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. Emilia Brzosko
2. Magdalena Szymura
3. Barbara Tokarska-Guzik

acomm01. Comments:

	degree	affiliation	assessment date
(1)	prof. dr hab.	Institute of Biology, Faculty of Biology and Chemistry, University of Białystok	14-04-2018
(2)	dr hab.	Division of Grassland and Green Areas Management, Institute of Agroecology and Plant Production, Wrocław University of Environmental and Life Sciences	10-04-2018
(3)	prof. dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	12-04-2018

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

Polish name: Rudbekia naga

Latin name: ***Rudbeckia laciniata*** L.

English name: Cutleaf coneflower

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

acomm02.	Comments:

The Latin and Polish names are given according to Flowering plants and pteridophytes of Poland – a checklist (Mirek et al. 2002 – P). The Latin name is accepted in the Plant List (2013 – B). Synonyms of the Latin name are as follows: *Rudbeckia heterophylla* Torrey et A. Gray., *Rudbeckia laciniata* var. *ampla* (A.Nelson) Cronquist, *Rudbeckia laciniata* var. *heterophylla* (Torr. & A.Gray) Fernald & B.G.Schub. (The Plant List 2013, CABI 2018 – B). Other synonyms for the English name other than those given below are as follows: greenhead coneflower; sochan; tall coneflower; thimbleweed; wild goldenglow (CABI 2018 – B).

In its native range (North America) 21 species of the *Rudbeckia* genus (Cox and Urbatsch 1994 – P) are distinguished, and in the case of *R. laciniata* five varieties (two varieties distinguished by The Plant List 2013 – B) also differing in their range: *R. laciniata* var. *ampla*, *R. laciniata* var. *bipinnata*, *R. laciniata* var. *digitata*, *R. laciniata* var. *heterophylla* and most widely known *R. laciniata* var. *laciniata* (Manual of the Alien Plants of Belgium 2015, CABI 2018 – B). In the Polish flora, two species are found in anthropogenic or seminatural habitats (Mirek et al. 2002 – P), of which *Rudbeckia hirta* is observed ephemerally outside cultivation (or as locally established species), and *Rudbeckia laciniata* is permanently established (Mirek et al. 2002, Tokarska-Guzik 2005b, Tokarska-Guzik et al. 2012, Zając and Zając 2015 – P).

Polish name (synonym I) Roztocznica naga	Polish name (synonym II) Rudbekia sieczna
Latin name (synonym I) *Helianthus laciniatus*	Latin name (synonym II) *Rudbeckia digitata*
English name (synonym I) Coneflower	English name (synonym II) Golden glow

a03.**Area** under assessment:

Poland

acomm03.	Comments:

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

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

aconf01.	Answer provided with a	low	medium	high **X**	level of confidence

acomm04.	Comments:

The Cutleaf coneflower *Rudbeckia laciniata* has in Poland the status of an established, invasive kenophyte (Tokarska-Guzik et al. 2012 – P). It is one of the earliest plants brought to Europe from North America for ornamental purposes (Francírková 2001, Tokarska-Guzik 2005b, Kącki 2009 – P). The species is found throughout the country, but is more often noted in the south (Zając and Zając 2001, Tokarska-Guzik et al. 2012, Zając and Zając 2015 – 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
	the human domain
	the other domains

acomm05.	Comments:

The Cutleaf coneflower *Rudbeckia laciniata* is a species with strong competitive properties, which negatively affects the domestic flora and native plant communities (Zubek et al. 2016, Stefanowicz et al. 2017 – P). Creating single-species, dense patches, it eliminates native species, transforming or even displacing whole communities (Tokarska-Guzik and Dajdok 2004, Tokarska-Guzik et al. 2012 – P, CABI 2018 – B). In river valleys, there is a high dynamism of development and dispersion. However, most often, despite mass appearances, the occurrence of this plant has a local range. It mainly colonizes wet habitats: both natural, semi-natural and anthropogenic (Tokarska-Guzik 2005b, Akasaka et al. 2015 – P, CABI 2018 – B). As a result, the presence of this species negatively affects the species richness of the patches and the diversity of riverside communities (Hejda et al. 2009, Kącki 2009 – P). Changing soil properties (mainly by reducing the content of phosphorus and nitrates), the species affects soil microbial communities, their biomass and activity, including the richness of arbuscular mycorrhizal fungi (Łopucki and Mróz 2012, Stefanowicz et al. 2016, 2017, Zubek et al. 2016 – P). It may reduce the natural values of protected areas (it occurs in 11 national parks, Bomanowska et al. 2014 – P). There are reports in sources that mature plants can cause disease symptoms in horses, pigs, sheep, rabbits, and even lead to their death (Skidmore and Petersen 1932 – P, CABI 2018 – B), but there are no current data confirming these reports. The species encroaches into meadow communities, in which it decreases the forage value of the hay, and for this reason it is recognized as a weed (EPPO 2009 – 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 **X**	level of confidence

