



Appendix A

## Harmonia<sup>+PL</sup> – procedure for negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland

### QUESTIONNAIRE

#### A0 | Context

Questions from this module identify the assessor and the biological, geographical & social context of the assessment.

##### a01. Name(s) of the assessor(s):

first name and family name

1. Władysław Danielewicz
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3. Anna Gazda

acomment01.	Comments:	degree	affiliation	assessment date
		(1) dr hab.	Department of Forest Botany, Faculty of Forestry, Poznań University of Life Sciences	29-03-2018
		(2) dr	Institute of Biology, Faculty of Biology and Chemistry, University of Białystok	16-04-2018
		(3) dr hab. inż.	Department of Forest Biodiversity, Institute of Forest Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Krakow	06-04-2018

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

Polish name: Robinia akacja  
Latin name: ***Robinia pseudoacacia*** L.  
English name: Black locust

acomm02.

Comments:

Species with very rich naming. Latin name is compatible with The Plant List (2013 – B). According to the DAISIE database (2006 – B), the Latin synonyms (except those given below) are as follows: *Pseudoacacia pseudoacacia* Borbás, *Robinia acacia* L., *Robinia pseudacacia* var. *rectissima* (L.) Raber, and English synonyms (except those given below) – Black laurel, Common locust, Yellow locust, Honey locust, White locust, Green locust, Shipmast locust, Locust, Common robinia, Robinia, White honey-flower. Polish synonyms, according to various sources (including Wajda-Adamczyk 1989, Czekalski 2006a – P) are grochodrzew, grochodrzew biały, grochowe drzewo, grochowiec, grochownik, robinia grochodrzew, biała akacja, akacja, pseudoakacja, fasztywa akacja.

Polish name (synonym I)  
Grochodrzew akacjowy

Polish name (synonym II)  
Robinia biała

Latin name (synonym I)  
*Robinia pringlei*

Latin name (synonym II)  
*Pseudoacacia communis*

English name (synonym I)  
Post locust

English name (synonym II)  
False acacia

**a03. Area under assessment:**

**Poland**

acomm03.

Comments:

–

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

- |                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/>            | native to Poland   |
| <input type="checkbox"/>            | alien, absent from Poland                                    |
| <input type="checkbox"/>            | alien, present in Poland only in cultivation or captivity    |
| <input type="checkbox"/>            | alien, present in Poland in the environment, not established |
| <input checked="" type="checkbox"/> | alien, present in Poland in the environment, established     |

aconf01.

Answer provided with a

low

medium

high

level of confidence

**X**

acomm04.

Comments:

The natural range of the species includes the eastern part of the USA (Huntley 1990 – P). In the western part of Poland, it has been cultivated at least since the mid-18th century (Höfker 1936 – P), in Greater Poland since about 1760 (Czekalski 2006a – P). In Polish dendrological collections recorded since 1806 (Hereźniak 1992 – P). Currently, it belongs to the most common trees of alien origin in the country, especially in roadside plantings, in rural areas, in old, unmanaged gardens and parks, on neglected cemeteries and in forests (Szymanowski 1957, Bellon et al. 1977, Pacyniak 1981, Gazda and Augustynowicz 2012 – P). The distribution of this species given in the "Atlas of distribution of vascular plants in Poland" indicates its occurrence in the whole country with the exception of a significant part of the north (Zajac and Zajac 2001 – P). Recent work indicates that this gap has been widened and that the species has spread in managed stands in almost the entire country – in 2012 out of 430 forest districts in Poland, only 11 did not show the presence of black locust on its territory (Wojda et al. 2015 – P). The species has also been found in protected areas in north-eastern Poland (Brzosko et al. 2016 – P). In Poland, the species has long been regarded by many authors as established (Kulesza 1926, Mirek et al. 2002, Rutkowski 2006, Tokarska-Guzik et al. 2012 – P), as in many other countries of Western and Central Europe (Ball 1968 – P, Başnou 2006 – B, Bartha et al. 2008, Vítková et al. 2017 – P). It belongs to the category of invasive plants, whose occurrence in Poland is very important – both a large number of positions and a large number of individuals in patches are known; the majority still increases the number of positions or the area occupied (Tokarska-Guzik et al. 2012 – P).

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

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

acom05.

