the air, especially when affected by strong gusts caused by the movement of passing vehicles (Lavoie et al. 2007, Essl et al. 2009 – P).

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

	low
	medium
X	high

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

acomm07. Comments:

The documented history of the introduction and further spread of *Ambrosia artemisiifolia* in many countries shows that the plant colonizes vast areas primarily due to unintentional and accidental human activities. Fruit (achenes) can be acquired when importing agricultural products including clover and cereal seeds from America and other countries in which ragweed is a common agricultural weed, including also contamination on docks and in mills, where imported grain or oil plants are reloaded (Brandes and Nitzsche 2006 – P). For example, in Poland an assumed 'insertion' of ragweed seeds with the import of potatoes was described in the 1950s-60s (Szotkowski 1981 – P). The species can also be introduced into the natural environment together with transported bird feed containing plants of the region of origin (Bohren et al. 2005, Alberternst et al. 2008, Vitalos and Karrer 2008, Essl et al. 2009 – P) and in transported soil contaminated with the seeds, which may be later used in work related to the strengthening of banks, construction of roads, parking lots or even as topsoil for gardens, etc. (CABI 2018 – B). Dissemination may also occur as a result of contamination of agricultural and garden equipment, e.g. mowers with seeds of the plant (Chauvel et al. 2006, Vitalos and Karrer 2009, Karrer 2014 – P). There is also a very high likelihood of conveyance with road and rail transport (Lavoie et al., 2007, Essl et al. 2009, Lommen et al. 2018 – P), which is playing an increasingly important role in the spread of ragweed.

In Poland, *Ambrosia* species, including *A. artemisiifolia*, were in 1990, included in the "List of diseases, pests and weeds against which plant quarantine is applied" (Regulation ... 1990 – I), which obliged the state to control imported goods in terms of their contamination with diasporas of ragweed species. The most common goods contaminated with ragweed seed at that time were maize, cereals, soybeans and sunflower seeds, as well as feed grains (Miklaszewska and Walczak 1976 – P). After another amendment to the Regulation, ragweed species were removed from this list. In addition, for species of the *Ambrosia* genus occurring in Poland, including *A. artemisiifolia*, an analysis and assessment of pest risk was also developed, where ragweed species were categorized as quarantine organisms (Karnkowski 2001a – P).

In recent years, the entanglement of ragweed seed with some of the aforementioned commodities has been observed, for example, with sunflower achenes (Jackowiak 2017, 2018 – A); the role of road and rail transport in the spread of this species is also increasing (Tokarska-Guzik et al. 2011 – P). Considering all the possible vectors for the dissemination of *Ambrosia artemisiifolia* diasporas, the probability of introducing the species to the natural environment of Poland due to unintended human activities can be assessed as high.

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

	low
	medium
X	high

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

acomm08. Comments:

The species does not have decorative or ornamental values and it is not a member of the group of plants recommended as nectar or energy plants. Nevertheless, the plants can be used as food for pigs and sheep (Crockett 1977 – P), also cattle, although after consumption they suffer from nausea (Stubbendieck et al. 1995 – P). In addition, the fruits of *A. artemisiifolia* contained in food mixtures are also often consumed by small birds and animals (Stubbendieck et al. 1995 – P). In Eastern Europe, ragweed has been deliberately introduced as a medicinal plant (Abramova 2012 – P). It is known that *Ambrosia artemisiifolia* is used in folk medicine. The plants contain specific chemical compounds, including sesquiterpene lactones, which have anti-inflammatory (Stubbendieck et al. 1995 – P), antibacterial and antiviral activities (Kim et al. 1993, Harmatha 2004 – P). Another potential application is the use of plants for removal of heavy metals (Bassett and Crompton 1975, Kang et al. 1998 – P). They effectively remove lead and cadmium during cultivation (Pichtel et al. 2000 – P). In Poland, it has been confirmed in cultivation at five botanical gardens, including three with spontaneous spread of the plant (also as a remnant of a former crop); seedlings and young plants are however being removed (Employees of botanical gardens ... 2018 – N). Therefore, the introduction of species into the environment cannot be completely ruled out as a result of intentional human activities, although currently using plants as a medicine or as a method for removing metals seems to be a controversial solution to dealing with the undesirable presence of the plant.

Although currently the probability of introducing species into the natural environment of Poland as the result of intentional human activities is low, in accordance with the procedure for assessing the risk of negative impacts of invasive and potentially invasive alien species in Poland (Harmony^{+PL} manual), for species that are already established in Poland, a high probability, with a high degree of certainty, should be assumed.

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:

Ambrosia artemisiifolia orginates from the eastern regions of North America (USA, Canada) (Löve 1976, Lorenzi and Jeffrey 1987, Kovalev, 1989 – P). The species occurs between 31°N and 52°N latitude (Scalone et al. 2016 – P). Potentially, it can colonize regions with a similar climate on other continents (Tokarska-Guzik et al. 2015 – I), up to 1000 m above sea level (CABI 2018 – B). Ragweed has been confirmed in most European countries, and also in Africa, Asia, Australia, New Zealand, Central and South America (CJB 2016, Euro + Med. 2016, CABI 2018 – B). It is an annual plant whose colonization success is connected with sexual reproduction through the production of a huge amount of viable and small fruits (achenes) and their effective spread, among other vectors by strong winds, which are necessary for dispersal over long distances and for the colonization of new areas (CABI 2018 – B). The seeds are very resistant to unfavourable conditions (for example low temperatures in winter in some areas). They form adurable soil bank seed and can remain in the soil for several, up to even 40 years, without losing germination activity (King 1966, Miklaszewska and Walczak 1976 – P). Most seeds are deposited by the plant in the surface layer of soil, up to a depth of 5 cm, at a density of from 200 to 2 800 per m^2 (Fumanal et al. 2006a – P). Usually the seeds require stratification before germination, but may also become dormant again (Altieri andLiebman 1988 – P), if germination conditions are not favourable. Burial of *A. artemisiifolia* seeds increases their germination potential by 0.5 to 7.1% (Sahoo 1998 – P). The influence of temperature on the rate of germination of seeds may be another factor determining the success of this invasive plant (Tokarska-Guzik et al. 2015 – I). In this respect, European populations in the secondary range are better adapted and seedlings have awider range of tolerance to low temperatures than in the natural range (Leiblein-Wild et al. 2013 – P). The optimum germination temperature is 11-13°C (Forcella et al 1997 – P) and the minimum 5 ° C (Li 1989 – P). The temperature being above zero in April is very important for ragweed, because it is the month when the plants begin to grow (Karnkowski 2001b – P). Germination is frequent in the case of digging seeds during cultivation works (Ohtsuka 1998 – P), and autumn ploughing is the most suitable conditions for seeds to sprout in spring (Altieri and Liebman 1988 – P).

