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. Alina Urbisz
3. Barbara Tokarska-Guzik

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	26-01-2018
(2)	dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	27-01-2018
(3)	prof. dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	31-01-2018

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

Polish name: Rdestowiec czeski (rdestowiec pośredni)*

Latin name: ***Reynoutria ×bohemica Chrtek & Chrtkova***

English name: Bohemian knotweed

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:

* NOTE:

In the appendix to the Regulation of the Minister of the Environment of 9 September 2011 on the list of plants and animals of alien species that could be a threat to native species or natural habitats in case of their release into the natural environment (Regulation 2011 – P) two Polish name for the species are given: "rdestowiec czeski" and "rdestowiec pośredni"; the latter name is currently prefered (Mirek at al. 2002 – P).

The Latin and Polish names are given according to the Flowering plants and pteridophytes of Poland - a checklist (Mirek et al. 2002 – P). In addition to the Latin synonyms given below, the species is described under many other names: *Fallopia sachalinensi*s var. *intermedia* (Tatew.) Yonek. & H. Ohashi, *Polygonum sachalinense* var. *intermedium* Tatew., *Reynoutria* ×*mizushimae* Yokouchi ex T. Shimizu, *Reynoutria sachalinensis* var. *intermedia* (Tatew.) Miyabe & Kudô, *Reynoutr*ia ×*vivax* auct., non J. Schmitz & Strank (The Plant List 2013 – B).

The taxonomic affiliation and nomenclature of species commonly referred to as knotweeds has been subject to many changes depending on the state of knowledge and the authors' approach (Schuster et al. 2011, 2015 – P). Currently, due to the similarity of their morphological, biological, ecological and other properties, invasive species of the genus *Reynoutria* (*Fallopia*): *R. japonica*, *R. sachalinensis* and their crossbreed *R.* ×*bohemica,* are often included as one group under the name *Reynoutria* spp., *Fallopia* spp. or *Fallopia complex* (e.g., Tiébré et al. 2007, Lamberti-Raverot et al. 2017 – P). The name Japanese knotweed s.l. is also often found – Asian (Japanese) knotweeds, which now includes all taxa (parent and hybrid species) along with hybrids resulting from backcrosses and crosses with other related species, including *Fallopia baldschuanica* (Bailey and Wisskirchen 2006, Bailey et al. 2009 – P).

Polish name (synonym I)	Polish name (synonym II)
Rdest pośredni	Rdest czeski
Latin name (synonym I)	Latin name (synonym II)
Fallopia ×bohemica	*Polygonum ×bohemicum*
English name (synonym I)	English name (synonym II)
Hybrid knotweed	

a03. **Area** under assessment:

Poland

acomm03. Comments:

–

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

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

aconf01. Answer provided with a

low	medium	high	level of confidence
		X	

acomm04. Comments:

Reynoutria ×bohemica has the status of an invasive kenophyte in Poland (Tokarska-Guzik 2005 - P). In 2012, the species was included in the group of alien, established and invasive species (Tokarska-Guzik et al. 2012 – P, Tokarska-Guzik et al. 2015a and b – I, Tokarska-Guzik et al. 2017 – P). The *R. ×bohemica* hybrid in Poland is the least well-known of the *Reynoutria* group, as is indicated by the relatively small number of recorded sites of this

species (over 300). It should be emphasized that the distribution of the species requires further research, and the number of identifications quoted is certainly an underestimate, due to frequent difficulties in distinguishing the hybrid from the parent species (especially Japanese knotweed) (Tokarska-Guzik et al. 2015b – I).

Initially, the species was considered to be one of the varieties of *R. japonica*. Plants under this name were distributed from Botanical Gardens around the world. They were probably derived from hybrid seeds (CABI 2018 – B).

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
	the human domain
X	the other domains

acomm05. Comments:

Reynoutria ×bohemica has a direct effect on the natural environment and poses a serious threat to it (Tokarska-Guzik et al. 2012 – P), through the formation of dense and extensive single-species populations, especially in habitats in river valleys where it effectively competes with native plant species, preventing their regeneration (Tokarska-Guzik et al. 2009, Toews 2012, Parepa et al. 2013, Chmura et al. 2015, Duqette et al. 2016 – P). The species limits and prevents the germination of seedlings of native plant species, creating a thick and slowly decaying layer of fallen leaves and stems (Gioria i Osborne 2010, Moravcová et al. 2011 – P), and also through the release of allelopathic substances inhibiting the growth of other plant species (Vrchotová and Šerá 2008, Murrell et al. 2011, Parepa et al. 2013 – P). Like the other knotweeds, it changes the physical and chemical properties of the soil and affects the activity of soil microorganisms (Siemens and Blossey 2007, Dassonville et al. 2011, Salles and Mallon 2014 – P). There are more and more cases of knotweed introduction into crops and unused fields, which may lead to difficulties or restrictions on the use of agricultural land (both through the physical and chemical effects on arable crops). To a limited extent, *Reynoutria ×bohemica* (similarly to its parent species) can affect animal breeding, causing wounds or digestive disorders. *Reynoutria ×bohemica* can negatively affect crops, among others by growing over arable fields that become unsuitable for cultivation (Onete et al. 2015 – P, Bzdęga 2017 – A). The mass presence of the species impedes access to water margins, limiting the possibilities of their economic and recreational use, leads to damage to hydrotechnical equipment and flood protection (Tokarska-Guzik et al. 2015a – I). The growing rhizomes destroy the surfaces of roads, and pavements and may cause cracks in walls, and even penetrate inside buildings (Tokarska-Guzik et al. 2015a – I).

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	level of confidence
		X	

acomm06.	Comments: *Reynoutria ×bohemica*, analogously to its parental species, belongs to the group of strongly invasive plants in many European countries, including those neighbouring Poland, from where numerous populations have been confirmed (Tokarska-Guzik et al. 2015b – I, CABI 2018 – B). The species is already widespread in many parts of the country, but it can still migrate into Poland from the border areas with the Czech Republic, Slovakia and Germany along river valleys and spread mainly through the dispersion of rhizomes with water (especially with river flow in flood) (Tokarska-Guzik and in. 2015b, Duqette et al. 2016 – P). Because the plant is characterized by a high regeneration potential, even from small fragments of rhizomes, the probability of self-expansion is high.

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: Both seeds and rhizomes of knotweed can be dispersed due to unintended human actions. The main way of their introduction in this case is the transportation of "contaminated" soil over long distances (also with contaminated machines and equipment) and then its use in other places, e.g. in river valleys during works related to the strengthening of banks, during construction works related to e.g. the construction of roads, parking lots, or clearing or deepening of drainage ditches (Alberternst and Böhmer 2011 – B, Tokarska-Guzik et al. 2015a and b, – I, Bzdęga and Tokarska Guzik 2006-2017 – A). The rhizomes have the greatest importance in the introduction of the hybrid. This is the most probable route of hybrid introduction in many European countries, especially in the eastern, southern and northern parts of the European secondary range (Tokarska-Guzik et al. 2015b – I, Tokarska-Guzik et al. 2017 – P). There is also a likelihood for seeds to be brought along with road and rail transport, but this path does not play a significant role in knotweed spread.