Comments:

The Black locust very effectively colonizes a wide spectrum of environments. It is counted among ten neophytes with the widest habitat niche (Chytrý et al. 2005 – P). Most often it inhabits xerothermic meadow communities, dry forests, agricultural landscape, roadsides, urban and industrial areas (Vitková and others 2017 – P). The main direct effect of the Black locust on the environment is related to the possibility of nitrogen binding and subsequent release to the soil in the process of slow decomposition of leaves. In stands occupied by the Black locust the amount of nitrogen in the humus profile can be over three times higher than originally (Rice et al. 2004 – P). While the impact on biological diversity of such a habitat transformation can be both negative (Benesperi and others 2012 – P) and positive (Von Hollel and others 2006 – P), it is a change in the native floristic composition, by the abolition of oligotrophic and acyophilic species on the appearance of nitrophilic species should be considered unfavorable and dangerous for local plant communities. In the case of biodiversity of fauna a clearly negative impact on invertebrates has not been found (Buchholz et al 2015 – P), and the impact on forest avifauna leads primarily to a decrease in the diversity of specialists to the benefit of the generalists (Hanzelka and Reif 2015b – P), while in the case of afforestation of the agricultural landscape, it is of little importance (Kujawa 2012 – P). Despite finding a number of substances with allelopathic potential (Nasir et al 2005 – P), it is probably poorly marked, and the impact on native vegetation is primarily affected by the transformation of the soil habitat conditions. Another impact is the change in light conditions. In stands controlled by this species, shortening of the crowns is smaller, and the cover of leaves is kept shorter than in the case of other deciduous trees (Hanzelka and Reif 2015a – P). This change in conditions promotes light-fast species, including herbaceous plants, especially grasses and geophytes, at the expense of survival of tree seedlings of shade-loving species, strengthening and consolidating the effect of forest stand conversion.

The specificity of the species (quickly and often luxuriantly growing tree, with an exotic shape, thorny, thick and stiff shoots, valuable wood, attractive for pollinating insects, abundantly producing tree trunks and producing extensive root system with root suckers, drought resistant, resistant to freezing temperatures, with low soil requirements, tolerance to salinity and the presence of numerous toxic compounds in the soil, enriching the soil with nitrogen compounds, easy to reproduce and cultivate), it can affect both domains positively and negatively. Due to its many functional advantages, it has been widely used for a long time as a decorative element of tree composition in green areas (Szymanowski 1957, Bugała 2000, Seneta and Dolatowski 2011 – P), as a part of shelters with water-tight, soil-protecting, anti-erosion, biocenotic significance etc. (Karg and Bałazy 2011, Kujawa et al. 2013, Danielewicz and Wiatrowska 2014 – P) and phytomelioration (Rahumonov and Parusel 2012, Wanic and Pająk 2012 – P), as a nectar plant (Grochowski 1988 – P) and supplying wood with very good strength parameters and fairly wide application (Zajączkowski 2013 – P) and also with high calorific value (Karaszkievicz 2013 – P). The Black locust does not have a major impact on farm animals, although horses may be sensitive to substances in its leaves and shoots (DAISIE 2006 – B). Certainly, however, it is a species with high honey values, valued by bee breeders due to its high yield and high fructose content. On the other hand, it can cause a negative effect on human health, once it is consumed, because it contains toxic albumins and flavonoids (Nelson et al. 2007, Veitch et al. 2010, Boer 2012, Haratym et al. 2013 – P).

## A1 | Introduction

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

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

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

aconf02.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm06. Comments:  
The species is found in all countries of Central Europe, and Poland is among the countries with the highest number of this species, similar to our southern and western neighbors (Vítková and others 2017 – P), which increases the risk of expansion. The Black locust is characterized by high colonization abilities, high potential of generative and vegetative reproduction and high tolerance in relation to environmental conditions (Radtke et al. 2013 – P), thus it is a species with a very strong expansion potential. Its independent spreading takes place mainly through the path of barochoria (falling diasporas – seeds, fruit – to the ground under the influence of gravity) or at small distances also through the wind, less often by animals (Huntley 1990, Stone 2009, Vítková and others 2017 – P). Long-distance movement of fruit or seeds is possible mainly through hydrochoria (spreading diasporas via water). Locally, expansion also occurs intensively by root suckers at a rate of about 1 meter per year (Kowarik 1996 – P).