acomm06.	Comments:

The species may migrate to Poland from neighbouring countries, especially those located south of Poland, where it is widespread and, as in the country, cultivated as an ornamental plant (Tokarska-Guzik 2005 – P, CABI 2018 – B). Free seed dispersal from these areas is possible with the participation of two natural vectors: wind and animals (the seeds easily attach to their hair, CABI 2018 – B). Transport of fragments of rhizomes acting as vegetative diasporas with river currents cannot be ruled out, as the species often occurs above their banks (Tokarska-Guzik 2005b, Walter et al. 2005, Kącki 2009, Dajdok and Tokarska-Guzik 2009 – P, CABI 2018 – B). *Rudbeckia laciniata* is an estabished species in Poland, an important role in the local spread of this plant is fully vegetative reproduction by underground rhizomes. The species produces numerous seeds, but only about half of them germinate (Francírková 2001 – P). Its positions focus mainly on watercourses and ruderal areas. The Cutleaf coneflower migrates mainly along river valleys (Török et al. 2003, Tokarska-Guzik and Dajdok 2004, Walter et al. 2005 – P).

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

	low
	medium
X	high

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

acomm07. Comments:

The species can be spread by pedestrians (seeds are transferred on shoes and clothing, as well as vehicles (Akasaka et al 2015 – P). Species spread is mainly connected with watercourses, but also with communication routes: roads and railway lines (Török et al. 2003, Tokarska-Guzik and Dajdok 2004 – P) and increases with the density of the network of roads and urban areas (Akasaka and others 2015 – P). Seeds and fragments of rhizomes can be transferred along with transported soil (CABI 2018 – B).

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

	low
	medium
X	high

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

acomm08. Comments:

The Cutleaf coneflower *Rudbeckia laciniata* was introduced as an ornamental plant and was planted in palace parks, gardens and cemeteries (Tokarska-Guzik 2005b, Dajdok and Śliwiński 2009 – P). Due to the attractive flowers and ease of cultivation, the species is still a desirable ornamental plant, often grown in home gardens. In rural gardens, one variety with bright yellow flowers has been grown for a long time ('Golden Glow'). Seedlings of the Cutleaf coneflower (including numerous colour varieties) are commonly available in garden and nursery stores and online sales (Lenda et al 2014 – P, CABI 2018 – B). In Poland, it has been confirmed in the collections of 13 botanical gardens, but mostly on a limited scale. In two cases spontaneous spreading of plants was confirmed: by seeds (Botanical Garden in Bolestraszyce) and vegetatively by rhizomes (Adam Mickiewicz University Botanical Garden in Poznań). In three places actions are taken to limit spontaneous spread (Employees of botanical gardens ... 2018 – N). It can easily get out of the places where it is grown into the natural environment. A common way of introducing the species into the environment is by the depositing of biomass of the plants (cut down fruiting shoots, rhizome fragments) outside the places of cultivation (on unofficial refuse dumps, in river valleys, in the area of oxbow lakes).