The invasive success of the species may also be the result of the plant's regeneration abilities (Brandes and Nitzsche 2006, Tokarska-Guzik et al. 2011 – P). *Ambrosia artemisiifolia* effectively regenerates from damage from attacks by herbivores by increasing the number of branches when the tip of the stem is eaten, and if the stress passes, the plants intensify their growth and competitive abilities (Brandes and Nitzsche 2006 – P). Damage or removal of plant stems, e.g. during mowing or grazing, it also induces the regeneration of plants from buds at the base (Brandes and Nitzsche 2006, Patracchini et al. 2011, Tokarska-Guzik et al. 2011, Milakovic and Karrer 2016 – P). The success of the species may partly be a consequence of the ability of the species to produce allelopathic compounds and their impact on other plant species, including on crops such as maize, rye, wheat or oats (Brückner et al. 2001, Lehoczky et al. 2011 – P). In addition, multiple introductions provide greater potential in colonizing new areas in the secondary range due to the high genetic variability of the populations (Genton et al. 2005, Gaudeul et al. 2011 – P).

Common ragweed, although it is not frost resistant, has a relatively high tolerance to climatic requirements and can be found in tropical wet and dry climates, through steppe and deserts to warm temperate and continental climates with both cool and hot summers (Oberdorfer 1994 – P, CABI 2018 – B). Although it is not established in colder areas (Bullock et al. 2012 – I), it has the possibility of adapting to a cold climate, among other methods, by shortening the time from germination to flowering and seed maturation (Béres 1994 – P). The climatic conditions in Poland correspond to the requirements of the common ragweed (Karnkowski 2001a – P). The similarity between the climate of Poland and the climate of both natural and secondary ranges of ragweed is around 94-100%, which means that the climate requirements of the species are met in Poland and do not constitute a significant obstacle to the spread of the species throughout the country; this is also confirmed by the current range of this species in the country (Tokarska-Guzik et al. 2015 – I).

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 its homeland (USA, Canada), *Ambrosia artemisiifolia* is naturally found along the banks of rivers and lakes. It can also occur on dry meadows, less often on the prairies. However it mainly occupies disturbed, ruderal habitats such as roadside, various types of wastelands, railway areas, including embankments, construction sites, quarries, built-up areas, disturbed banks of rivers, and in addition rough and cultivated land, among other places the edges of arable fields or cultivated fields, also orchards, vineyards, nurseries (Basset and Crompton 1975, Fumanal et al. 2008, Milakovic et al. 2014, Essl et al. 2015, Gentili et al. 2016 – P, CABI 2018 – B). In its secondary range, *Ambrosia artemisiifolia* exhibits a wide ecological amplitude and habitat spectrum. The species has a relatively high tolerance for soil requirements. It can grow on loamy or sandy soils, but grows well on wet, heavy soils with apH of 6.0-7.0 (Bassett and Crompton 1975 – P). The results of recent studies show that the plants can also cope with soils with a pH of 8 and acidic soils at pH <5 (Montagnani et al. 2017 and literature cited there – P). The optimal type of soil is mud and loam clay; plants growing in such conditions are full of vigour, grow abundantly and reach a height of 30 to 90 cm, while plants growing in strongly acidic soil are quite fragile and reach only from 7.5 to 15 cm in height (Bassett and Crompton 1975 – P). The species is sensitive to flooding (Brandes and Nitzsche 2006 – P). In its secondary range, it colonizes similar habitats to those occupied within the native range. In anthropogenic habitats it appears very quickly mainly in mechanically disturbed ground, including on fields with various types of crops, in orchards, gardens, on fallows, unused pastures, roadside, along watercourses, on various types of wasteland (Weber and Gut 2005, Fărcăşescu and Lauer 2007 – P, CABI 2018 – B), also in the vicinity of railway reloading stations, grain elevators and cereal grain cleaning points (Mackiewicz 2015 – I, Tokarska-Guzik 2012-2017 – I). The species also enters dry meadows and banks around open water (Tokarska-Guzik et al. 2015 – 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:

	very low
	low
X	medium
	high
	very high

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

acomm11. Comments:

Dispersion from a single source /Single-source dispersal (Type A data). The effectiveness of ragweed distribution depends on the amount of seeds that can initiate the development of the next generation. The key vector in the spread of ragweed is the dispersal of the fruits (achenes surrounded by a cover provided with small appendages), which fall near the mother plants and are then transferred to new areas by strong winds, water, melting snow, or birds (by anemo-, hydro- or zoochory). The number of seeds produced by a single plant is very diverse. Plants germinating in April produce from 3,000 to 4,000 seeds (Béres 1994, Béres in. 2002 – P), while those germinating in August only from 14 to 16 seeds (Szigetvári and Benkö 2008 – P). The highest number reported was 62,000 (Bassett and Crompton 1975 – P). The number of seeds produced by the plant is strongly dependent on the population density: 3,200 seeds for 0.75 plants/m^2, 1,770 seeds for 3.0 plants/m^2 (Chikoye et al. 1995 – P) but also depends on local habitat conditions (Lommen et al 2017 – P). In the area of 1 m^2 there may be from 1 to 45 or more plants (Varga et al. 2000, 2002, Brandes and Nitzsche 2006 – P). On heavily infested areas, up to 500 plants/m^2 can be found (EPPO 2001 – B). Achenes are necessary for spreading over long distances and colonizing new areas (CABI 2018 – B). The results obtained so far suggest the possibility of the spread of seeds with the participation of wind to a distance of about 2 m from the mother plants and indicate the small role of this part of the dispersal process (Dickerson 1968 – P). However, the average wind speed in Poland is around 11 km / h, and in gusts it can reach up to 100 km / h; in recent years such weather phenomena have occurred more frequently and therefore probably the importance of particularly strong winds may be greater than previously thought. It has been shown that direct dispersal of seeds is possible to a distance of about 25 m due to air flow caused by passing vehicles (von der Lippe et al. 2013 – P). The proliferation of plants due to mowing also plays a significant role (Vitalos et al. 2009 – P).

Expansion of population (data type B). The range and rate of migration can be estimated indirectly on the basis of the growing number of *A. artemisiifolia* localities, but it should be taken into account that the results obtained so far reflect primarily the imperfect state of the examination of its occurence. The rate of ragweed spread in Ukraine in 55 years (1942-1997) was estimated at 67.6 km^2/year (Song and Prots 1998 – P). In Poland, the first documented sites of common ragweed come from the second half of the 19th century from the western, south-western and northern parts of the country (Tokarska-Guzik 2005 – P). In the period from 1873 to 2002, there were 101 *A. artemisiifolia* localities in Poland (Tokarska-Guzik 2001, 2005 – P). In recent years, the species has been dynamically expanding its area of occurrence (Tokarska-Guzik et al. 2011 – P, Tokarska-Guzik 2012-2017 – I). The largest number of sites have so far been recorded in the south-western regions of the country (Zając and Zając 2001 – P). The rcorded distance between new localities of the species in consecutive years exceeded 500 m (Tokarska-Guzik 2012-2017 – I).