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: Knotweeds (*R. japonica* Japanese knotweed and *R. sachalinensis* giant knotweed) due to their decorative qualities (plant form and size, striking inflorescences and aggregate fruits) were introduced to cultivation both in Europe and North America, initially to botanical gardens, and then also to home gardens (Tokarska-Guzik et al. 2015b – I, Tokarska-Guzik et al. 2017 – P). *R. ×bohemica*, the hybrid knotweed, was first described in the 1980s in the Czech Republic (Chrtek and Chrtková 1983 – P), and then confirmed from other European countries and beyond (Tokarska-Guzik et al. 2015b – I, Tokarska-Guzik et al. 2017 – P). Initially it was not distinguished from one of the parent species, *R. japonica* Japanese knotweed, the observed morphological differences suggesting that it fitted within the variability of this species. Considering that both *R. japonica* and *R. sachalinensis* were grown as ornamental plants in nurseries in Leiden in the Netherlands (Siebold's Garden of Acclimatization), it can be assumed that a hybrid was formed right there, and was subject to distribution later on. In this way botanical gardens around the world, with collections

having the two above-mentioned species growing next to each other, disseminated seeds of a hybrid character, as Japanese knotweed. Studies on herbarium specimens carried out in the United Kingdom have also enabled the partial historical reconstruction of the spread of the hybrid outside of cultivation. Based on them, 1954 is considered to be the earliest date of the hybrid's emergence in wild conditions in the United Kingdom, in County Durham (Tokarska-Guzik et al. 2015b – I and literature cited therein). *Reynoutria ×bohemica*, along with the other species japanese knotweed and giant knotweed, are included in the group of energy (biomass production) plants; all taxa (species and hybrid) have been recommended as melliferous plants and their utility value is known, primarily as plants used in herbal medicine. These properties undoubtedly contributed to their intentional introduction by man. However, due to the threat they pose (Anioł-Kwiatkowska and Śliwiński 2009, Tokarska-Guzik et al. 2015b – I), their cultivation is strictly forbidden throughout the country (Regulation of the Minister of the Environment of 9 September 2011 on the list of plants and animals of alien species that could be a threat to native species or natural habitats in case of their release into the natural environment – Regulation 2011 – P). However, *Reynoutria ×bohemica* grows in many places of its past and present cultivation (municipal and backyard gardens, cemeteries), from where it can "escape" as a result of improper care actions, e.g. depositing plant fragments outside the cultivation area (Tokarska-Guzik et al. 2015b – I). It is also impossible to completely exclude the introduction of the species into the environment due to deliberate human activities, especially in municipal areas (gardens, wastelands), from where the plants can spontaneously spread.

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	level of confidence
				X	

acomm09. Comments:

Within the borders of the natural range of the parental species, their hybrid *R. ×bohemica* knotweed, known from Europe since 1982, was first noticed as late as at the end of the twentieth century and was described under the name *Reynoutria × mizushimae* Yokouchi ex T. Shimizu (Bailey 2003 - P). Next, the presence of this taxon was confirmed in 1999 and 2000 by Bailey from the north-western part of the Honshu Island (Bailey 2003 - P). The maps illustrating the European reach of the two species – Japanese knotweed and giant knotweed – were published in the late 1970s (Jalas and Suominen 1979 – P), while for *R. ×bohemica*, only at the beginning of the 21st century (Bailey and Wisskirchen 2006 – P).

The area where *Reynoutria ×bohemica* hybrid knotweed is present in Europe has not been precisely recognized. Until now, this taxon was most frequently recorded in northern and central Europe (Bailey 2003 – P), including, for the first time, from the Czech Republic (Chrtek and Chrtková 1983 – P), and then from the United Kingdom (Bailey et al. 1995 – P), Germany (Keil and Alberternst 1995 – P), Hungary (Balogh 1998 – P), as well as from Poland (Fojcik and Tokarska-Guzik 2000 – P). The previous data in the literature describe its contemporary range on the European continent as being between 43°S and 67°N, as well as between 10°W and 25°E (Balogh 2008 – P). The maps partly illustrating the extent of *R. ×bohemica* were published for Europe by Bailey and Wisskirchen (2006 – P) and for the Czech Republic by Mandák et al. (2004 – P). However, its range is gradually expanding, reaching the Mediterranean region (where it is also found in cultivation, e.g. on the Istrian

Peninsula in Croatia, Tokarska-Guzik 2006-2017 – A). Outside of Europe, it is also present in North America, both in Canada and the USA (CABI 2018 – B).

Similarly to the parental species, knotweed reproduces primarily vegetatively via the rhizomes, allowing quick and effective area occupation. Both rhizomes and shoots are characterized by fast growth rates and high regenerative abilities. A new plant may develop from a small fragment of a rhizome or a shoot segment containing a single node placed in soil or water (CABI 2018 – B). As in the case of the parent species, sexual reproduction in the hybrid is not common, and seedlings rarely form as a result of backcrossing with one of the parental forms (Tokarska-Guzik et al. 2015a and b – I, CABI 2018 – B). According to Bailey et al. (2009) knotweed seedlings are rare in Europe's climatic conditions. It has been confirmed that their dieback is associated with too little water, and a temperature of -5°C present for longer than for two days eliminates half of them (Funkenberg et al. 2012 – P).

Based on the history of the origin and the spread of the hybrid within the limits of the European secondary range and its observed tendencies to expand its range (including increasingly frequent seedling listings) it should be assumed that the climatic conditions in Poland are optimal.

Reynoutria ×bohemica prefers a temperate, mesothermic climate, with two rainy seasons and two dry periods, with the mean temperature of the coldest month in the range between 0°C and 18°C, and with the mean temperature of the warmest month exceeding 10°C (CABI 2018 – B).

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:

Reynoutria ×bohemica in the secondary range demonstrates a wide ecological amplitude and habitat spectrum. Its requirements for soil type, pH or humidity do not differ significantly from those preferred by the parent species (CABI 2018 – B). The hybrid, like *R. japonica*, demonstrates a clear tolerance to salinity (CABI 2018 - B) which is confirmed by its present in salt marsh habitats in the USA (Richards et al. 2008 – P). *Reynoutria ×bohemica* also dominates other habitats analogous to those occupied by *R. japonica*, especially riverside (riparian) and ruderal ones, e.g. roadsides, railway embankments or urban wastelands (Fojcik and Tokarska-Guzik 2000 – P, CABI 2018 – B). The hybrid is also often found in the close vicinity of fresh water, such as rivers and streams, as well as in habitats typical for urban and suburban zones (CABI 2018 – B). The hybrid is more and more often recorded in agricultural areas, e.g. in maize (Tokarska-Guzik et al. 2009 – P, Bzdęga 2017 own observation – A).