A2 | Establishment

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

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

	non-optimal
	sub-optimal
X	optimal for establishment of *the species*

aconf05.	Answer provided with a	low	medium	high **X**	level of confidence

acomm09.	Comments:

The native areas of the Cutleaf coneflower are regions of eastern and central North America with a temperate climate (Tokarska-Guzik 2005b – P, CABI 2018 – B). Climatic conditions in Poland favour the spread of the species. It occurs in all climatic regions of the country (Zając and Zając 2001, 2015, Tokarska-Guzik 2005b, Tokarska-Guzik et al. 2012 – P), although it does not reach high altitudes in the mountains; up to 750 m above sea level on Babia Góra in the Western Beskidy mountains is the highest place it can be found (Zając and Zając 2015 – P). The occurrence of the species in many European countries (from Scandinavia to the countries of Central and Southern Europe) and in Asian countries (Dajdok and Śliwiński 2009 – P, EPPO 2009 – I, Kącki 2009 – P, CABI 2018 – B) proves its tolerance of a wide range of climatic conditions. As the species prefers a cool, humid climate, and rarely occurs in hot, arid regions (CABI 2018 – B), it can be assumed that progressive warming and reduction of rainfall may limit its occurrence.

a10.Poland provides **habitat** that is

	non-optimal
	sub-optimal
X	optimal for establishment of *the species*

aconf06.	Answer provided with a	low	medium	high **X**	level of confidence

acomm10.	Comments:

In its secondary range, the Cutleaf coneflower *Rudbeckia laciniata* occupies similar habitats as in the native area of its occurrence. These are mainly wet habitats, such as wetlands, swamps, floodplains, as well as meadows, forest edges and disturbed habitats (Tokarska-Guzik 2005a, Walter et al. 2005, Frajman 2009 – P, EPPO 2009 – I, Tokarska-Guzik et al. 2012, Akasaka et al. 2015 – P, CABI 2018 – B). The species tolerates a wide range of soils (sandy, clays, loamy) from acidic to alkaline (CABI 2018 – B). It occurs mainly along watercourses and in ruderal habitats and on roadsides (Kącki 2009 – P). Cutleaf coneflower grows and spreads mainly through underground stolons (Francírková 2001 – P), and its seeds germinate only in highly disturbed habitats, devoid of vegetation (EPPO 2009 – I), so the presence of anthropogenic habitats is conducive to the spread of the species (Akasaka et al. 2015 – P). The species covers areas below 700 m above sea level. (EPPO 2009 – I), and in Poland it is present at even slightly higher altitudes (Tokarska-Guzik 2005b, Zając and Zając 2015 – P). Habitat conditions favourable for its occurrence prevail throughout the country.

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: Population expansion (data type B): In Europe,the Cutleaf coneflower was first recorded in gardens in 1615 (Jalas 1993 – P). However, the first observation of this species outside cultivation comes from the end of the 18th century from Poland, from the area of Lower Silesia (Fiek 1881 – P). In a short time it became established in the territory of Poland, increasing the number of its localities from 3 known in the mid-19th century to 2251 recorded by 2005 (Tokarska-Guzik 2005b – P). Currently, *Rudbeckia laciniata* is known from almost the entire territory of the country, but with a clear concentration of localities in the south and with a small number of sites in north-eastern Poland (Zając and Zając 2001, 2015 – P). Approximation (data type C): The Cutleaf coneflower produces large amounts of seeds (1,600/plant and 94,000/m^2, Francírková 2001 – P, EPPO 2009 – I). Their germination reaches 40% under greenhouse conditions and 35% under natural conditions (Francírková 2001 – P). According to EPPO (2009 – I), it can only germinate under disturbed conditions. The species forms a soil seed bank, and the seeds retain germination capacity for up to three years (Francírková 2001, Osawa and Akasaka 2009 – P). It regenerates very well from small fragments of rhizomes, as little as 1 centimetre (Francírková 2001 – P) in diameter. Free seed dispersal from these areas is possible with the participation of two natural vectors: wind and animals (seeds easily attach to their hair, CABI 2018 – B). It is also possible to transport fragments of rhizomes acting as vegetative propagules by water, because the species often occurs along river banks (Tokarska-Guzik 2005b, Anastasiu et al. 2008, Kącki 2009, Walter et al. 2015 – P, CABI 2018 – B). Considering the data collected so far, the ability of the species to spread should be assessed as very large.