Bearing in mind the information gathered, the ability of the species to proliferate without human asistance has been assessed as medium.

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:

Introducing *Ambrosia artemisiifolia* into a new environment and then the further spread of the species is possible primarily due to unintended human actions, including through the trade and transport of agricultural products such as cereals, oil crops, bird feed containing plant diasporas, as well as soil transport from infected areas to species-free areas that can be used later, for example, as garden soil (Bohren et al 2005, Brandes i Nitzsche 2006, Alberternst et al. 2006, Vitalos i Karrer 2008, Essl et al. 2009 – P, CABI 2018 – B), also on wheels of vehicles and agricultural machinery together with other aspects of road and rail transport (Lavoie et al. 2007, Essl et al. 2009, Lommen et al. 2018 – P). The intentional introduction of the species by humans and its spontaneous further spread cannot be ruled out. It has been used as feed for pigs or sheep (Crockett 1977 – P), also as a medicinal plant (Abramova 2012 – P). Analysis of the availability of seeds and seedlings of common ragweed demonstrated that they are not included in the commercial offer in Podlasie (Mackiewicz 2015 – I). However, one potential threat may be the introduction of the species for use in phytoremediation for the treatment of heavy metal contaminated soils (Bassett and Crompton 1975, Kang et al. 1998 – P); the plant effectively removes lead and cadmium during repeated harvesting (Pichtel et al. 2000 – P). It has been shown that on soils with a high concentration of zinc, ragweed can accumulate up to seven times more zinc compared with maize plants (Bassett and Crompton 1975 and the literature cited there – P). However, due to the dangers posed by ragweed, its presence is absolutely undesirable throughout the country. The prevalence of common ragweed in many areas of the country, in various habitat types, creates a high likelihood of further spread of the species during various types of earthworks (e.g. construction of roads, power lines) and regulatory works (reinforcing flood embankments), mowing roadsides with equipment carrying contaminated soil. The frequency of spread may also be influenced by improperly carried out procedures, including mowing of street verges too early or too late and improper utilization of above-ground parts of plants, for example, leaving mown biomass on site or depositing it in composters, all of which creates the possibility of creating new introductions.

A4a | Impact on the environmental domain

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

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

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

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

X	inapplicable
	low
	medium
	high

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

acomm13.	Comments: The species is a plant, it does not show these types of interactions.

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

	low
	medium
X	high

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

acomm14. Comments:

Ambrosia artemisiifolia is a pioneer species of open disturbed habitats, where it forms dense, extensive and compact populations (HALT AMBROSIA 2014 – I). In ruderal habitats the species succeeds in competition with other native ruderal plants due to its high ability to colonize bare soil and the competitive advantage associated with its rapid germination and development, while in stable natural habitats (meadows dominated by perennials), interspecies competition may limit the development of Common ragweed (ANSES 2017 – I). However, the species can effectively eliminate native plants, hindering their development and growth. First of all, it limits space, access to light, water and nutrients (Béres et al. 2002 – P). It takes twice as much water as neighbouring plants. It adapts very easily to different habitat conditions of soil, temperature and light (Miklaszewska and Pągowska 2007 – P). It endangers many rare species of bare mud, among others *Elatine alsinastrum*, *Limosella aquatica*, *Linderia procumbens*, *Montia fontana* and *Peplis portula* (Pál et al. 2006 – P). Its presence leads to negative changes in habitats and the reduction of biodiversity (CABI 2018 – B), in particular the impoverishment of species diversity in communities of segetal weeds (Bullock et al. 2012 – P), wchich are a valuable source of food for animals and several species of insects and birds (Pinke et al. 2011 – P). It has been shown that ragweed is common in uncultivated fields, inhibiting the renewal of both annual and perennial native species, reducing their diversity and delaying the processes of succession (Maryushkina 1991 – P). *Ambrosia* plants are also stronger competitors than native plant species in newly occupied ruderal habitats (Protopopova et al. 2006 – P). They can even penetrate into the dense patches created by *Festuca rupicola*, especially if the communities are overgrazed and trampled by cattle and other farm animals (Solomakha et al. 1992 – P). There are reports that some native plant species: *Lolium perenne*, *Dactylis glomerata* and *Medicago sativa*, are able to effectively limit the growth, development and production of seeds of *A. artemisiifolia* (Valkova i in 2009, Milanova et al. 2010 – P). Common ragweed may prevent germination of seedlings of many native species by the release of allelopathic compounds (Béres et al. 2002, Sang et al. 2011 – P), inhibiting germination and development of other plants (Béres et al. 1998, Brückner 1998, Brückner et al. 2003, Hodişan et al. 2009 – P).

Undesirable effects of Common ragweed include penetration into valuable natural and protected areas. It can colonize, among others dry meadows, tall herb communities and open forests (Bullock et al 2012, Essl et al. 2015 – P). The presence of ragweed has already been recorded in two Polish national parks, where it is highly probable that the plant arrived with birdseed (Bomanowska et al 2014, Sołtys-Lelek and Wiśniowski 2015 – P, Tokarska-Guzik et al. 2015 – I). There are also reports, among others from Germany, from Daßfeld (Lower Bavaria), where the plant threatened sand dunes and rare plant species that were protected as anature reserve, due to the illegal depositing of material to improve the substrate which included the invasive plant diaspora (Alberternst et al. 2006 – 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	high **X**	level of confidence

acomm15. Comments:

In Poland, there are no native species with which the common ragweed could crossbreed. *Ambrosia artemisiifolia* crossbreeds with other two invasive species of the *Ambrosia* genus occurring in the country: *A. trifida* and *A. psilostachya*. Hybrids of *A. artemisiifolia* ×*A. trifida* (*A.* ×*helenae* Rouleau) (Wylie 1915, Wagner 1958, Vincent et al. 1987, Vincent et al. 1988, Strother 2006 – P) have thickly lobed leaves, in which they resemble *A. trifida*, and are completely sterile (Vincent et al. 1988 – P). Such hybrids were observed in the 1940s in France, in the Botanical Garden in Bordeaux (Chauvel et al. 2015 – P). Hybrids of *A. artemisiifolia* ×*A. psilostachya* (*A.* ×*integradiens* W.H. Wagner) were found in the USA in several places in Michigan; they often form clonal populations that persist for many years, but it is not known whether fertile seeds are produced (Wagner and Beals 1958 – P). In Ann Arbor, Michigan, a fertile hybrid of *A. artemisiifolia* and *A. acanthicarpa* (Payne 1962 – P), a species originating in California and also recorded outside North America, was also produced by greenhouse experiments. The leaves of the resulting hybrids are larger and more cut than in parental species. In contrast, the fruits (achenes) resemble those appearing in *A. artemisiifolia*, except that they have longer protuberances and spines; flowers are also similar to *A. artemisiifolia* flowers (Basset and Crompton 1975 – P).