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

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

aconf03.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomm07. Comments:  
The Black locust is a species permanently established, present for over 400 years in Europe (DAISIE 2006 – B) and over 200 years in Poland (Tokarska-Guzik et al. 2012 – P). The vast majority of positions appeared through human introduction, but rapid growth, fruiting already at the age of 6 and a large amount of permanent seeds (even 12,000 per square meter under the canopy of adult trees, seed life up to 10 years) make the risk of accidental transfer of seeds with soil or bedding high (CABI 2017– B, Vítková et al. 2017 – P). Due to the frequent occurrence of the species in the agricultural landscape, there is a high probability of its unconscious introduction to the natural environment mainly during earthworks (e.g. road, associated with the functioning of gravel sites, garbage dumps and post-industrial waste landfills, etc.) and soil mixing with fragments of plants (roots), fruit or seeds) in the areas of natural and semi-natural plant communities, especially forest, shrub, meadow and grasslands. There are known cases of transferring species to the edges of forests along with other wastes coming from gardens and garden plots (Danielewicz 1980-2017 – A).

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

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

aconf04.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acommm08. Comments:  
Currently, the species is not introduced into forest stands on a wider scale and it is not often used in newly established or reconstructed roadside, mid-field, near-water tree plantings, etc., even though it is sometimes recommended for this type of crop (Zajączkowski 2001, Karg and Bałazy 2011 – P). Due to the intended human activities, the greatest threat may be the dissemination of plantation crops established, for example in forest or non-forest areas, but valuable in terms of nature, but the development prospects for such crops seem small in Poland (Stolarski 2012 – P, Zajączkowski 2013 – P).

## A2 | Establishment

Questions from this module assess the likelihood for *the species* to overcome survival and reproduction barriers. This leads to *establishment*, defined as the growth of a population to sufficient levels such that natural extinction within *the area* becomes highly unlikely.

**a09.** Poland provides **climate** that is:

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

aconf05.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acommm09. Comments:  
In its homeland, the species reaches its optimum in a temperate warm and humid climate (Huntley 1990 – P). Its wide secondary coverage in the world (CABI 2017 – B) shows that it has the ability to adapt to a much wider scale of climatic conditions than those that prevail in its natural geographical range. In the majority of Poland, with the exception of the coldest mountainous and north-eastern parts of the country, there are climatic conditions that meet the requirements of the species (Bojarczuk et al 1980 – P). The Black locust is considered moderately resistant to frost (Radtko et al. 2013 – P), hence probably it occurs with the lowest frequency in north-eastern Poland, but it also establishes there. Renewal on the generative and vegetative path was observed in the harshest, lowland climatic conditions – in the Suwałki region (Brzosko and others 2016 – P). Therefore, climatic conditions do not constitute a barrier to the establishment of this species in Poland.

**a10.** Poland provides **habitat** that is

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

aconf06.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acommm10. Comments:  
In the area of natural range, in the eastern part of North America (the Appalachians and adjacent areas as well as Oklahoma, Arkansas and Missouri), the species is found on soils of various genesis and various properties, including on sandy, loam and clay soils, alkaline, neutral and sour, dry, fresh and humid soils (Huntley 1990, Stone 2009 – P). In Poland it

often grows and is established in urbanized and post-industrial areas, on strongly changed, sometimes ruderal habitats, which indicates its wide adaptation scale even to extreme soil conditions. The majority, about 80%, of forest stands are located on medium fertile habitats of fresh mixed coniferous forest and fresh mixed forest (Klisz and Wojda 2013, Wojda et al. 2015 – P), which can be considered optimal for the establishment of the species in forests, although the physiological optimum is achieved on more fertile habitats (Pacyniak 1981 – P).

The Black locust requires light to develop, although young specimens (up to 6-8 years) tolerate partial shading (Bartha et al 2008 – P). The factors limiting the growth of the Black locust include: poor aeration of the soil and its too high humidity (Bartha et al 2008 – P).

### 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
- very high

aconf07. Answer provided with a 

low	medium	high <b>X</b>
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 level of confidence

acomm11. Comments:  
Dispersion from a single source (Type A data).  
Seeds of black locust can be primarily dispersed by gravity (barochory; plant's seeds fall beneath the parent plant) and by wind (anemochory), and rarely in the case of riverside sites also by water (hydrochory) or by animal ingestion and defecation of a seed (endozoochory) (Cierjacks et al. 2013, Vitková et al. 2017 – P). Researchers agree on the low, natural mobility of the species, but the exact distance of the dispersion can be difficult to determine. Most seeds can cover a distance of only a few meters, but in favorable conditions, several dozen to 100 meters (Radtke et al. 2013, Vitková and others 2017 – P). Exceptionally, hydrochoric dispersion was found up to 1200 meters (Säumel and Kowarik 2013 – P). The basic mechanism of population expansion is, as in other clonal plants, the expansion of the surface part of the root system and increasing the aboveground space occupied by root suckers. In this way, the species can expand several (1-3) meters per year (Kowarik 1996, Huntley 2004 – P).