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 species, due to its size, the attractive, large flowers and the ease of cultivation, is used as an ornamental plant and has long been grown in home gardens (Tokarska-Guzik et al. 2012 – P, Akasaka et al. 2015 – P, CABI 2018 – B). It is also considered a nectar plant (Dajdok and Śliwiński 2009 – P). It is available in garden stores, including on the internet. Seeds of the species may be unintentionally spread by walking tourists (on shoes and clothing) as well as on vehicles (Akasaka et al. 2015 – P). It can be assumed that the presence of the species in 11 Polish national parks (Bomanowska et al. 2014 – P) is partly the result of tourism in their areas. The spread of the species increases with the density of the network of roads and urban areas (Akasaka and others 2015 – P). Seeds and fragments of rhizomes can be transferred along with transported soil (CABI 2018 – B). The species is kept in collections of many botanical gardens and arboretums (see Comments to question a08). In Podlasie the Cutleaf coneflower is planted near roadside crosses and chapels (Brzosko 2016-2017 – A). In addition, the dispersal of plants through seeds and rhizomes during the management of gardens may also have an important role in its spread.

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 herbivoryis**:

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 affect native species through predation, parasitism or herbivorousness.

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:

In natural communities the Cutleaf coneflower *Rudbeckia laciniata* significantly reduces the number of native plant species (Tokarska-Guzik et al. 2012, Zubek et al. 2016, Stefanowicz et al. 2017 – P). Creating single-species, dense patches it eliminates indigenous species, transforming entire communities (Török et al. 2003, Tokarska-Guzik and Dajdok 2004, Tokarska-Guzik et al. 2012, Akasaka et al. 2015 – P, CABI 2018 – B). In places of its mass occurrence it usually forms areas of high density (about 27 thousand individuals/ha) and very high biomass (Tokarska-Guzik and Dajdok 2004 – P). The Cutleaf coneflower has been classified in Poland as an invasive species that poses a threat to the following natural habitats: 3220 – alpine rivers and the herbaceous vegetation along their banks, 3240 – Alpine rivers and their ligneous vegetation, 6430 – hydrophilous tall herb fringe communities of plains and of montane to alpine levels, and 91E0 – alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Tokarska-Guzik et al. 2012 – P). Up to 3 m tall, dense stands of the species, growing strongly vegetatively, cause deterioration in the light conditions for native species and act mechanically, consequently displacing them from the occupied area. As a result, the presence of this species negatively affects the species richness of the patches and the diversity of riverside communities (Dajdok and Śliwiński 2009, Stefanowicz et al. 2017, 2018 – P); its influence on the dynamics of renewal of woody species in the riverside forest communities is also signalled (EPPO 2009 – I). The species may be in competition with native plants pollinated by *Bombus* bumblebees, which willingly visit the flowers of the Cutleaf coneflower (CABI 2018 – B). At the same time, it should be noted that in areas poor in dicotyledonous species, the Cutleaf coneflower can be an important source of nectar for bumblebees and bees, as well as for other insects.

The high competitive power of *R. laciniata* results from its abundant production of seeds, their relatively high germination capacity and the creation of a permanent (seeds retain germination capacity for up to three years) soil seed bank (Francírková 2001, Osawa and

Akasaka 2009 – P). Another factor increasing the competitiveness of the species is the ability to grow vegetatively through rhizomes and the ability to regenerate even from small fragments (Francírková 2001 – 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:

There are no known hybrids of *Rudbeckia laciniata* with native species in Europe. In Europe, naturally, there are no native taxa of the *Rudbeckia* genus.

Probability: low x effect small = impact none/very small.

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

X	very low
	low
	medium
	high
	very high

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

acomm16. Comments:

There are no data on pathogenic or parasitic species, including endemic ones of Cutleaf coneflower that have been transferred from its native range. However, the fungus *Corynespora cassiicola*, which causes leaf spotting, was found on the leaves of the species in Brazil (Da Silva et al 2006 – P). It is a widespread fungus in the tropics and subtropics, occurring on several hundred plant species, including crops (Dixon et al 2009 – P). It has also been found on the skin of people.