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

	very low
X	low
	medium
	high
	very high

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

acomm16. Comments:

Many natural enemies of representatives of the *Ambrosia* genus, including *A. artemisiifolia*, are found in their native range as opposed to very few being found in the secondary range (Goeden and Ricker 1976, Gerber et al. 2011, Essl et al. 2015 – P, CABI 2018 – B). 217 insect taxa associated with these plants have been identified (Harrisa and Piper 1970 – P), as well as numerous arthropods (Goeden et al. 1974 – P). Within the home range, plants are more vigorously attacked by specialized parasites, in contrast to the secondary area where they are less specialized, and the damage they cause is often insignificant (Goeden and Ricker 1976, Gerber et al. 2011, Essl et al. 2015 – P).

Due to the fact that *A. artemisiifolia* has been the subject of numerous biological control programmes, 28 species of insects have been identified that feed on these plants, including orthoptera, heteroptera and homoptera, including beetles and butterflies (Maceljski and Igrc 1990 – P). In the native range of ragweed, about 70 species of arthropods were recognized (Julien et al. 2012 – P), and moreover 20 species of fungal pathogens associated with these plants have been identified in Eurasia, including *Puccinia xanthii*, a pathogen from the rust group (Gerber et al 2011 – P).

An example of natural enemies of the species are: *Harpalus pensylvanicus* – a natural enemy feeding on ragweed seeds, *Liriomyza trifolii* – commonly known as serpentine leaf miner, a natural enemy feeding on *Ambrosia* leaves, also two leaf beetles *Ophraella communa* – introduced species from Japan and Taiwan, and *Zygogramma suturalis* – feeding on ragweed seedlings and leaves, which can reduce their amount by 50-70%, which has been introduced into Russia, Croatia and China, also *Acontia candefacta*, a moth feeding on the leaves of species of the *Ambrosia* and *Aster* genera (Essl et al. 2015, Stojanović et al. 2017 – P, CABI 2018 – B and literature cited there).

Among plant parasites for which ragweed is a host, there are fungi, e.g. Sclerotinia sclerotiorum, an obligatory parasite of over 400 species of plants, wild growing as well as cultivars, causing a disease called white mould (CABI 2018 – B and literature cited there)

There is no more detailed data on the transmission of pathogens or parasites to native plant species.

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	high
	X	

level of confidence

acomm17. Comments:

Ambrosia artemisiifolia causes changes in the physical and chemical properties of the soil, and thus in the activity of soil microorganisms (Foster et al. 1980, Li et al. 2014, Qin et al. 2014 – P). Plants may directly regulate the amount of available nitrogen and organic carbon resources. It has been shown that fields not covered by ragweed had from 4 to 6 times higher concentrations of nitrates in the soil compared to the soils of fields recently colonized by the species (Foster et al. 1980 – P). The amount of nitrogen collected by ragweed plants in the first year of their presence in the fields was estimated at 2.49 g/m^2 in total, with 12% of this amount deposited in the seeds of the invasive plant and the remaining part in more easily decomposing vegetative tissues (Foster et 1980 – P). In addition, it was found that in areas colonized by *A. artemisiifolia*, the soil has better biochemical properties, which is associated with the increased use of carbon by soil organisms. Increased soil fertility, as well as the functioning of microfauna in places with *Ambrosia*, may be beneficial for the species and facilitate the occupancy of new habitats (Qin et al 2014 – P). Other resaerch has shown that, the content of organic carbon and the concentration of available nitrogen, phosphorus and potassium in the soil were 2.4, 1.9 and 1.7 times higher, respectively, in highly colonized places, at the same time the pH was lower, compared to places without the species (Li et al. 2014 – P). Invasion by *A. artemisiifolia* also leads to an increase in the level of anoxia in the soil and an increase in the number of bacteria that reduce sulphate and the number of actinomycetes (Li et al. 2014 – P).

Biochemical properties of the soil in places with *Ambrosia* inhibit the growth of other co-occurring plant species, including *Galinsoga parviflora,* alfalfa (*Medicago sativa*) and foxtail species (*Setaria* spp.). This facilitates the development of the ragweed plants and their ability to compete with co-existing plants. In addition, the ragweed biomass was 50-130% higher when the species was competing simultaneously with the three co-existing plants. The results indicate that the invasion of *A. artemisiifolia* modifies the activity of soil microorganisms in a way that promotes it itself, inhibiting the development of native plant species (Li et al. 2014 – P).

River floodplains may be overgrown by ragweed plants (CABI 2018 – B). Although there are no more detailed data concerning its contribution to opposing coastal erosion and changes in water flow, reckless activities such as the elimination of invasive species may result in difficult to reverse changes in rare habitats in the future, e.g. in riverside floodplains such as those on the Drava River in Croatia, where (as elsewhere) *Ambrosia* has been recorded (Csiky and Purger 2008 – I).

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

	low
X	medium
	high

aconf14.	Answer provided with a	low	medium **X**	high	level of confidence

acomm18. Comments:

The species has been noted, among other situations in the Czech Republic, in a rare thermophilic vegetation of annual and biennial plants accompanying root crops and growing over ruderal areas (from the *Eragrostion*, *Salsolion ruthenicae* plant communities) (Kropác 2006 – P), It has been observed also in Croatia, in a rare community of fine therophytes on moist and wet mineral substrates available for vegetation only for a short time during the year, and where some of these communities correspond to the habitat of the banks or drained bottoms of water reservoirs (3130) (from the *Isoëto-Nanojuncetea* class) (Csiky and Purger 2008 – I).

The species is perceived as very invasive, including because of its adaptive and competitive abilities, and its allelopathic potential is also recognized as one of the factors ensuring the plant's invasive success, especially on various disturbed habitats (Basset and Crompton 1975, Weber and Gut 2005, Fărcăescu and Lauer 2007 – P, CABI 2018 – B). Allelopathic chemicals that are secreted by ragweed, especially sesquiterpenes and flavonoids (Béres et al. 2002, Sang et al. 2011 – P), inhibit the germination and growth of other plants (Béres et al. 1998, Brückner et al. 2001, Hodişan et al. 2009, Lehoczky et al. 2011, Montagnani et al. 2017 and literature cited therein – P). Undesirable impacts also include the penetration of the species into valuable natural areas, such as grasslands, dry meadows, high herb communities, open forests or riverside flood plains (Kropác 2006, Csiky and Purger 2008, Bullock i in 2012, Essl et al. 2015, Tokarska-Guzik et al. 2015 – I) and protected areas in general (Alberternst et al. 2006, Bomanowska et al. 2014, Sołtys-Lelek and Wiśniowski 2015 – P).