A3 | Spread

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

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

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

	very low
	low
	medium

	high
X	very high

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

acomm11. Comments:

Similarly to the parental forms, the hybrid also spreads primarily in a vegetative way by multiplying rhizomes, which enables quick and effective takeover of new areas. Rhizomes and shoots are characterized by fast growth rates and high regenerative abilities, and new plants can develop from small fragments of either (Tokarska-Guzik et al. 2015a and b – I, Tokarska-Guzik et al. 2017 – P and literature quoted therein). Winged fruits - nuts (formed in the so-called mixed populations in which parental species occur side by side. Note that a wider description of sexual reproduction and the possibility of hybrid seed formation can be found in the study by Tokarska-Guzik et al. 2015b – I), falling mostly near the parental plants can be transferred to new areas by wind (so–called anemochory) and water (so–called hydrochory), but their role in establishment in new places is limited (Tiébré et al. 2007 – P). At the same time propagation by seeds in *Reynoutria ×bohemica* is considered to be the main factor determining its invasive character, through the strategy of forming new more invasive genotypes (Buhk and Thielsch 2015, Strgulc and Dolenc 2015 – P, Bzdęga and Tokarska-Guzik 2010-2017 – A).

Dispersion from a single source (type A data). It can be assumed that in case of *Reynoutria ×bohemica*, as in the parental forms, there is the possibility of spreading seeds within a dozen or so metres beyond the parent population. In case of *R. japonica*, this distance is up to 16 m (dispersion is very low) away from the parent population (Tiébré et al. 2007 – P). Rhizomes may grow a few or several metres from the mother plant. These distances can be increased by strong winds (seeds) or water; both seeds and rhizomes can be transported by water over long distances, especially with flood waters (very high dispersion).

Population expansion (type B data). Based on the data so far collected, it is difficult to assess the rate of expansion of the *R. ×bohemica* range. A small number of the records of the hybrid in Poland probably still result from problems with distinguishing it from the parental species (Tokarska-Guzik et al. 2015b – I). For example, such mistakes were confirmed during the revision of herbarium material originating from Montenegro, Croatia and Bulgaria, in which it was confused with giant knotweed (Širka et al. 2013 – P), as well as in herbarium materials from Poland (Tokarska-Guzik et al. 2015b – I). Gradually, data about the presence of *Reynoutria ×bohemica* p are supplemented, confirming that its distribution is wider than previously expected.

Estimation (type C data). A determination of the ability of Bohemian knotweed to increase the area it inhabits based on an estimation of its biological mobility indicates an extremely high capability for the hybrid to spread without human involvement. Like the parental species, the hybrid is characterized by enormous possibilities for vegetative reproduction. The new plant may develop from a 1 cm rhizome section weighing not more than 0.7 g, as well as from a small section of the shoot containing a single node, placed in soil or in water (Bailey et al. 2009 – P, Alberternst and Böhmer 2011 – B). Bímová and others (2003 - P) indicated differences in the ability and speed of regeneration of individual taxa depending on the conditions (water/soil). *Reynoutria ×bohemica* presents the highest regeneration rate when compared with the parent species (61%). The share of sexual reproduction in spread is also increasing (Bzdęga et al. 2016 – P).

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

	low
	medium
X	high

aconf08.	Answer provided with a	low	medium	high **X**	level of confidence

acomm12.	Comments: The conscious introduction of the invasive knotweeds, including *Reynoutria ×bohemica*, into a new environment is not allowed (Regulation 2011 – P, Tokarska-Guzik et al. 2015b – I), however, due to the decorative qualities of the plant (including the large decorative leaves, the late blooming), it is not possible to exclude intentional introduction of the species by humans, especially in the urban environment (home gardens, wastelands), from where it can spread to adjacent areas spontaneously. It is possible to consciously introduce *Reynoutria ×bohemica* to use its biomass for energy purposes (Pude and Franken 2001 – P), including for the production of biogas (Strašil and Kára 2010 – P). The high productivity of *Reynoutria ×bohemica* biomass and its suitability in the process of co-fermentation with maize and apple pomace has been demonstrated, creating the potential for using the plant as an alternative source of biogas (Kupryś-Caruk et al. 2014 – P). However, this is another source of potential threat to the environment, therefore knotweed cultivation is absolutely undesirable throughout the country. All knotweeds can also be used as heating material, yet obtaining it from places where it already exists should be recommended (Tokarska-Guzik et al. 2009 – P). Knotweeds can present great importance in the human economy as a raw material (a valuable source of resveratrol) obtained from both natural and controlled crops, intended for use in the pharmaceutical industry and for applications in herbal medicine (Tokarska-Guzik et al. 2015b – I). Experimental cultivars of *Reynoutria ×bohemica* indicate the possibility of obtaining 2.6 t from dry matter and 8.5 kg of stilbene from 1 hectare (Kovářová et al. 2010 – P) which is used in the chemical industry. The quite frequent (yet still insufficiently documented) *Reynoutria ×bohemica* presence in many regions of the country, in various habitat types, creates a high probability of further spreading of fragments of the hybrid during various types of earthworks (e.g. construction of roads, power lines) and regulatory works (regulation of river channels, strengthening flood embankments), along with soil, water and with equipment being used (including in winter, when snow ploughs are used for snow removal). The frequency of spread is also influenced by improperly performed treatments for the elimination and utilization of both above-ground and underground parts of plants.