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

- low
- medium
- high

aconf08. Answer provided with a 

low	medium	high <b>X</b>
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 level of confidence

acomm12. Comments:  
According to the DAISIE database, it is the most commonly planted tree species in Europe (DAISIE 2006 – B). Direct participation of human beings in the spread of this species consists mainly of: introducing it to urban and rural greenery, tree stands (now much less

frequently than in the past), planting crops (now more often than in the past), moving its vegetative or generative parts by collecting plant waste as well as for various works related to the movement of earth masses. The Black locust is kept in collections of botanical gardens and

arboretums (confirmed in 28 out of 42 surveyed facilities), in most of them (20) it spreads spontaneously; at the same time, measures are taken to limit the spread (removal of seedlings, mowing, cutting out suckers) (Employees of botanical gardens ... 2018 – N). The spreading of the species is conducive to maintaining large areas of anthropogenically disturbed habitats (wasteland, excavations, trash, embankments, areas devastated by industry, etc.) and neglected care of the decorated greenery. An important role in the local spread of the species by means of root suckers is played by all treatments, during which the mechanical damage of stems (e.g. cutting or pruning) and roots (e.g. plowing) contribute to its lush vegetative growth.

## 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/EEG 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/EEG 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:

- inapplicable
- low
- medium
- high

aconf09. Answer provided with a 

low	medium	high
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 level of confidence

acomm13. Comments:  
These effects do not apply to the Black locust, because it is an autotrophic plant.

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

- low
- medium
- high

aconf10. Answer provided with a 

low	medium	high <b>X</b>
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 level of confidence

acomm14. Comments:  
As a tree with a fast growth rate and high vegetative growth capacity, capable of creating monolithic tree stands, the species affects native plant species and their communities primarily through competition for living space, light and nutrients. Research, analyzing the impact of the Black locust on vegetation, showed a significant change in the species composition of flora under the influence of the invasion of this species (Montagnini et al 1991, Pelloquin and Hiebert 1999, Von Holle et al. 2006, Vítková and Kolbek 2010 – P). The

Black locust is a species that is well-suited to the colonization of various types of disorders, so it is a very serious competition for other species of pioneer trees and shrubs (Motta et al 2009 – P). Its expansion is a big threat to the physical existence of valuable non-forest communities, especially heat- and photophilous grasslands and shrubs (Celiński and Filipek 1958, Ćwikliński 1972, Jermaczek and Pawlaczyk 1999, Perzanowska and Kujawa-Pawlaczyk 2004, Barańska et al. 2013 – P). A negative impact of the species on biodiversity results from the changes it causes in the natural soil environment by increasing the nitrogen content and gaining an advantage in the competition for nitrogen over other plants (Rice et al 2004, Rahomonov and Parusel 2012, Kujawa et al. 2013 – P). Under the influence of the dominance of the species in the forest stand, communities with clearly changed structure and floristic composition arise. These are usually phytocoenoses floristically poorer than hornbeam forests, and richer than borates, in which the species typical for pine forests and deciduous forests are replaced by alien non-forest organic plants, most often characteristic of common nitrophilic rudimentary communities from the *Artemisietaea* class (Pacyniak 1981, Glicka 1989, Dzwonko and Loster 1997, Ratyńska 2001, Kujawa et al. 2013 – P). Together with them, invasive woody plants may appear, for example, the American *Padus serotina* or maple ash *Acer negundo* (Danielewicz 1991 – P). Changes in the structure and floristic composition of communities with species in other European countries are generally of a similar nature, but a slightly wider range, related to the regional, often greater, diversity of habitats and vegetation (Pott 1995, Botta-Dukát 2008, Vítková and Kolbek 2010, Benespero et al. 2012, Vítková et al. 2017 – P). Data collected in the vicinity of Turew (south Greater Poland) suggest that the impact of the species on different groups of organisms is diverse (strong for plants, small for insect and spider clusters, significant for avifauna and fungal biota), however, for most taxa the full recognition of this effect is missing (Kujawa et al 2013 – P). Allelopathic properties of the species (Nasir et al 2005 – P) have been found in laboratory tests, which indicates the possibility of its impact on native species by chemical compounds contained in plant secretions.

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

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

aconf11. Answer provided with a 

low	medium	high <b>X</b>
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 level of confidence

acomm15. Comments:  
There are no known cases of crossbreeding this species with native species.