Based on the data quoted, it could be concluded that the occurrence of the species in Poland may lead to disturbed biotic factors in the ecosystem, but the lack of sufficient data on the impact of ragweed on natural ecosystems results in a lower impact and degree of assessment.

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:

The species is a plant, also it has no parasitic properties

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

- [ ] inapplicable
- [ ] very low
- [ ] low

	medium
X	high
	very high

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

acomm20. Comments:

The species is a serious threat to many crops because, due to the strong development of above ground and underground parts it causes the overgrowing of crops and contributes to the rapid drying and depletion of soil (Savotikov and Smetnik 1995 – P), which becomes unsuitable for cultivation (Miziniak and Banaszak 1998 – N, Essl et al. 2009 – P). *Ambrosia artemisiifolia* absorbs twice as much water (in proportion to its dry matter) than crops (Savotikov and Smetnik 1995 – P), corn or beans among others (Dickerson 1968 – P). For this reason, the species affects the quality and size of crop yeilds; it has been demonstrated that the yield can be significantly reduced or even completely lost (Shamonin and Smetnik 1986 – P). On cultivated fields, the species can cause enormous losses, among others in the yield of maize, sunflower, soy, bean, which also indicates that ragweed is a strong competitor (Chikoye et al. 1995, Chollet et al 1999, Clewis et al. 2001 – P, CABI 2008 – B, Zwerger and Eggers 2008, Kukorelli et al. 2011 – P). For example, losses in maize yields reach 69-73% (Varga et al. 2000, 2002, Balogh et al. 2008, Essl et al. 2009 – P), whereas in the case of beet, it has been experimentally demonstrated that the root yield can be reduced by 40% or 50%, and sugar content by 13-15% (Bosak and Mod 2000 – P).

The common ragweed also prevents the normal development of many plant species, including crops, by the release of allelopathic compounds (Béres et al. 2002, Sang et al. 2011 – P), which inhibit germination as well as further development (Béres et al. 1998, Brückner 1998, Brückner et al. 2003, Hodişan et al. 2009 – P). Ragweed releases allelopathic compounds through its roots and leaves, also from decomposing leaves (Montagnani et al. 2017 and literature cited there – P). The effect of the allelopathic interaction of the species was demonstrated, among others against wheat, rye, barley and oilseed rape, when water extracts from roots and mature ragweed leaves had a significant inhibitory effect on the germination of these plants, while stem extracts only inhibited germination of wheat and rye (Hodişan et al. 2009 – P). Allelopathic *A. artemisiifolia* extracts also inhibit germination of peas, beans, maize and sunflower (Béres et al. 1998 – P) and oats (Lehoczky et al. 2011 – P). The inhibitory effect of common ragweed on the germination and growth of tomato by more than 50%, the reduction of lettuce growth (Vidotto et al. 2013 – P) and the complete inhibition of germination in cress and radish (Molinaro et al. 2016 – P) have also been proved. The chloroform extract from *A. artemisiifolia* inhibits growth and reduces the level of chlorophyll in algae (*Chlorella vulgaris* and *Chlamydomonas sp*.) (Brückner et al. 2001 – P) including those used, among others as diet supplements (*Chlorella*), as well as for bioremediation and biofuel production (*Chlamydomonas*). At the same time, a lack of allelopathic effects of the species was found in alfalfa, whose germination was not inhibited (Hodişan et al. 2009 – P).

On the assumption that the species is spreading in Poland and on account of the yield structure there, it is predicted that the impact will concern above 2/3 of cultivations of plants which are subjected to invasion (high likelihood) and the condition of plants or the crop yield of the isolated cultivation in the worst case will be reduced by about, or over, 20% (high effect/consequence).

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
X	medium
	high
	very high

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

acomm21. Comments:

Ambrosia artemisiifolia may indirectly affect the condition and yield of crop plants by hybridizing with closely related species: *A. trifida* and *A. psilostachya*, forming, especially in the case of the *A. artemisiifolia* × *A. psilostachya* (*A. × integradiensis* W.H. Wagner) clonal populations that persist for many years (Wagner and Beals 1958 – P). In Europe, sterile hybrids of *A. artemisiifolia* × *A. trifida* have been reported (*A. × helenae Rouleau*) (Wagner 1958 – P). There are, however, no more detailed data on the frequency of occurrence or creation of crossbreeds with the parent species. The common ragweed hybrids may adversely affect crop plants, among other ways by the rapid overgrowing of fields and meadows that become unsuitable for cultivation (Savotikov and Smetnik 1995 – P, Miziniak and Banaszak 1998 – N, Essl et al. 2009 – P).

Admittedly the effect of the hybridization is great; there is however a low probability of hybridisation with related species from the *Ambrosia* genus occurring in Poland, since both the above-mentioned species are still rarely met with here.

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

	very low
	low
	medium
	high
X	very high

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

acomm22. Comments:

The presence of *Ambrosia artemisiifolia* disturbs the integrity of crops by preventing and severely limiting the agricultural use of land due to its intensive overgrowing and displacement of crops (Savotikov and Smetnik 1995, Essl et al. 2009 – P, cf. see comments in a05 and a20). In colonized areas, ragweed occurs in various crops, such as cereals (wheat, rye, barley, oats), maize, root crops (sugar beet, potatoes), soybean, sunflower, fodder plants, grapes and orchards, meadows, pastures, etc. (Savotikov and Smetnik 1995, Karnkowski 2001 and literature quoted there – P).

In Poland, the cultivation of cereal and root crops extends across almost the entire territory of the country. The importance of these crops is very large. In 2015, the area of cereal crops (wheat, rye, barley, oats, triticale and cereal mixtures) amounted to 7,511,800 ha (69.9%, of the total area under cultivation), the area of maize for grain was about 670,300 ha (6.2% of the total area under cultivation), the maize area for fodder purposes amounted to 555,200 ha (5.2% of the total area under cultivation), the potato area was 292,500 ha (2.7% of the total area under cultivation) and the beet area was 180,100 ha (1.7% of the total area under cultivation). Meadows and pastures are common. In 2015, the area of meadows was 2 658 126 ha, and the area of pastures was 434,708 ha (GUS 2016 – I). The area of sunflower and soy plantations is small (there is no detailed data).

On the assumption that the species is spreading all over Poland it is possible to show that the likelihood of disturbing cultivations is high (can concern above 2 out of 3 cultivations) and effect/consequence can be high (impact very high).

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

	very low
	low
	medium

	high
X	very high

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

acomm23. Comments:

Ambrosia artemisiifolia is a host for many pathogens of plants and insects that are primarily pests of crop plants (CABI 2018 – B). The insects and other parasites, especially those considered to be crop pests, living on the species in its natural range, as well as in its secondary range, have been extensively described (Harris and Piper 1970, Goeden et al. 1974, Goeden and Ricker 1976, Gerber et al. 2011, Essl et al. 2015 – P, CABI 2018 – B).