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 non-parasitic plant, it does not cause this type 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: *Reynoutria ×bohemica*, like the other two parental species present in Poland, effectively competes with native plant species, often preventing them from growing and regenerating (Tokarska-Guzik et al. 2009, Toews 2012, Parepa et al. 2013, Chmura et al. 2015, Duqette et al. 2015 – P, Tokarska-Guzik et al. 2015b – I, Tokarska-Guzik et al. 2017 – P). Due to the dense setting of the large leaves on the stems, it achieves a competitive advantage over native plants by limiting their access to light (Siemens and Blossey 2007 - P). Plants form a thick and slowly decaying layer of fallen leaves and stems. This litter limits the development of species specific to the habitat (Chmura et al. 2015 – P, Tokarska-Guzik et al. 2015b – I). Also, allelopathic effects or interaction of the hybrids with soil microorganisms may contribute to the crowding out of native species at sites occupied by *R. ×bohemica* populations (Siemens and Blossey 2007 – P). Among the undesirable interactions, the most harmful includes *Reynoutria ×bohemica* penetration into protected areas, including riverside areas, including the Natura 2000 area - „Graniczne Meandry Odry" ["Border Meanders of the Oder"] (Koszela and Tokarska-Guzik 2008, Bzdęga and Tokarska-Guzik 2006-2017 – A). The latest data provided by Kampinoski National Park and Pieniński National Park confirm the presence of *Reynoutria ×bohemica* in the area of the parks and in their buffer zones (Tokarska-Guzik et al. 2015b – I). All species of knotweeds have a significant effect on the biodiversity of natural and semi-natural habitats, and in particular on riparian ecosystems, posing a threat to native plants and invertebrates (Gerber et al. 2008 – 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 knotweed could interbreed. *Reynoutria ×bohemica* interbreeds with the other two invasive species of the *Reynoutria* genus, *Reynoutria japonica* and *R. sachalinensis*, present in the country. In addition to the hybrid described under the name *Reynoutria ×bohemica* resulting from the crossing of *R. japonica* and *R. sachalinensis*, two back hybrids have been described so far: *Reynoutria japonica* var. *japonica* × *Reynoutria ×bohemica* and also *Reynoutria ×bohemica* × *Reynoutria R. sachalinensis* – found in Wales (Bailey 2003 – P). One cannot exclude the presence of hybrids originating from backcrossing also in Poland (Bzdęga and Tokarska-Guzik 2010-2017 – A).

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 **X**	medium	high	level of confidence

acomm16. Comments:

For *Reynoutria ×bohemica*, there is no detailed data on the effect on native species by transferring pathogens or parasites harmful to them (Balogh 2008 – P), which may also be due to the problems with its identification. It can be expected that a significant portion of those found in *R. japonica* are also present in the hybrid (CABI 2018 – B). However, in this case, there is no more detailed data on pathogen or parasite transfer to native 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:

Reynoutria ×bohemica, like the other species of knotweed, negatively affects the integrity of ecosystems by disturbing the abiotic factors. The presence of the hybrid causes changes in the physical and chemical properties of the soil and the activity of soil microorganisms (Dassonville et al. 2011 – P). Analogously with the other knotweeds, the hybrid knotweed can directly regulate the amount of available nitrogen resources by inhibiting the process of biological denitrification by soil bacteria, which leads to the accumulation of nitrate resources in the soil and thus enables the plants to grow their biomass intensely and thus to facilitate effective invasion (Salles and Mallon 2014 – P). Invasion of *Reynoutria ×bohemica* is accompanied by a significant increase in biomass both above and below ground, which in turn may lead to changes over the course of biogeochemical cycles, as well as cycle of water and its availability. The dangerous effects of river and stream banks being dominated by any knotweed species includes the uprooting of large patches of these plants during rapid floods which contributes to the erosion of embankments (Bergstrom et al. 2008 – P). Effects also includes the accumulation of a large volume of biomass on hydrotechnical equipment, which may lead to damage to their structure, as well as being the cause of local submersions and floods (Tokarska-Guzik et al. 2015b – I). Limiting the access to light, especially for herbaceous species is an important factor affecting the integrity of the ecosystem. Mass presence of *Reynoutria ×bohemica* can cause practically irreversible changes in the processes occurring in habitats requiring special care (including, in particular, the hydrophilous tall herb fringe communities of plains and of montane to alpine levels – 6430, Tokarska-Guzik et al. 2015b – I).

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:

Reynoutria ×bohemica is considered to be a more invasive species compared with the parental forms (GB NNSS 2018 – I), characterized by a greater potential for creating dense patches (as a result of vegetative propagation) in large sunlit, nitrogen-rich and humid areas (GB NNSS 2018 – I). The plants cause major changes in the structure and species composition of local ecosystems, including riparian forests, willow shrubberies and riparian herbaceous vegetation. They compete effectively with native plant species, preventing their regeneration (Tokarska-Guzik et al. 2009, Chmura et al. 2015 – P). Allelopathic chemical substances produced by knotweeds inhibit the germination and growth of other plants (Vrchotová and Šerá 2008, Tokarska-Guzik et al. 2015b – I). The species can compete with native plants for pollinators, however on account of its late flowering this phenomenon is limited to native plants flowering in late summer. The penetration of the species into protected areas should be also listed among the adverse effects (Tokarska-Guzik et al. 2015a and b – I, Bzdęga and Tokarska-Guzik 2006-2017 – A). The species has a negative effect on Natura 2000 natural habitats, including mainly: alpine rivers and their ligneous vegetation with *Salix elaeagnos* (3240), alpine rivers and their ligneous vegetation with *Myricaria germanica* (3230), hydrophilous tall herb fringe communities of the plains and of montane to alpine levels (6430), alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Pandion*, *Alnion incanae*, *Salicion albae*) (91E0), riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along major rivers (*Ulmenion minoris*) (91F0) (Tokarska-Guzik et al. 2015b – I, Tokarska-Guzik et al. 2017 – P). In the Czech Republic, a negative influence of the knotweed on an endangered species was found in the case of *Myricaria germanica* German tamarisk, which is present on gravel sites along mountainous rivers with periodic floods. *Reynoutria ×bohemica* penetrates this type of habitats and completely eliminates the communities of willow-tamarisk shrubs, including *M. germanica* (CABI 2018 – B). Due to its large size and rapid growth in the initial period of the vegetation season, *Reynoutria ×bohemica* significantly reduces the number of native species in locations where it is present. Its dense populations transform the native soil seed bank (Bzdęga and Tokarska-Guzik 2006-2017 – A). This manifests itself in the depletion of the species composition typical for specific communities. The dense knotweed patches can also provide a refuge for many animal species.

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, it also has no parasitic properties.

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

	inapplicable
	very low
X	low
	medium
	high
	very high

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

acomm20. Comments:

Like other invasive knotweed, *Reynoutria ×bohemica* may adversely affect crop plants, including by entering fields and meadows which then become unsuitable for cultivation (Onete et al. 2015 – P, Bzdęga 2017 – A). Allelopathic chemicals produced by the species, as in other knotweeds, inhibit the germination and growth of other plants (Vrchotová and Šerá 2008 – P, Tokarska-Guzik et al. 2015b – I). These phenomena are not common yet, while the chemical interactions require further study and monitoring. It is estimated that the effect will influence less than 1/3 of crops being invaded (low probability) and in the worst case the condition of plants or an individual crop yield is reduced by about 5% (low effect).