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

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

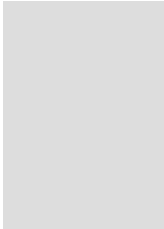
aconf12. Answer provided with a 

low	medium	high <b>X</b>
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 level of confidence

acomm16. Comments:  
With the introduction of the Black locust into the environment, there is a risk of introducing the specialist parasite – *Obolodiplosis robiniae*. This species was found in Poland for the first time only in 2006. It is considered to be less harmful (Alien Species in Polish Fauna – B). Among other alien parasites there are small butterflies *Parectopa robiniella* and *Phyllonorycter robiniella*. Both are monophags, feeding only on the Black locust, not found





on other species of plants in the secondary range (Cierjacks et al 2013 – P). Six species of viruses, fungi from the group of powdery mildews, e.g. *Erysiphe trifolii* developing on numerous representatives of the Fabaceae family, as well as fungi causing wood rot (Mańka 2005 – P) have some importance. The species is a frequent host of the common mistletoe *Viscum album* (Stypiński 1997, Bartha et al. 2008 – P). Lack of information in the extensive literature devoted to the Black locust on the transfer of other pathogens and parasites allows to presume that the Black locust is not a vector of other troublesome alien species.

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

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

aconf13.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomment17. Comments:  
 In abundant sites, the species has a negative impact on the integrity of the ecosystem by disturbing (worsening) light conditions in non-forest collected communities (Barańska et al 2013 – P) and changes (mainly eutrophication) of the natural chemical properties of habitats (Rice et al 2004, Nasir et al. 2005, Bartha et al. 2008, Rahomonov and Parusel 2012, Wanic and Pająk 2012, Kujawa et al. 2013, Buzhdygan et al. 2016, Vítková and others 2017 – P). Thanks to the ability to bind nitrogen, the Black locust accumulates large amounts of this nutrient, and then releases it into soil in the process of slow decomposition of leaves. In stands occupied by the Black locust, the amount of nitrogen in the humus profile can be over three times higher than originally (Rice et al 2004 – P).

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

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

aconf14.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
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acomment18. Comments:  
 The disruption of biotic factors and the loss of the integrity of the ecosystem result primarily in changes in the structure of plant communities. The species has the ability to create solid stands or thickets, which in forests and large-area forestations results in controlling the tree layer by a alien element, reducing native trees and shrubs which are the main component of these communities in natural conditions, inhibiting the regeneration of phytocoenoses and the exchange of typical species for balanced systems, compatible with the biotope, for plants less typical for forests or alien to them. In the case of non-forest communities, the disturbance of biotic factors by competition leads to the complete disappearance of the earlier type of phytocoenosis and changes in the plant formation. This type of disturbance is mainly exposed to xerothermic grasslands, sometimes fresh meadows, and in the case of forests – oak-hornbeam, beech forest, acid oak, warm and luminous oak forest, hillside meadows and some pine forests (Tokarska-Guzik and other 2012 – P). The impact of the species on the integrity of the ecosystem has been recognized, among others, in Hungary, where the species has long been widely used in forest plantations and greenery areas (Bartha et al. 2008 – P). The effectiveness of direct allelopathic effects is still poorly studied, despite the finding of substances such as robinetin, myricetin and quercetin, which could have an impact on the biotic factors (Nasir et al 2005 – P). The inhibitory effect on the growth of some woody species has been confirmed so far (Bartha et al 2008 – P).

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

aconf15. Answer provided with a 

low	medium	high
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 level of confidence

acomm19. Comments:  
The discussed species is an autotrophic plant.

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

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

aconf16. Answer provided with a 

low	medium	high
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 level of confidence

acomm20. Comments:  
Conflict with the cultivation of plants concerns mainly forestry, where the Black locust can be competitive in relation to native species only in the phase of succession and regeneration after disturbances (foundations, windmills and other gaps). The Black locust is considered a nuisance plant hindering the restoration of forests after felling stands with its participation or in the vicinity of the place from where it penetrates to woodcut areas (Bellon et al. 1977 – P), and strongly inhibits the development of native forest species and, therefore demanding control (Obidziński and Woziwoda 2014, 2016 – P). However, the clear dependence of this species limits the possibility of displacing native species to the initial stages of these processes, while as the forest's vault closes, the Black locust is competed by native species shading the usually lower Black locust. In wintering conditions, the Black locust seeds do not germinate, and vegetative reproduction through root growth is significantly reduced (as cited in Obidziński and Woziwoda 2016 – P). Infestation of the Black locust may have significant effects (consequences high), but the probability of its occurrence anywhere in the stand is low due to high demands on light.