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:

Morphological traits (e.g. tall shoots), effective vegetative reproduction and the possibility of its occurrence in conditions of high population density make the Cutleaf coneflower very strongly modify the habitats it occupies (Łopucki and Mróz 2012 – P). The dense and tall stands limit the access of light, which causes the disappearance of native species (Tokarska-Guzik and Dajdok 2004, Dajdok and Śliwiński 2009, Zubek et al. 2016, Stefanowicz et al. 2017 – P); in places of its mass occurrence, the Cutleaf coneflower modifies the thermal and moisture conditions of the ground level layer of the habitats occupied, thus creating places that differ microclimatically from the patches of native vegetation (Łopucki and Mróz 2012 – P). The species changes the properties of soil, mainly reducing the content of phosphorus (P) and nitrates (N-NO3) (Stefanowicz et al. 2017, 2018 – P). This affects soil microbial

communities, their biomass and activity, including the richness of arbuscular mycorrhizal fungi (Stefanowicz et al. 2016, Zubek et al. 2016 – P).

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:

The species in natural communities significantly reduces the number of native plant species (Tokarska-Guzik et al. 2012, Zubek et al. 2016, Stefanowicz et al. 2017 – P). The species, migrating along watercourses, disturbs the structure and functioning of natural ecosystems (Török et al. 2003, Tokarska-Guzik and Dajdok 2004 – P). Because Cutleaf coneflower grows intensively vegetatively, it can quickly form pure aggregations (Dajdok and Śliwiński 2009, Stefanowicz et al. 2017, 2018 – P), which cause the elimination of native plant species and may result in a reduction in the number or the complete elimination of pollinators. Flowers of the species are eagerly visited by species of the *Bombus* bumblebee (CABI 2018 – B), which may be competition for other plants pollinated by insects of this genus.

In this way, the trophic network changes. Cutleaf coneflower has been confirmed in 11 Polish national parks (Bomanowska et al. 2014, Radliński et al. 2015 – P), and thus may threaten the integrity of valuable ecosystems found in these parks.

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 does not affect plant cultivation through herbivory or parasitism.

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

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm20. Comments:

There are no known cases of the negative impact of this species on crops. It seems that its characteristics are not conducive to its spread into crops. Regular agrotechnical treatments limit the probability of the species spreading in crops (Szymura 2012 – A). However, according to EPPO, the species is recognized as a weed (EPPO 2009 – I). Massive encroachment of the Cutleaf coneflower into damp meadows may cause displacement of the plant species typical of these habitats, and as a consequence reduce their utility value. In rare reports, information can be found about chemical compounds isolated from the roots of Cutleaf coneflower that inhibit the germination and growth of some plants (Łopucki and Mróz 2012 – P).

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:

Plants cultivated in Poland belong to other taxonomic groups than *Rudbeckia laciniata*, which is an important barrier in the exchange of genes between species and taxa in crops. Probability: low x effect/consequences low = impact very low.

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:

Assessment of the impact of the Cutleaf coneflower on crops results from the potential penetration of the species into meadow communities and the displacement of the native species of these habitats, which leads to a reduction in the stock-feeding value of such meadows (it also lead to a reduction in its nature conservation value). Cutleaf coneflower can compete for pollinators with native species, influencing the relationship between wild pollinators and the local flora (Dajdok and Śliwiński 2009, Kącki 2009 – P).

Medium probability x medium effect/consequences = medium impact.

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

	very low
X	low
	medium
	high
	very high

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

acomm23. Comments:

The fungus *Corynespora cassiicola*, which causes leaf spotting (Da Silva et al. 2006 – P), was found on the leaves of the species in Brazil. This is a widespread fungus in the tropics and subtropics, occurring on several hundred plant species, including crops (Dixon et al 2009 – P). Its occurrence on the skin of people has also been reported. There are no data on the occurrence of this and other pathogens on the species and their transfer to cultivated species in Poland. Because in the areas where studies on *Corynespora cassiicola* were carried out, it was found, for example, on tomatoes, it can be assumed that the species can be transferred to cultivation situations. However, there is no information that pathogenic or parasitic species, including endemic ones, have been transferred from the native range of Cutleaf coneflower.

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. It does not affect the health of a single animal or animal 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
X	medium
	high
	very high

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

acomm25. Comments:

The species can affect the health of individual animals by their accidentally ingesting the shoots of plants. Sources provide information that mature plants may have a negative impact on the health of pigs, rabbits, sheep (EPPO 2009 – I, CABI 2018 – B), leading even to the death of an animal (large effect). Such cases may, however, be sporadic, because animals may avoid the plants (low probability). There are no reports documenting similar impacts.