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

	inapplicable
X	no / very low
	low
	medium
	high
	very high

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

acomm21. Comments:

Reynoutria ×bohemica, as a hybrid of two species from the genus Reynoutria: *R. japonica* and *R. sachalinensis*, may indirectly affect the condition and yield of crop plants by creating difficult to control populations (CABI 2018 – B). There are also known backcrosses with parental species, e.g. with *R. sachalinensis* (so-called introgression) (Bailey et al. 2009, Bailey 2013 – P). The hybrid, similarly to the parental forms, as well as the hybrids formed with their participation, may negatively affect crops, e.g. by growing over arable fields and meadows which then become unsuitable for cultivation (Onete et al. 2015 – P, Bzdęga 2017 – A). However, *Reynoutria ×bohemica* does not interbreed with plants commonly cultivated in Poland.

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

	very low
	low
X	medium
	high
	very high

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

acomm22. Comments:

The presence of all species from the *Reynoutria* genus, including *R. ×bohemica*, limits the agricultural use of land (Tokarska-Guzik et al. 2009, Onete et al. 2015 – P, Bzdęga 2017 – A).

Knotweeds are found on agricultural wastelands, but over the recent years, they have become more frequent and abundant in crops, e.g. in Switzerland (Bohren 2011 – P). Analogously, as with the effect of these taxa on disturbing ecosystem integrity, it can be assumed that they can affect the condition or yield of crops via changes in the agroecosystem properties. These phenomena are not common yet and require further study and monitoring.

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

X	very low
	low
	medium
	high
	very high

aconf19. Answer provided with a

low	medium	high
	X	

level of confidence

acomm23. Comments:

There is insufficient data on the effect of the hybrid on crops associated with the fact that it is a host or vector of pathogens and parasites harmful to these plants.

A4c | Impact on the domesticated animals domain

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

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

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf20. Answer provided with a

low	medium	high

level of confidence

acomm24. Comments:

The species is a plant.

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

	very low
X	low
	medium
	high
	very high

aconf21. Answer provided with a

low	medium	high
	X	

level of confidence

acomm25. Comments:

Dry and sharply-broken shoots of *R. japonica*, as well as *R. sachalinensis*, can cause cuts to grazing animals such as sheep (Kirpluk 2016 – P). No adverse effects were found in cattle,

	although animals feeding on giant knotweed demonstrated temporary anorexia and hypothermia (CABI 2018 – B). Presumably, this situation may also apply to *Reynoutria ×bohemica*.

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 nor 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:

X	very low
	low
	medium
	high
	very high

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

acomm28.	Comments: A negative effect of *Reynoutria japonica* and *R. sachalinensis* on human health has not been demonstrated (Alberternst and Böhmer 2011 – I). It should be assumed that a similar situation applies in the case of the hybrid. However, knotweed populations on river and stream banks can cause difficulties in access for hikers and anglers. Rhizomes of plants may also cause a risk of tripping, for example on pavements and footways (GB NNSS 2018 – 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
	medium
	high
X	very high

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

acomm30. Comments:

Reynoutria ×*bohemica*, as with the parental species, *R. japonica* and *R. sachalinensis*, is a serious threat in river valleys, as it can destroy flood protection and hydrotechnical constructions. Dead matter remaining above ground and underground plants can significantly limit or inhibit water flow. The hybrid, like the other knotweeds, occurs in areas with housing and economic infrastructure. As in the case of the other species, it can cause damage by the growth of the rhizomes. By penetrating the ground (intensive annual growth), *Reynoutria* ×*bohemica*, rhizomes can damage foundations, building walls and drainage channels, road surfaces, pedestrian walkways or car parks (Beerling 1991 – P, Alberternst and Böhmer 2011 – B, Tokarska-Guzik et al.). 2015a and b, GB NNSS 2018 – I). With its presence along roads, *Reynoutria* ×*bohemica* can limit visibility and obscure road signs. In addition, the massive presence of the plant also limits access to water reservoirs, e.g. for anglers (Tokarska-Guzik et al. 2015b – I).

A5a | Impact on ecosystem services

Questions from this module qualify the consequences of *the organism* on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of *the species*.

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

	significantly negative
	moderately negative

	neutral
X	moderately positive
	significantly positive

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

acomm31. Comments:

Reynoutria ×bohemica, similarly to Japanese knotweed and giant knotweed, can be perceived as a useful plant, the biomass of which could be used for energy needs. However, there is no detailed literature data on the efficiency of its biomass for this purpose. Presumably, the calorific value is close to *R. japonica*, at around 18.4 GJ/t (Kovářová et al. 2011 – P). The suitability of *Reynoutria ×bohemica* for biogas production is also reported (Kupryś-Caruk et al. 2014 – P).

The presence of *Reynoutria ×bohemica* in the environment can be perceived as beneficial, e.g. by owners of apiaries due to the melliferous properties of the plant and its relatively late flowering providing benefits to bees in late summer. Knotweed shoots are also used in floristry (flowering).

Reynoutria ×bohemica, like the other species, is used in phototherapy. It contains many biologically active compounds, including resveratrol – a chemical compound belonging to the antioxidant group (Chen et al. 2013, Peng et al. 2013 – P).

At the same time, *Reynoutria ×bohemica* may adversely affect crops, e.g. by entering fields and meadows which then become unsuitable for cultivation. Allelopathic chemicals produced by the species, as with the other knotweeds, inhibit germination and growth of other plants (cf question a20). These phenomena are not common yet, while the chemical interactions require further studying and monitoring.

To sum up one can acknowledged that the influence of the species on provisioning services is moderately positive.

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

Reynoutria ×bohemica affects regulatory services. Its large populations cause changes in the physical and chemical properties of soil (including the availability of nitrogen) and in the activity of soil microorganisms (cf question a17). Invasion of *Reynoutria ×bohemica* is accompanied by a significant increase in biomass both on and below the ground surface, which in turn may lead to changes over the course of biogeochemical cycles, as well as cycle of water and its availability. The dangerous effects of the river and stream banks being dominated by any of the knotweed species includes the uprooting of large patches of these plants during rapid floods which contributes to the erosion of embankments (Bergstrom et al. 2008 – P). They can also damage the structure of floodbanks and contribute to local and wider flooding (Tokarska-Guzik et al. 2015 b - I). The plants cause major changes in the structure and species composition of local ecosystems, including riverside ones. They effectively compete with native plant species, preventing their regeneration. The allelopathic chemicals produced by knotweed inhibit the germination and growth of other plants (compare question 18).

All knotweed taxa, due to their biological characteristics, may have impact on other potential regulatory services, which are not based on specific tests such as: air quality regulation (dust retention and pollution absorption), air exchange, wind protection, noise reduction, etc.

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

The plant has decorative and utility qualities. It is an attractive plant, the shoots of which resemble bamboo, hence it is still kept in gardens. The stems and seedlings of *Reynoutria ×bohemica* are used in floristry, where caution is recommended in these cases with regard to the use of fresh material, due to the possibility of creating potential new introductions (Tokarska-Guzik et al. 2015b – I, Bzdęga and Tokarska-Guzik 2006-2017 – A).