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

- inapplicable
- no / very low
- low
- medium

<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf17.	Answer provided with a	low	medium	high	level of confidence
				<b>X</b>	

acomm21. Comments:  
 From Poland, there are cases of spontaneous crossbreeding of this species with another North American representative of the genus – clammy locust *Robinia viscosa* Vent. As a result of this process, a multiform circle of pink flowering hybrids called *R. xambigua* Poir., is formed, which are considered to be fully domesticated plants (Zieliński et al. 2015 – P). There are, however, no observations indicating a greater threat from hybrids.

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

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

aconf18.	Answer provided with a	low	medium	high	level of confidence
				<b>X</b>	

acomm22. Comments:  
 The species is used in soil reclamation and protection against erosion. The ability to bind nitrogen has a positive effect on soil fertility, which in the context of crops should be considered as a positive factor. At the same time, invasion usually occurs in areas not used for agriculture, so it does not interfere with non-forest crops. In the case of forest crops, the Black locust is planted in protective stands. Its functions changing the properties of the habitat in the forestry (in the context of crop integrity) are rather regulatory than generating disturbances.

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

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

aconf19.	Answer provided with a	low	medium	high	level of confidence
			<b>X</b>		

acomm23. Comments:  
 Among parasites feeding on the Black locust, apart from monophages mentioned earlier (question a16), there are mistletoe, dozens of fungal species, and a strawberry latent ringspot virus and a peanut stunt virus (Bartha et al. 2008, Cierjacks et al. 2013 – P). In the absence of research on the scale of the phenomenon, the importance of the Black locust as a vector and the widespread transmission of parasites to native species, it is now assumed that the importance of this species as a vector of pathogens is not significant.

### 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:

- 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 and has no impact on the health of a single animal or plant production through predation or parasitism.

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

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

aconf21. Answer provided with a 

low	medium <b>X</b>	high
-----	--------------------	------

 level of confidence

acomm25. Comments:  
The Black locust is considered a species used by wild herbivores and cattle (DAISIE 2006 – B), but cases of horse intoxication are known, probably after ingestion of roots, bark, pods, seeds or seedlings of this species, containing toxic substances (Caloni and Cortinovis 2015 – P). Symptoms of such poisoning are: mydriasis, pulse acceleration, salivation, diarrhea, apathy and inertia; in extreme cases, death can occur in one day (Stępniaak-Sołyga 2004 – P). Robinin may have poisonous properties for some animals (Veitch et al. 2010 – P). Biting the Black locust is difficult due to spikes on the shoots and hard bark. In the absence of precise data on the frequency of cases of food poisoning by horses, it can be assumed that the likelihood of harmful contact is medium, as well as its effect.

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

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

aconf22. Answer provided with a 

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

 level of confidence

acomm26. Comments:  
The species is a plant and has no impact on animals or animal production through the transmission of pathogens and animal parasites.

## 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:

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

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

acomm27. Comments:  
The species is a plant and has no impact on human health through parasitism.

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

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

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

acomm28. Comments:  
Roots, bark, pods and seeds of black locust contain poisonous toxalbumin, which after consumption are the cause of red blood cell agglutination and tissue breakdown, although this type of events are not frequent (Nelson et al. 2007, Haratym et al. 2013, Boer 2012 – P). Symptoms of poisoning in people are abdominal pain, nausea, vomiting, bloating, fever and visual disturbances. Poisoning occurs through the intake of poisonous parts of plants or their decoctions. The risk of confusion with other common crop plants is small, but isolated cases have been described by Cooper and Johnson 1998 (for Veitch et al 2010 – P). Due to the few information about robinia poisoning, it can be assumed that the probability of harmful contact of this species with humans is low, whereas the effect is moderate if, according to literature information, such events occur, which are rare, but may be the cause of several days of absence in work.

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

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

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

acomm29. Comments:  
The species is a plant, it does not carry harmful pathogens and parasites.

## A4e | Impact on other domains

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

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

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

aconf26.	Answer provided with a	low	medium	high	level of confidence
			<b>X</b>		

acomment30. Comments:  
In cases of the excessive root systems, there may be a violation of the cohesion of roads, pavements, squares, monumental plates, etc. Due to root penetration, elements of shallow underground infrastructure (power lines, pipelines) may be damaged. Such action is not a result of the specific impact of the Black locust (compared to other tree species), but rapid growth and intensive vegetative reproduction may intensify such interaction in the case of the Black locust.