Ambrosia artemisiifolia is also an alternative host for crop diseases (CABI 2018 – B). Among the fungal pathogens, one should mention the *Golovinomyces cichoracearum* fungus from the *Erysiphales* group, which parasitizes plants from the Asteraceae family and causes a disease called powdery mildew, as well as *Pustula obtusata*, *P. tragopogonis*, pathogens from the oomycetes group, *Plasmopara halstedii* species found on all continents and causing downy mildew in sunflower crops. An epidemic on ragweed of this last pathogen has been observed in large areas of the central regions of Hungary and also of *Entyloma compositarum* and *E. polysporum* or *Puccinia xanthii*, a plant pathogen infecting sunflowers. Common ragweed can also be a host for parasitic weeds such as *Cuscuta gronovii*, a parasitic plant originating from North America, where it is considered a harmful weed. Other fungal parasites for which ragweed is a host plant also include *Protomyces gravidus*, also *Phoma spp.* and *Sclerotinia sclerotiorum*, an obligatory parasite of over 400 plant species, both cultivated and wild growing, causing a disease called white mould (Essl et al. 2015, CABI 2018 – B and literature cited therein).

From the list of EPPO A1, the presence of fungi of the genus *Septoria* was noted on *Ambrosia*, which causes a disease called leaf spot and attack, among others, growing tomatoes. In the EPPO A2 list, on the other hand, there is the insect *Liriomyza trifolii* (LIRITR), commonly known as serpentine leaf-miner, feeding on the leaves of ragweed, a pest primarily affecting the cultivation of ornamental plants and vegetables.

Assuming that the species is spreading in Poland, it can be expected that due to the Polish crop structure, the impact may be very high.

A4c | Impact on the domesticated animals domain

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

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm24. Comments:

The species is not a parasitic plant.

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
X	high
	very high

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

acomm25. Comments:

Ambrosia artemisiifolia has a negative impact on animal production, by affecting the health of livestock, as well as the quality of milk. Cattle and horses are allergic to pollen of common ragweed, which causes allergic reactions during the pollination period; the reaction is related to the sensitivity of animal skin and is manifested, among others, in inflammation of the skin (Laan et al. 2007 – P). The species produces many types of secondary metabolites (Hodgins et al. 2013, Sülsen et al. 2013 – P), which protect the plants, among other things, against herbivores. However, parts of the plants and their seeds may be diet components of several wild mammals, birds and insects, but because of the metabolites contained within them, they are not tasty to cattle, which feed on *Artemisia* only when alternative feed is lacking (Marten and Andersen 1975, Bullock et al. 2012 – P). If ragweed is present in the diet of cattle, which, in the absence of proper feed, are fed with a large amount of ragweed plants, then the milk has a changed taste and is considered an undesirable product (Spencer 1957 – P). The presence of common ragweed may also indirectly bring about the reduction of animal production and generate losses, through the overgrowth of meadows, pastures and the formation of extensive homogeneous patches of ragweed plants, which results in the reduction in the cover of more appropriate plant food for grazing animals.

Assuming that the species is spreading in Poland, it should be assessed that the impact is high.

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:

The species is a plant. Plants are not hosts or vectors of animal parasites / 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:

X	inapplicable
	very low

	low
	medium
	high
	vert high

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

acomm27. Comments:

The species is not a parasitic organism

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

	very low
	low
	medium
	high
X	very high

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

acomm28. Comments:

Ambrosia artemisiifolia has a very negative effect on human health. The pollen of the plant is a strong allergen (Smith 1984, Lewis et al. 2000 – P) and a primary source of pollen allergies in the native as well as the secondary range of the species (Smith et al. 2013, Essl et al. 2015 – P). It is estimated that the amount of pollen grains produced by one plant is several billion in one season (Fumanal and in 2007a – P), while as little as 5-10 pollen grains in 1 m^3 is considered harmful (Jäger 1991, Bosquet et al. 2001, Kozłowska et al. 2007, Boehme et al. 2009 – P). The highly allergenic ragweed pollen is highly sensitizing (Déchamp 1999, Moller et al. 2002 – P) and is the cause of numerous health problems in humans (Taramarcaz et al. 2005 – P). Contact with *A. artemisiifolia* may cause allergic respiratory problems (Deschamps 1995 – P), as well as atopic and contact dermatitis, and other serious diseases and allergic reactions such as asthma, conjunctivitis, rhinitis and hay fever (Déchamp 1999, Moller et al. 2002 – P). Reactions occur as a result of the inhalation of air containing these allergens and by direct contact with the plant, e.g. during manual weeding (Guin and Skidmore 1987, Deschamps 1995, Gordon 1999 – P). Increasing the concentration of CO_2 in the atmosphere in urbanized areas stimulates an increase of ragweed production (Ziska et al. 2003 – P), which presumably has resulted in an increase in the number of patients diagnosed with allergic diseases in the last 10-20 years (Farkas et al. 1998 – P). It has also been shown that traffic-related pollutants exacerbate the allergic activity of ragweed pollen (Ghiani et al. 2012 – P), similarly increasing the NO_2 concentration, which directly affects the increase of ragweed pollen allergens (Zhao et al. 2016 – P). Many research results show that the level of allergy to pollen of *A. artemisiifolia* is constantly growing and is correlated not only with the increase of pollution, but also with the increase of urbanization (Montagnani et al. 2017 and literature quoted there – P). Recent studies also indicate that susceptibility to allergy should also be associated with the co-occurrence of other species from the same family, i.e. *Artemisia* species (Stępalska et al. 2016 – P). Exposure to high pollen counts of *A. artemisiifolia* leads to an increase in the number of people with allergic reactions. In Europe, ragweed pollen caused an increase in the prevalence of allergies (Burbach et al. 2009 – P). In Hungary, 80% of all allergies were thought to be caused by ragweed pollen, in Vienna only 30%, and in Germany – 1.25% (Jäger 2000, Reinhardt et al. 2003 – P). Pollen of the common ragweed may cause severe allergic reactions in a large part of the population (Lipiec and Rapiejko 2005, Stępalska et al. 2016, Rapiejko et al. 2017 – P). Currently, costs of several million euros are incurred annually in different countries due to allergies, e.g. the annual cost of ragweed infections in Germany is estimated at 32 million euros, most of which are costs incurred by the health sector (Reinhardt et al. 2003 – P), while in Hungary it is 110 million euros annually (Tóth et al. 2004 – P).

	The negative impact of ragweed on health has been signalled by both European ecologists and immunologists (Essl et al. 2009 and literature cited therein – P), and national strategies to prevent the further spread of diseases caused by allergenic plants are being developed (Bohren et al. 2006 – P). It also emphasized that the role of global changes that will worsen the situation over the next few decades, and that the effects will include changes in species distribution, plant growth and development, as well as in pollen allergy itself (including Ziska and Caulfield 2000, Rogers et al. 2006 – P).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf25.	Answer provided with a	low	medium	high	level of confidence

acomm29.	Comments: The species is a plant. Plants are not hosts or vectors of human parasites / pathogens.