In case of all knotweed taxa, due to their biological features, one can draw attention to the following potential cultural services, which are not based on specific research: effects on spatial aesthetics, both positive (masking aesthetically unpleasing elements, Gilbert 1992 - P) and negative (wastelands covered with knotweeds are not aesthetically pleasing, particularly in winter, especially in urban and recreational zones, also these usually constitute places with additional litter); positive effect on health (regulation of humidity and air quality); business benefits (cultivation for decorative and utility purposes).

Reynoutria ×bohemica forms dense, extensive patches in large spaces, including recreational and tourist areas (e.g. on the banks of rivers and water reservoirs, limiting access to water (Tokarska-Guzik et al. 2006 – P, Bzdęga and Tokarska-Guzik 2006-2017 – A). The presence of tall plants along roads may reduce visibility and cause a threat to road safety (Tokarska-Guzik et al. 2015b – P). Dry knotweed shoots can be a hazard in winter. *Reynoutria ×bohemica* can however also be considered valuable in the reclamation of heavily polluted areas, etc.

To sum up it is recognised that negative and positive influence of species for cultural services give an overall neutral assessment.

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

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

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

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf30.	Answer provided with a	low	medium **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 subsequent barriers related to its occurrence in Poland will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B) (cf the comment in question a06).

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 **X**	high	level of confidence

acomm35.	Comments: Assuming that in the future the temperature will increase by 1–2°C, the probability that the species will overcome additional barriers related to subsistence and reproduction in Poland will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B) (cf comment a09).

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: Assuming that in the future the temperature will increase by 1-2°C, the probability that the species will break subsequent barriers - which have so far prevented its spread in Poland - will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B)(cf the comment in question a09). Unlike two parental species, *R. ×bohemica* seems to demonstrate ecological abilities which are not directly in terms expressed by its parental species, as is the case with its morphology and physiology. This is the ability to develop new features regardless of niche adaptation and range extension (Bailey and Wisskirchen 2006 – P). This can be manifested, for example, by gradual propagation of the hybrid in the simultaneous absence of *R. japonica* (Balogh 2008 – P). As the temperature increases, it can also be assumed that the share of sexual reproduction in the propagation of the hybrid will increase.

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

	decrease significantly
	decrease moderately
X	not change

	increase moderately
	increase significantly

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

acomm37. Comments:

It is assumed that due to climate change the effect of the described hybrid on wild plants and animals - as well as habitats and ecosystems in Poland - will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B) (cf the comment in question a09).

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:

It is assumed that due to climate change the effect of the described hybrid on crops or plant production in Poland will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B) (cf the comment in question a09).

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:

It is assumed that due to climate change, the impact of the described hybrid on livestock and household animals as well as on animal production in Poland will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B) (cf the comment in question a09).

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:

It is assumed that due to climate change the effect of the described species on people in Poland will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B) (cf the comment in question a09).

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

It is assumed that due to climate change the effect of the described species on other objects in Poland will not change. *Reynoutria ×bohemica* prefers a temperate climate with the mean temperature of the coldest month in the range between 0°C and 18°C, and with mean temperature of the warmest month exceeding 10°C (CABI 2018 – B).

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1,00
Spread (questions: a11-a12)	1.00	1.00
Environmental impact (questions: a13-a18)	0.65	0.80
Cultivated plants impact (questions: a19-a23)	0.15	0.70
Domesticated animals impact (questions: a24-a26)	0.25	0.50
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	1.00	1.00
Invasion (questions: a06-a12)	1.00	1.00
Negative impact (questions: a13-a30)	1.00	0.80
Overall risk score	1.00	
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: The assessment of the degree of *Reynourtia ×bohemica* invasiveness performed in the case of Poland confirms its status as a "very invasive alien species". The maximum score (1.0) was obtained in the module 'Impact on other objects' (a30). The score for the 'Environmental impact' module (questions a13 – a18) amounted to 0.65, which entitles us to place the species in the "high" impact category (0.61–-0.80). At the same time, the species scored zero in the 'Human impact' module (questions: a27-a29), and had low scores in modules: 'Cultivated plants impact' (0.15, questions: a19-a23) and 'Domesticated animal impact' (0.25, questions: a24-a26). The obtained result is analogous to that of *Reynoutria japonica* Japanese knotweed, yet it should be emphasized that *Reynoutria ×bohemica* is considered to be a taxon with even higher invasive potential compared with its parent species. Due to the fact that this hybrid is widespread in Poland and presents great ability to spread, and that the current methods of elimination are characterized by low effectiveness at high costs, actions to limit the negative effect of the species on valuable natural areas and further studies leading to the development of more effective methods of combating should be recommended.

Data sources

1. Published results of scientific research (P)

Anioł-Kwiatkowska J, Śliwiński M. 2009. Obce rośliny energetyczne – zagrożenie dla flory Polski. Pamiętnik Puławski 150: 35-44

Bailey JP. 2003. Japanese Knotweed s.l. at home and abroad. In: L. Child, JH. Brock, K. Prach, P. Pyšek., PM. Wade, W. Williamson (eds.), Plant invasions – ecological threats and management solutions. pp. 183-196. Backhuys, Leiden, The Netherlands.

Bailey JP. 2013. The Japanese knotweed invasion viewed as a vast unintentional hybridization experiment. Heredity 110(2): 105-110

Bailey JP, Bímová K, Mandák B. 2009. Asexual spread versus sexual reproduction and evolution in Japanese Knotweed s.l. sets the stage for the "Battle of the Clones". Biological Invasions 11: 1189-1203

Bailey J.P., Child, L. E., Wade, M. 1995. Assessment of the genetic variation and spread of British populations of *Fallopia japonica* and its hybrid *Fallopia ×bohemica*. In: P. Pyšek, K. Prach, M. Rejmanek, M. Wade (eds.), Plant invasions – general aspects and special problems. pp. 141–150. SPB Academic Publishing, Amsterdam.

Bailey JP, Wisskirchen R. 2006. The distribution and origins of *Fallopia ×bohemica* (Polygonaceae) in Europe. Nordic Journal of Botany 24: 173-200

Balogh L. 2008. Japanese, giant and Bohemian knotweed (*Fallopia japonica* (Houtt.) Ronse Decr., *F. sachalinensis* (Frdr. Schmidt) Ronse Decr. and *F. ×bohemica* (Chrtek et Chrtková) J. P. Bailey). In: Z. Botta-Dukát, L. Balogh (eds.), The most important invasive plants in Hungary. pp. 13-33. Institute of Ecology and Botany, Hungarian Academy of Sciences, Vácrátót, Hungary.