## 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:

- |                                     |                        |
|-------------------------------------|------------------------|
| <input type="checkbox"/>            | significantly negative |
| <input type="checkbox"/>            | moderately negative    |
| <input type="checkbox"/>            | neutral                |
| <input checked="" type="checkbox"/> | moderately positive    |
| <input type="checkbox"/>            | significantly positive |

aconf27.	Answer provided with a	low	medium	high	level of confidence
			<b>X</b>		

acomment31. Comments:  
Species important for beekeeping (Jabłoński and Kołtowski 1993, Bartha et al. 2008 – P), supplying valuable wood raw material used as veneer wood, construction wood of high requirements in mining, civil and water construction, special wood for poles, masts, sports equipment, brewing barrels, suitable for wood lathe and wood carving, in dyeing and tanning (Spaniewo Neyman and Owczarzak 2014 – B), recently sought after by alien entrepreneurs for garden accessories, and on grapevine plantations traditionally used for making stakes (Banach et al. 2013 – P). It is a good quality fuel, and the wood itself is durable due to the low water content (Zajączkowski and Wojda 2012 – P). This species is also increasingly grown as an energy plant for the production of biofuels and biomass (Cierjacks et al 2013, Vitková et al. 2017 – P). Nevertheless, the demand for this raw material is usually low (Piszczek et al 2012 – P), and the expansion of the Black locust in the forest stands takes place at the expense of other species valuable in forestry. Due to the pioneering nature and the ability to bind nitrogen, the Black locust is used in the reclamation of land and wasteland (Bartha et al. 2008 – P), also in Poland. Because the plant contains essential oils, flavonoids and anthocyanin pigments is used (mainly flowers

are used as a raw material) in herbal medicine and cosmetology (Bartha et al. 2008 – P). The flowers are suitable for frying in pancake and crepe batter.

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

<input type="checkbox"/>	significantly negative
<input type="checkbox"/>	moderately negative
<input type="checkbox"/>	neutral
<input checked="" type="checkbox"/>	moderately positive
<input type="checkbox"/>	significantly positive

aconf28.	Answer provided with a	low	medium	high	level of confidence
				<b>X</b>	

acom32. Comments:  
Species valued as a nectar plant (benefits for bees and other pollinators) and stabilizing soil (prevention of erosion). In turn, enrichment of soil with nitrogen by this species is treated as a positive impact (in poor habitats) and, on the other hand, in natural habitats as a factor causing the dominance of nitrophilic species in natural habitats. In addition, due to the open crown of trees it is considered to contribute to drying the soil under the leaves dominated by this species.

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

<input type="checkbox"/>	significantly negative
<input checked="" type="checkbox"/>	moderately negative
<input type="checkbox"/>	neutral
<input type="checkbox"/>	moderately positive
<input type="checkbox"/>	significantly positive

aconf29.	Answer provided with a	low	medium	high	level of confidence
			<b>X</b>		

acom33. Comments:  
On one hand, this species is planted in parks, gardens and rows along roads and has a decorative function and is a permanent, many-year element of many objects of recreational, historical and cultural importance. On the other hand, despite the long history of colonization of Poland, the Black locust is a landscape and alien species and its mass penetration into valuable xerothermic and alluvial communities significantly changes their physiognomy and lowers the natural and aesthetic values. Establishment in a large territory of the country also has a negative impact on the landscape through its unification, and also reduces the tourist values of protected areas (Najberek and Solarz 2011 – P).

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

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

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

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

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

aconf30. Answer provided with a 

low	medium	high <b>X</b>
-----	--------	------------------

 level of confidence

acomm34. Comments:  
 Until now, the success of the invasion of this species was the largest in areas with sub-Mediterranean climate (Sukopp and Wurzel 2003 – P), perhaps because the Black locust is characterized by only moderate resistance to frost (as cited in Radtke et al. 2013 – P). Assuming that forecasts from other European countries (Kleinbauer and others 2010 – P) prove themselves, climate change, and especially its warming, will contribute to broadening the scope of its physiological and ecological optimum, and therefore it can overcome further barriers related to its cultivation in regions that are currently too cold (north-eastern Poland and mountain areas characterized by the most severe climatic conditions). This is supported by the earlier blooming and prolongation of the growing season of this species (Jabłońska et al 2015 – 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
- increase significantly

aconf31. Answer provided with a 

low	medium	high <b>X</b>
-----	--------	------------------

 level of confidence

acomm35. Comments:  
 Due to climatic changes that may affect the elevation of plant floor boundaries in the mountains, it is possible for this species to overcome the barrier associated with the thermal factor that until now prevented it from surviving in mountain conditions.