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. It does not affect the health of a single animal or animal production through the transmission of pathogens and parasites harmful to these animals.

A4d | Impact on the human domain

Questions from this module qualify the consequences of *the organism* on humans. It deals with human health, being defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (definition adopted from the World Health Organization).

a27. The effect of *the species* on human health through **parasitism** is:

X	inapplicable
	very low
	low
	medium
	high
	vert high

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

acomm27. Comments:

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:

X	very low
	low
	medium
	high
	very high

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

acomm28. Comments:

There are no data on the negative effect of *Rudbeckia laciniata* on human health. Probability low + low effect = very low impact.

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. It does not affect human health as a result of the transmission of pathogens and parasites harmful to humans.

A4e | Impact on other domains

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

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

	very low
X	low
	medium
	high
	very high

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

acomm30. Comments:

In Europe, this plant is associated with edges of rivers, streams and brooks (Török et al. 2003, Tokarska-Guzik and Dajdok 2004, Walter et al. 2005 – P). It is also found on ruderal habitats or on roadsides (Wróbel 2006 – P). Locally, its clusters and expansion sites are also found on dykes around ponds. However, it most often occurs on the outskirts of drainage ditches and riverbeds (Tokarska-Guzik and Dajdok 2004 – P). Sometimes on flood terraces it enters the edge of meadows and riparian forests (Kącki 2009 – P). Massive presence of the species may lead to erosion of the banks of watercourses and reservoirs, causing the need to take protective measures. Medium probability x low effect = low impact.

A5a | Impact on ecosystem services

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

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

The Cutleaf coneflower *Rudbeckia laciniata* is an ornamental plant commonly distributed in the horticultural industry (CABI 2018 – B). Due to its late flowering period, it was used also

as a nectar plant, providing benefits to bees in a period when many native plants have already finished blooming (Łopucki and Mróz 2012 – P). Its application in biomass production is being considered (Mudryk et al. 2013 – P). Information suggests that eating plants can cause disease symptoms in pigs, sheep, rabbits and even lead to their death (Skidmore and Petersen 1932 – P, CABI 2018 – B); however, these data are not documented (see question a25). Despite the indicated toxic properties, Native Americans used the plant, especially its above-ground parts, for food and medicinal purposes (Mosher 2015 – I). Massive encroachment of the Cutleaf coneflower into meadow communities and displacement of indigenous species from these habitats may lead to a reduction in the value of stock-feeding meadows (see question a20 and a21).

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

The species is associated with edges of rivers, streams and brooks (Török et al. 2003, Tokarska-Guzik and Dajdok 2004, Walter et al. 2005 – P). Locally, its clusters and expansion sites are also found on dykes around the ponds. However, it most often occurs on the outskirts of drainage ditches and riverbeds (Tokarska-Guzik and Dajdok 2004 – P). The species is characterized by strong competitive properties, which results in limiting the diversity of native flora and changes in the structure of vegetation (Tokarska-Guzik et al. 2012, Akasaka et al. 2015, Zubek et al. 2016, Stefanowicz et al. 2017) (see question a18). This applies to both natural, seminatural and anthropogenic communities (Tokarska-Guzik 2005, Akasaka et al. 2015 – P, CABI 2018 – B). The species changes the properties of the soil, affecting soil microbial communities, their biomass and activity, including the richness of arbuscular mycorrhizal fungi (Stefanowicz et al. 2016, Zubek et al. 2016, Stefanowicz et al. 2017 – P) (see question a17). The species may contribute to change in pollinator systems (CABI 2018 – B). However, it should be noted at the same time that in areas poor in dicotyledonous species, the Cutleaf coneflower can be an important source of nectar for bumblebees and bees, as well as other insects. The seeds can be a source of food for birds (the native range is used by the American Goldfinch *Spinus tristis*).