A4e | Impact on other domains

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

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

	very low
	low
X	medium
	high
	very high

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

acomm30.	Comments: Due to the large possibilities for adaptation and the wide habitat spectrum, *Ambrosia artemisiifolia* can colonize by quickly overgrowing not only cultivated areas, meadows and pastures, but also habitats near ports and trans-shipment stations, grain elevators and cereal grain cleaning points, along roadsides, roadsides, embankments and railway tracks. In these places, *A. artemisiifolia* may overgrow elements of port and railway infrastructure and passageways. This overgrowth is a threat to disturbed and transformed areas, to which the species easily penetrates and spreads quickly. Plants of a large size that appear massively along roads may limit visibility on road curves and obscure road signs (Bzdęga 2015-2017 – A). The species can also be a real threat in river valleys and flooded rivers when overgrown by the plant (Csiky and Purger 2008 – I, Montagni et al. 2017 – P and literature cited there, CABI 2018 – B). Although there are no detailed data for the contribution of the plant to coastal erosion and changes in water flow, individuals can reach up to 2 m in height and their dead biomass can limit or inhibit water flow, thus hindering the navigability of rivers and negatively affecting the condition of hydraulic engineering equipment.

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:

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

The invasive common ragweed adversely affects ecosystem services causing large losses in yields of crops by disturbing the integrity of crops, preventing and limiting the agricultural use of land due to intensive overgrowing (including the effects of its allelopathic properties), resulting in lower yields and quality (Chikoye et al. 1995, Chollet et al. 1999, Bosak and Mod 2000, Varga et al. 2000, 2002, Clewis et al. 2001, Balogh et al. 2008 – P, CABI 2008 – B, Zwerger and Eggers 2008, Essl et al. 2009, Kukorelli et al. 2011 – P), as well as by detrimental effects on arable crops by being the host of pathogens and pests of these crops (Harrisa and Piper 1970, Goeden et al. 1974, Goeden and Ricker 1976, Gerber et al. 2011, Essl et al. 2015 – P, CABI 2018 – B). The species has been recognized as one of the most difficult weeds to control in crops (Wilcut and Swann 1990, Clewis et al. 2001 – P). At the same time *Ambrosia artemisiifolia* has a negative impact on animal production, through harmful effects on animal health, as well as the quality of milk produced (Crockett 1977, Stubbendieck et al. 1995 – P). The plants produce many organic allelopathic compounds, including sesquiterpene lactones (Bullock et al. 2012, Vidotto et al. 2013 – P), which inhibit the germination and growth of other plant species, both in the natural and agricultural environment, and have therefore been taken into account as a potential natural herbicide. It has been shown that the bioherbicidal activity is a property of lactone isabelins, which may be used in the future for biological weed control (Molinaro et al. 2016 – P). At the same time, *Ambrosia artemisiifolia* is known in folk medicine for the anti-inflammatory, antibacterial and antiviral effects (Kim et al. 1993, Stubbendieck et al. 1995, Harmatha 2004, Abramova 2012 – P) of compounds from the same group, i.e. sesquiterpene lactones. However, first and foremost allelopathic compounds produced by ragweed facilitate invasion by the species and strengthen its dominance in the colonized areas (Brückner et al. 2001, Lehoczky et al. 2011 – P). In summary, the impact of the species on supply services was found to be very negative.

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

Ambrosia artemisiifolia may have a negative impact on regulatory services as a result of, inter alia, changes in the physical, chemical and biological properties of soils (Foster et al.

1980, Li et al. 2014, Qin et al. 2014 – P). Invasion by the species leads to changes in the amount of available resources of nitrogen, organic carbon, phosphorus and potassium (Foster et al. 1980, Li et al. 2014 – P), also to an increase the level of anoxia in the soil and an increase in the number of sulphate-reducing bacteria (Li et al. 2014 – P). In places colonized by the species, the soil has seemingly better biochemical properties, which is associated with increased use of carbon by soil microorganisms and promotes intense growth in ragweed biomass, facilitating effective competition with other plants and the occupation of new habitats (Qin et al. 2014 – P). The presence of ragweed modifies the activity of soil microorganisms in a way that promotes it alone, inhibiting the development of native plants (Li et al. 2014 – P). In addition, the ability of *A. artemisiifolia* to form mycorrhiza leads to an increase in tolerance of the species to abiotic and biotic stresses, improves the condition and growth of the plants, and additionally this dependence is positively correlated with environmental disturbances (Essl et al. 2015 – P). Symbiosis with mycorrhizal fungi can help plants colonize new habitats and encourages species invasion in Europe (Fumanal et al. 2006b – P). In addition, the allelopathic compounds secreted by ragweed contained in the soil environment inhibit germination and growth of other plants, including crops (Béres et al. 1998, Brückner et al. 2001, Hodişan et al. 2009, Lehoczky et al 2011, Montagnani et al. 2017 and literature cited there – P). Furthermore, the pollen of *A. artemisiifolia* is highly sensitizing, its presence in the air significantly reduces air quality. The species is host to numerous pathogens of plants and pests of crops, which can regulate their numbers. The demonstrated ability of ragweed to accumulate heavy metals means that they can be included among the plants useful in the phytoremediation of heavily contaminated areas (including Bassett and Crompton 1975, Kang et al. 1998, Pichtel et al. 2000 – P).

Nevertheless, the final assessment, summarizing the impact of *A. artemisiifolia* on regulatory services remains very negative.

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

The species is hazardous in urban areas, in public urban areas, including in gardens, parks, and recreational areas, also on roadsides, railway areas, wasteland, and in stands of crops due to its strong toxic properties (it causes serious allergic diseases) (including Smith 1984, Jäger 1991, Deschamps 1995, Farkas et al. 1998, Déchamp 1999, Lewis et al 2000, Bosquet et al. 2001, Moller et al. 2002, Kozłowska et al. 2007, Fumanal et al 2007a, Boehme et al. 2009, Smith et al. 2013, Essl et al. 2015 – P). In areas where *Ambrosia artemisiifolia* is a well distributed species, extensive patches of plants may reduce the aesthetic (landscape) quality of a given area, as a result of which the tourist attractiveness of the vegetation of the terrain also decreases. The presence of tall plants along roads may reduce visibility and cause a threat to road safety (our own observations – A). In conclusion, it was considered that the negative and positive impact of the species on cultural services is moderately negative.