Beerling DJ, Huntley B, Bailey J. 1995. Climate and the distribution of *Fallopia japonica*: use of an introduced species to test the predictive capacity of response surfaces. Journal of Vegetation Science 6: 269-282

Bergstrom JD, Kallin P, Obropta Ch. 2008. Implementing restoration projects upstream from the Teaneck Creek Conservancy. Urban Habitats 5(1): 166-170

Bímová K., Mandák B., Pyšek P. 2003. Experimental study of vegetative regeneration in four invasive *Reynoutria* taxa (Polygonaceae). Plant Ecology 166(1): 1–11

Bohren C. 2011. Exotic weed contamination in Swiss agriculture and the non-agriculture environment. Agronomy for Sustainable Development 31: 319-327

Buhk C, Thielsch A. 2015. Hybridisation boosts the invasion of an alien species complex: Insights into future invasiveness. Evolution and Systematics 17(4): 274-283

Bzdęga K, Janiak A, Książczyk T, Lewandowska A, Gancarek M, Śliwińska E, Tokarska-Guzik B. 2016. A survey of genetic variation and genome evolution within the invasive *Fallopia* complex. PLoS ONE 11(8): e0161854.

doi:10.1371/journal.pone.0161854

Chen H., Tuck T., Ji X., Zhou X., Kelly G., Cuerrier A., Zhang J. 2013. Quality assessment of Japanese Knotweed (*Fallopia japonica*) grown on Prince Edward Island as source of resveratrol. Journal of Agricultural and Food Chemistry 61(26): 6383–6392.

Chmura D, Tokarska-Guzik B, Nowak T, Woźniak G, Bzdęga K, Koszela K, Gancarek M. 2015. The influence of invasive *Fallopia* taxa on resident plant species in two river valleys (southern Poland). Acta Societatis Botanicorum Poloniae 84(1): 23-33

Chrtek J., Chrtková A. 1983. *Reynoutria* ×*bohemica*, novy křiženec z čeledi rdesnovitych. Journal of the National Museum (Prague), Natural History Series 152(2): 120

Dassonville N, Guillaumaud N, Piola F, Meerts P, Poly F. 2011. Niche construction by the invasive Asian knotweeds (species complex *Fallopia*): Impact on activity, abundance and community structure of denitrifiers and nitrifiers. Biological Invasions 13: 1115-1133

Duqette MC, Compérot A, Hayes LF, Pagola C, Bezile F, Dubé J, Lavoie C. 2016. From the source to the outlet: understanding the distribution of invasive knotweeds along a North American river. River Research and Applications 32: 958-966 (DOI: 10.1002/rra.2914)

Fojcik B, Tokarska-Guzik B. 2000. *Reynoutria* ×*bohemica* (Polygonaceae) – nowy takson we florze Polski. Fragmenta Floristica et Geobotanica 7: 63-71

Funkenberg T, Roderus D, Buhk C. 2012. Effects of climatic factors on *Fallopia japonica* s.l. seedling establishment: evidence from laboratory experiments. Plant Species Biology 27(3): 218-225

Gerber E, Krebs C, Murrell C, Moretti M, Rocklin R, Schaffner U. 2008. Exotic invasive knotweeds (*Fallopia* spp.) negatively affect native plant and invertebrate assemblages in European riparian habitats. Biological Conservation 141: 646-654

Gilbert OL. 1992. The ecology of an urban river. British Wildlife 3: 129-136

Gioria M, Osborne B. 2010. Similarities in the impact of three large invasive plant species on soil seed bank communities. Biological Invasions 12(6): 1671-1683

Jalas J, Suominen J. 1979. Atlas Florae Europaeae. 4. Polygonaceae. Committee for Mapping of the Flora of Europe, Helsinki, Finland

Keil P, Alberternst B. 1995. *Reynoutria* ×*bohemica* Chrtek & Chrtkova im westlichen Ruhrgebiet. Natur und Heimat 55: 85–88

Kirpluk I. 2016. Gatunki z rodzaju rdestowiec *Reynoutria* spp. In: A Obidziński, Kołaczkowska E, Otręba A. (eds.). Metody zwalczania obcych gatunków roślin występujących na terenie Puszczy Kampinoskiej. pp. 59-65. Kampinoski Park Narodowy, Izabelin

Koszela K., Tokarska-Guzik B. 2008. Alien plant species in the protected landscape area of the Odra river meanders: habitat preferences and threats. Biodiversity Research and Conservation 9–10: 73–80

Kovářová M, Frantík T, Koblihová H, Bartůňková K, Nývltová Z, Vosátka M. 2011. Effect of clone selection, nitrogen supply, leaf damage and mycorrhizal fungi on stilbene and emodin production in knotweed. BMC Plant Biology 11: 98 (DOI:10.1186/1471-2229-11-98)

Kupryś-Caruk M, Podlaski S, Wiśniewski G. 2014. Przydatność rdestowca czeskiego (*Reynoutria* ×*bohemica* Chrtek & Chrtkova) do produkcji biogazu rolniczego. Zeszyty Problemowe Postępów Nauk Rolniczych 579: 27-36

Lamberti-Raverot B, Piola F, Thiébaut M, Guillard L, Vallier F, i in. 2017. Water dispersal of the invasive complex *Fallopia*: The role of achene morphology. Flora 234: 150-157

Mandák B, Pyšek P, Bímová K. 2004. History of the invasion and distribution of *Reynoutria* taxa in the Czech Republic: a hybrid spreading faster than its parents. Preslia 76: 15–64.

Mirek Z, Piękoś-Mirkowa H, Zając A, Zając M. 2002. Flowering plants and pteridophytes of Poland. A checklist. Biodiversity of Poland 1: 1-442

Moravcová L, Pyšek P, Jarošík V, Zákravský P. 2011. Potential phytotoxic and shading effects of invasive *Fallopia* (Polygonaceae) taxa on the germination of dominant native species. NeoBiota 9: 31-47

Murrell C, Gerber E, Krebs C, Parepa M, Schaffner U, Bossdorf O. 2011. Invasive knotweed affects native plants through allelopathy. American Journal of Botany 98: 38-43

Onete M, Ion R, Florescu L, Manu M, Bodescu FP, Neagoe A. 2015. Arieş river valley as migration corridor for alien plant species and contamination source for surrounding grasslands and agricultural fields. Agronomy 58: 398-405

Parepa M, Markus M, Krebs C, Bossdorf O. 2013. Hybridization increases invasive knotweed success. Evolutionary Applications 1-8

Peng W., Qin R., Li X., Zhou H. 2013. Botany, phytochemistry, pharmacology, and potential application of *Polygonum cuspidatum* Sieb. et Zucc.: a review. Journal of Ethnopharmacology 148: 729–745.