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 **X**	high	level of confidence

acomm33. Comments:

Due to its aesthetic value, the species is grown in home gardens as an ornamental plant (Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012, Akasaka et al. 2015 – P, CABI 2018 – B). It is widely available in garden stores, including on the Internet. The species is kept in collections of many botanical gardens and arboretums (Employees of botanical gardens ... 2018 – N). In Podlasie, the species is planted near roadside crosses and shrines (Brzosko 2016-2017 – N). Native Americans used its roots, stems and leaves for indigestion and burns, and made salads of young leaves, due to their nutritional qualities (CABI 2018 – B,

EPPO 2009 – I). The species may reduce the tourist attractiveness of the colonised areas, especially along the river banks, hindering access to them and reducing visibility. Cutleaf coneflower invasion negatively affects the aesthetics of the landscape, especially during the death of the shoots (Szymura 2012 – A), although at the same time the presence of Cutleaf coneflower in human surroundings is rather positive due to its decorative qualities.

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	high **X**	level of confidence

acomm34. Comments:

The species is established and occurs throughout the country in semi-natural and natural habitats (Zając and Zając 2001, Tokarska-Guzik et al. 2012 – P), has already defeated geographical barriers and is spreading spontaneously. Forecasted climate changes will not affect the introduction of the species.

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:

The species is established and occurs throughout the country (Zając and Zając 2001, Tokarska-Guzik et al. 2012 – P), and the greater number of sites in the southern part of Poland is the result of the distance from the first places of introduction (Kącki 2009 – P).

In addition, it successfully reproduces through seeds and vegetatively multiplies (Brzosko et al. 2016 – P). The assumed climate changes are within the scope of its tolerance and probably will not have a major impact on its establishment.

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

	decrease significantly
X	decrease moderately
	not change
	increase moderately
	increase significantly

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

acomm36. Comments:

The species is established and occurs throughout the country (Zając and Zając 2001, Tokarska-Guzik et al. 2012 – P), and the greater number of sites in the southern part of Poland is the result of the distance from the first places of introduction (Kącki 2009 – P). It successfully reproduces by seeds and vegetatively multiplies (Brzosko et al. 2016 – P). As the species prefers a cool, humid climate, and rarely occurs in hot, arid regions (CABI 2018 – B), it can be assumed that progressive climate warming may locally limit its spread or affect changes in its local ranges. The forecasts should also take into account other factors affecting the success of the species, including mycorrhiza (Majewska et al. 2017 – 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:

	decrease significantly
X	decrease moderately
	not change
	increase moderately
	increase significantly

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

acomm37. Comments:

The species is already established and occurs throughout the country (Zając and Zając 2001, Tokarska-Guzik et al. 2012 – P). As the species prefers a cool, humid climate, and rarely occurs in hot, arid regions (CABI 2018 – B) it can be assumed that progressive climate warming may reduce its occurrence, and therefore slightly and locally reduce its impact on ecosystems in Poland. However, this is one of the possible scenarios. There are no detailed studies on this subject. The potential effect of climate change on the impact of the Cutleaf coneflower on wild populations of plants and animals may be related to its use by wild pollinators that benefit from its availability late in the season.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm38. Comments:

The impact of the species on arable crops by competition was assessed as very small (see question a20), whilst by crop integrity disorders, as medium (see question a22). Climate change should not change that. There are no detailed studies on this subject.

a39. IMPACT ON THE DOMESTICATED ANIMALS DOMAIN – Due to climate change, the consequences of *the species* on domesticated animals and animal production in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm39. Comments:

The impact on a individual animal and animal breeding is only manifested in the assumed toxic effects of the plant after its consumption (see question a25) and probably will not change as a result of predicted climate changes. There is no detailed research in this area.

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	high **X**	level of confidence

acomm40. Comments:

Negative impact of the species on humans has not yet been confirmed, and the forecasted climate changes should not change this situation, but knowledge of possible impacts should be supplemented.

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:

No changes in the impact of the Cutleaf cornflower on infrastructure due to climate change are predicted, however knowledge of this type of impact should be supplemented.

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)	0.60	1.00
Cultivated plants impact (questions: a19-a23)	0.15	1.00
Domesticated animals impact (questions: a24-a26)	0.50	0.50
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.25	1.00
Invasion (questions: a06-a12)	1.00	1.00
Impact (questions: a13-a30)	0.60	0.90
Overall risk score	0.60	
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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