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

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

aconf32. Answer provided with a 

low	medium	high <b>X</b>
-----	--------	------------------

 level of confidence

acomm36. Comments:  
 Gaps in the distribution of the species in the north of the country are likely to fill with progressive global warming. Changes in climatic conditions in the mountains can also shift the boundaries of plant floors, and therefore the vertical range of this species. Expansion of the Black locust in the north of the country is already visible by comparing data from the publications Zając and Zając (2001 – P), and Wojda et al. (2015 – P).

**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:



<input type="checkbox"/>	decrease significantly
<input type="checkbox"/>	decrease moderately
<input type="checkbox"/>	not change
<input checked="" type="checkbox"/>	increase moderately
<input type="checkbox"/>	increase significantly

aconf33.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
----------	------------------------	-----	--------	------------------	---------------------

acomm37. Comments:  
Assuming that the increase in average temperature will be accompanied by a drop in atmospheric precipitation and humidity (Liszewska 2014 – P), it can be expected that moist habitats will disappear, while the share of fresh and dry habitats will increase, and the range of optimal conditions will increase optymalnych for the Black locust, which may increase its competitive strength against wild native species. It is more likely if the frequency and role of environmental disturbances (Szwagrzyk 2014 – P), also conducive to the spread and expansion of pioneer plants, including Black locust (Motta et al. 2009 – P), will increase as well. If, by any chance, rainfall would increase, the impact of robinia on the natural environment should not change significantly in relation to the currently observed.

**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:**

<input type="checkbox"/>	decrease significantly
<input type="checkbox"/>	decrease moderately
<input checked="" type="checkbox"/>	not change
<input type="checkbox"/>	increase moderately
<input type="checkbox"/>	increase significantly

aconf34.	Answer provided with a	low	medium	high <b>X</b>	level of confidence
----------	------------------------	-----	--------	------------------	---------------------

acomm38. Comments:  
The main impact of the invasion of this species on the cultivation of plants is noted in forestry, where this species achieves success in the initial stages of succession, especially on dry and oligotrophic habitats, but is then displaced by climatic species (Motta et al 2009 – P). It is somehow possible, that change in environmental conditions caused by global warming will affect the weakening of the competitive potential of native species for the Black locust (Kleinbauer et al. 2010 – P).

**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:**

<input type="checkbox"/>	decrease significantly
<input type="checkbox"/>	decrease moderately
<input type="checkbox"/>	not change
<input checked="" type="checkbox"/>	increase moderately
<input type="checkbox"/>	increase significantly

aconf35.	Answer provided with a	low	medium <b>X</b>	high	level of confidence
----------	------------------------	-----	--------------------	------	---------------------

acomm39. Comments:  
It is predicted that climate change will favor the invasion of this species (Kleinbauer and others 2010 – P), hence its more numerous occurrence combined with the valued melliferous values may have a positive impact on the beekeeping industry. Such a situation currently takes place in Hungary (Vitková and others 2017 – P).

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

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

aconf36. Answer provided with a 

low	medium	high <b>X</b>
-----	--------	------------------

 level of confidence

acomm40. Comments:  
Poisoning with the Black locust is rare despite the prevalence of this species, thus climate change should not change this condition.

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

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

aconf37. Answer provided with a 

low	medium	high <b>X</b>
-----	--------	------------------

 level of confidence

acomm41. Comments:  
There is no reason to claim that this species could have a different impact on other objects in Poland than at present.

## Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.63	1.00
Environmental impact (questions: a13-a18)	0.65	1.00
Cultivated plants impact (questions: a19-a23)	0.25	0.80
Domesticated animals impact (questions: a24-a26)	0.25	0.50
Human impact (questions: a27-a29)	0.50	1.00
Other impact (questions: a30)	0.25	0.50
Invasion (questions: a06-a12)	0.88	1.00
Impact (questions: a13-a30)	0.65	0.76
Overall risk score	0.57	
Category of invasiveness	moderately invasive alien species	

## A6 | Comments

This assessment is based on information available at the time of its completion. It has to be taken into account. However, that biological invasions are, by definition, very dynamic and unpredictable. This unpredictability includes assessing the consequences of introductions of new alien species and detecting their negative impact. As a result, the assessment of the species may change in time. For this reason it is recommended that it regularly repeated.

acomm42. Comments:  
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## 3. Unpublished data (N)

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## 4. Other (I)

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## 5. Author's own data (A)

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