Pude R, Franken H. 2001. *Reynoutria bohemica* an alternative to *Miscanthus giganteus*? Bodenkultur 52: 19-27

Regulation 2011. Regulation of the Minister of the Environment of 9 September 2011 on the list of plants and animals of alien species that could be a threat to native species or natural habitats in case of their release into the natural environment (Journal of Laws No 210, item 1260).

Richards CL, Walls RL, Bailey JP, Parameswaran R, George T, Pigliucci M. 2008. Plasticity in salt tolerance traits allows for invasion of novel habitat by Japanese knotweed s.l. (*Fallopia japonica* and *F.* ×*bohemica*, Polygonaceae). American Journal of Botany 95(8): 931-942

Salles JF, Mallon CA. 2014. Invasive plant species set up their own niche. New Phytologist 204: 435-437

Schuster TM, Reveal JL, Bayly NJ, Kron KA. 2015. An updated molecular phylogeny of Polygonoideae (Polygonaceae): relationships of *Oxygonum*, *Pteroxygonum*, and *Rumex*, and a new circumsciption of *Koenigia*. Taxon 64(6): 1188-1208

Schuster TM, Wilson KL, Kron KA. 2011. Phylogenetic relationships of *Muehlenbeckia*, *Fallopia*, and *Reynoutria* (Polygonaceae) investigated with chloroplast and nuclear sequence data. International Journal of Plant Sciences 172(8): 1053-1066

Siemens TJ, Blossey B. 2007. An evaluation of mechanisms preventing growth and survival of two native species in invasive Bohemian knotweed (*Fallopia* ×*bohemica*, Polygonaceae). American Journal of Botany 94(5): 776-783

Strašil Z, Kára J. 2010. Study of knotweed (*Reynoutria*) as possible phytomass resource for energy and industrial utilization. Research in Agricultural Engeneering 56(3): 85-91

Strgulc KS, Dolenc KJ. 2015. Sexual reproduction of knotweed (*Fallopia* sect. *Reynoutria*) in Slovenia. Preslia 87: 17-30

Širka H.V., Lakušić D., Šinžar-Sekulić J., Nikolić T., Jovanović S. 2013. *Reynoutria sachalinensis*: a new invasive species to the flora of Serbia and its distribution in SE Europe. Botanica Serbica 37(2): 105–112

Tiébré MS, Vanderhoeven S, Saad L, Mahy G. 2007. Hybridization and sexual reproduction in the invasive alien *Fallopia* (Polygonaceae) complex in Belgium. Annals of Botany 99(1): 193-203

Toews HPC. 2012. Introduction of native tree species in sites invaded by Japanese Knotweed Taxa and a study of its affect of the seedbank, Biology. 41 State University of New York Fredonia, Fredonia.

Tokarska-Guzik B. 2005. The establishment and spread of alien plant species (kenophytes) in the flora of Poland. Prace Uniwersytetu Śląskiego Nr 2372. Wydawnictwo Uniwersytetu Śląskiego, Katowice.

Tokarska-Guzik B, Bzdęga K, Knapik D, Jenczała G. 2006. Changes in plant species richness in some riparian plant communities as a result of their colonisation by taxa of *Reynoutria* (*Fallopia*). Biodiversity Research and Conservation 1-2: 123-130

Tokarska-Guzik B, Bzdęga K, Tarłowska S, Koszela K. 2009. Gatunki z rodzaju rdestowiec – *Reynoutria* Houtt. (= *Fallopia*). In: Z. Dajdok, P. Pawlaczyk (eds.), Inwazyjne gatunki roślin ekosystemów mokradłowych Polski. pp. 87-99. Wydawnictwo Klubu Przyrodników, Świebodzin.

Tokarska-Guzik B, Fojcik B, Bzdęga K, Urbisz Al, Nowak T, Pasierbiński P, Dajdok Z. 2017. Inwazyjne gatunki z rodzaju rdestowiec *Reynoutria* spp. w Polsce – biologia, ekologia i metody zwalczania. Prace naukowe Uniwersytetu Śląskiego nr 3647, Wydawnictwo Uniwrsytetu Śląskiego, Katowice.

Tokarska-Guzik B, Dajdok Z, Zając M, Zając A, Urbisz A, Danielewicz W, Hołdyński Cz. 2012. Rośliny obcego pochodzenia w Polsce ze szczególnym uwzględnieniem gatunków inwazyjnych {Alien plants in Poland wih particular reference to invasive species]. pp. 196. Generalna Dyrekcja Ochrony Środowiska, Warszawa.

Vrchotová N, Šerá B. 2008. Allelopathic properties of knotweed rhizome extracts. Plant, Soil and Environment 54: 301-303

2. Databases (B)

Alberternst B, Böhmer HJ. 2011. NOBANIS – Invasive Alien Species Fact Sheet – *Fallopia japonica*. – From: Online Database of the European Network on Invasive Alien Species – NOBANIS. (www.nobanis.org) Date of access: 2018-01-18

CABI 2018. *Reynoutria ×bohemica* Chrtek & Chrtková. (https://www.cabi.org/isc/datasheet/108332) Date of access: 2018-01-21

The Plant List. 2013. *Reynoutria ×bohemica* Chrtek & Chrtková. (http://www.theplantlist.org) Date of access: 2018-01-09

3. Unpublished data (N)

-

4. Other (I)

GB NNSS. 2018. Bohemian knotweed, *Fallopia japonica ×sachalinensis* = *F*. ×*bohemica*. (http://www.nonnativespecies.org//factsheet/factsheet.cfm?speciesId=1497) Data dostępu: 2018-01-25

Tokarska-Guzik B, Bzdęga K, Nowak T, Urbisz Al, Węgrzynek B, Dajdok Z. 2015a. Propozycja listy roślin gatunków obcych, które mogą stanowić zagrożenie dla przyrody Polski i Unii Europejskiej. pp.178 Generalna Dyrekcja Ochrony Środowiska, Warszawa

(https://www.gdos.gov.pl/files/artykuly/5050/PROPOZYCJA_listy_gatunkow_obcych_ver_online.pdf)

Tokarska-Guzik B, Fojcik B, Bzdęga K, Urbisz Al, Nowak T, Pasierbiński P. 2015b. Wytyczne dotyczące zwalczania rdestowców na terenie Polski. pp. 219 Generalna Dyrekcja Ochrony Środowiska, Warszawa

(http://www.gdos.gov.pl/files/artykuly/5050/Wytyczne_dotyczace_zwalczania_rdestowcow_na_terenie_Polski.pdf)

5. Author's own data (A)

Bzdęga K. 2017. Own observations

Bzdęga K, Tokarska-Guzik B. 2006-2017. Own data.

BzdęgaK, Tokarska-Guzik B. 2006-2017. Own observations