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
X	increase significantly

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

acomm34. Comments:

Assuming that in the future the temperature will increase by 1-2°C, the probability that the species will overcome further barriers related to occurrence in Poland will increase significantly. The wide geographical range of occurrence of *Ambrosia artemisiifolia* confirms a large tolerance of the species to climatic requirements. The range of tolerance for the species to the preferred climatic parameters is given by CABI (2018 – B). The assessment of its potential distribution based on the modelling of the ecological niche using data on the current occurrence of the species within its native and secondary range, using 16 algorithms, suggests the probability of a significant spread of the species (Cunze et al. 2013 – P). All of the models analyzed predict the expansion and the northward shift of the future range of the species in Central and Northern Europe over the next decades. Potentially at risk of invasions by this species, especially in the context of climate change, are northern France, Germany, Benelux countries, the Czech Republic, Poland (especially regions located in the northern part of the country), the Baltic States, Belarus and the entire area of Russia. It is expected that global warming will promote the further development and invasive potential of *A. artemisiifolia* in Europe and will lead to a significant widening of the boundaries of its distribution and northward shift (Cunze et al. 2013 – P). Analogous results were obtained in modelling using climatic parameters and land use (Bullock et al. 2012 – I). It was shown that in the absence of climate change and land use, the species will continue to spread until 2080, but in the European Union the phenomenon is limited compared with expansion in Russia. However, in all scenarios assuming climate change, the areas dominated by ragweed will increased initially, and after about 2040 will decrease. However, the distribution of the species will move towards northern Europe, where a strong expansion of the species will be a threat in Germany, northern France, the Czech Republic, Poland, Lithuania, eastern Ukraine and Belarus, in contrast to the areas currently occupied by ragweed, which are foreseen to have a reduced invasion (Bullock et al. 2012 – I). Similarly, other researchers are predicting growth and widening of the species range in the face of climate change (Essl et al. 2015, Chapman et al. 2016 – P). Recent research shows that by 2100 the range of occurrence of not only *A. artemisiifolia*, but also other invasive species of the *Ambrosia* genus, including *A. trifida* and *A. psilostachya*, which also occur in Poland, will increase towards Northern and Eastern Europe in all climate scenarios and, consequently, high risk areas for allergies will expand in size (Rasmussen et al. 2017 – P).

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
X	increase significantly

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

acomm35. Comments:

Assuming that in future the temperature will increase by 1-2°C, the probability that the species will overcome further barriers related to its persistence and reproduction in Poland will increase significantly. *Ambrosia artemisiifolia* prefers, among other requirements, a warm moderate climate with a dry summer, or a wet period all the year round and anaverage summer temperature >10°C and during the coldest month >0°C, or alternatively a continental climate with wet periods all year round, where the average summer temperature is >10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). These climatic changes should favour the survival and reproduction of the species in the northern part of the country.

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
X	increase significantly

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

acomm36. Comments:

Assuming that in the future the temperature will increase by 1-2°C, the probability that the species will break the existing barriers that have prevented it from spreading in Poland will increase significantly. *Ambrosia artemisiifolia* prefers, among other requirements, a warm moderate climate with a dry summer or wet periods all year round and an average summer temperature >10°C and during the coldest month >0°C, or alternatively a continental climate with wet periods all year round, where the average summer temperature is >10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). Currently, there is an increase in the frequency of this species, mainly in the southern and central part of the country (Tokarska-Guzik 2012-2017 – I). The forecasted climate change may be conducive to expanding the range of the species towards the northern regions of the country.

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
X	increase significantly

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

acomm37. Comments:

It is assumed that due to climate changes, the impact of the described species on wild plants and animals as well as habitats and ecosystems in Poland will increase significantly. *Ambrosia artemisiifolia* prefers, among other requirements, a warm moderate climate with dry summer or wet periods all year round and an average summer temperature >10°C and during the coldest month >0°C, or alternatively a continental climate with wet periods throughout the year where the average summer temperature is>10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). The forecasted climate changes may be conducive to extending the range of the species towards the northern regions of the country (see a36), but also to its entry into semi-natural and natural habitats (dry meadows, river valleys).

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
X	increase significantly

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

acomm38. Comments:

It is assumed that due to climate changes, the impact of the described species on arable crops or other plant production in Poland will increase significantly. *Ambrosia artemisiifolia* prefers, among other requirements, a warm moderate climate with a dry summer or wet periods all year round and an average summer temperature >10°C and during the coldest month >0°C, or alternatively a continental climate with wet periods all year round, where the average summer temperature is >10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). The forecasted climate change may be conducive to extending the range of the species towards the northern regions of the country (see a36), but also to its more efficiently entering crops and their neighbouring areas.

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
X	increase significantly

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

acomm39. Comments:

It is assumed that due to climate change the impact of the described species on livestock and domestic animals as well as livestock production in Poland will increase significantly. *Ambrosia artemisiifolia* prefers, among other requirements, a warm moderate climate with a dry summer or wet periods all year round and an average summer temperature >10°C and

during the coldest month >0°C, or alternatively a continental climate with wet periods all year round, where the average summer temperature is >10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). The forecasted climate changes may contribute to expanding the range of the species towards the northern regions of the country (see a36), but also to its entering into agricultural areas (meadows and pastures), increasing the likelihood of direct contact between animals and the plants.

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
X	increase significantly

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

acomm40. Comments:

It is assumed that due to climate change the impact of the described species on people in Poland will increase significantly. *Ambrosia artemisiifolia* prefers, among other requirements, a warm moderate climate with a dry summer or wet periods all year round and an average summer temperature >10°C and during the coldest month >0°C, or alternatively a continental climate with wet periods all year round, where the average summer temperature is >10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). The forecasted climate changes may contribute to expanding the range of the species towards the northern regions of the country (see a36), but also to the entry of the species into different types of habitats, increasing the likelihood of direct contact between humans and the plants.

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
X	increase moderately
	increase significantly

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

acomm41. Comments:

It is assumed that due to climate change the impact of the described species on other domains in Poland will increase moderately. *Ambrosia artemisiifolia* prefers, among other requirements a warm moderate climate with a dry summer or wet periods all year round and an average summer temperature >10°C and during the coldest month >0°C, or alternatively a continental climate with wet periods all year round, where the average summer temperature is >10°C and the coldest month <0°C. The species also thrives in tropical, steppe and desert climate conditions. Ragweed is susceptible to frost. The range of tolerance of the species to its preferred climatic parameters is also given by CABI (2018 – B). The forecasted climate changes may contribute to extending the range of the species towards the northern regions of the country (see a36), but also to the entry of the species into different types of habitats, increasing the likelihood of the species' impact on infrastructure (see a30).

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.75	1.00
Environmental impact (questions: a13-a18)	0.55	0.70
Cultivated plants impact (questions: a19-a23)	0.65	0.90
Domesticated animals impact (questions: a24-a26)	0.75	1.00
Human impact (questions: a27-a29)	1.00	1.00
Other impact (questions: a30)	0.50	0.50
Invasion (questions: a06-a12)	0.92	1.00
Impact (questions: a13-a30)	1.00	0.82
Overall risk score	0.92	
Category of invasiveness	very 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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