



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. Zygmunt Dajdok
2. Barbara Tokarska-Guzik
3. Bogdan Jackowiak

acomment01.	Comments:		
	degree	affiliation	assessment date
	(1) dr	Department of Botany, Institute of Environmental Biology, University of Wrocław	19-06-2018
	(2) prof. dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	25-06-2018
	(3) prof. dr hab.	Department of Plant Taxonomy, Institute of Environmental Biology, Faculty of Biology, Adam Mickiewicz University in Poznań	11-07-2018

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

Polish name: Kroplik żółty
Latin name: ***Mimulus guttatus*** DC.
English name: Monkeyflower

acommm02.

Comments:

The Latin name of the species was given as in 'The Plant List' (2013 – B). Synonymous Latin names of the species include: *M. luteus* auct. – non L. 1763; *M. arvensis* Greene; *M. bakeri* Gandog.; *M. brachystylis* Edwin; *M. clementinus* Greene; *M. cordatus* Greene; *M. cuspidata* Greene; *M. decorus* (A.L. Grant) Suksdorf; *M. equinnus* Greene; *M. glabratus* Kunth var. *ascendens* Gray; *M. glareosus* Greene; *M. grandiflorus* J.T. Howell; *M. grandis* (Greene) Heller; *M. guttatus* ssp. *arenicola* Pennell; *M. guttatus* ssp. *arvensis* (Greene) Munz; *M. guttatus* ssp. *haidensis* Calder & Taylor; *M. guttatus* ssp. *litoralis* Pennell; *M. guttatus* ssp. *micranthus* (Heller) Munz; *M. guttatus* ssp. *scouleri* (Hook.) Pennell; *M. guttatus* var. *arvensis* (Greene) A.L. Grant; *M. guttatus* var. *decorus* A.L. Grant; *M. guttatus* var. *depauperatus* (Gray) A.L. Grant; *M. guttatus* var. *gracilis* (Gray) Campbell; *M. guttatus* var. *grandis* Greene; *M. guttatus* var. *hallii* (Greene) A.L. Grant; *M. guttatus* var. *insignis* Greene; *M. guttatus* var. *laxus* (Pennell ex M.E. Peck) M.E. Peck; *M. guttatus* var. *lyratus* (Benth.) Pennell ex M.E. Peck; *M. guttatus* var. *microphyllus* (Benth.) Pennell ex M.E. Peck; *M. guttatus* var. *nasutus* (Greene) Jepson; *M. guttatus* var. *puberulus* (Greene ex Rydb.) A.L. Grant; *M. hallii* Greene; *M. hirsutus* J.T. Howell; *M. langsдорфii* Donn ex Greene; *M. langsдорфii* var. *argutus* Greene; *M. langsдорфii* var. *arvensis* (Greene) Jepson; *M. langsдорфii* var. *californicus* Jepson; *M. langsдорфii* var. *grandis* (Greene) Greene; *M. langsдорфii* var. *guttatus* (Fisch. ex DC.) Jepson; *M. langsдорфii* var. *insignis* (Greene) A.L. Grant; *M. langsдорфii* var. *microphyllus* (Benth.) A. Nels. & J.F. Macbr.; *M. langsдорфii* var. *minus* Henry; *M. langsдорфii* var. *nasutus* (Greene) Jepson; *M. langsдорфii* var. *platyphyllus* Greene; *M. laxus* Pennell ex M.E. Peck; *M. longulus* Greene; *M. luteus* L. var. *depauperatus* Gray; *M. luteus* var. *gracilis* Gray; *M. lyratus* Benth.; *M. maguirei* Pennell; *M. marmoratus* Greene; *M. micranthus* Heller; *M. microphyllus* Benth.; *M. nasutus* Greene; *M. nasutus* var. *micranthus* (Heller) A.L. Grant; *M. paniculatus* Greene; *M. pardalis* Pennell; *M. parishii* Gandog. – non Greene; *M. petiolaris* Greene; *M. prionophyllus* Greene; *M. procerus* Greene; *M. puberulus* Greene ex Rydb.; *M. puncticalyx* Gandog.; *M. rivularis* Nutt.; *M. scouleri* Hook.; *M. subreniformis* Greene; *M. tenellus* Nutt. ex Gray; *M. thermalis* A. Nels.; *M. unimaculatus* Pennell. (Tokarska-Guzik and Dajdok 2010 – B, Lansdown 2011 – I).

The Polish name is given as in 'Flowering plants and pteridophytes of Poland' – a checklist (Mirek et al. 2002 – P). Other synonyms of the English name (apart from those listed) include: Seep monkeyflower, Seep-spring monkeyflower.

Polish name (synonym I)

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Polish name (synonym II)

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Latin name (synonym I)

Mimulus whipplei A.L. Grant

Latin name (synonym II)

Mimulus guttatus var. *guttatus*

English name (synonym I)

Common monkeyflower

English name (synonym II)

Creek monkeyflower

a03. Area under assessment:

Poland

acommm03.

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
- alien, present in Poland in the environment, established

aconf01.

Answer provided with a

low

medium

high

X

level of confidence

acomm04.

Comments:

Monkeyflower was introduced to Poland in its present borders as an ornamental plant. The first spontaneous sites were observed in 1824 (Piękoś 1972, Tokarska-Guzik 2005 – P). In time, further sites started to appear mainly on the banks of streams and rivers, as well as within the communities formed in the area of seepages and springs (Tokarska-Guzik and Dajdok 2009 – P). Currently, monkeyflower is classified as a permanently established plant of alien origin in Poland – in the study by Tokarska-Guzik et al. (2012 – P) it is considered as a regionally invasive species – Category III (grouping ‘species found in a small number of sites with a high abundance or dispersed across many sites with a small number of individuals, posing ecological, economic or social risk’).

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

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

acomm05.

Comments:

The analysis of the impact of monkeyflower indicates that it does affect the natural environment. The most numerous individuals of the species appear on the banks of flowing waters, including the streams of the Sudetes, their forelands and foothills. In many river sections, the species enters *Sparganio-Glycerion fluitantis* communities developing on the banks. The patches of vegetation with significant presence of this plant belong to a separate plant association called *Veronico beccabungae-Mimuletum guttati*, described by Kwiatkowski (2003 – P) in the Bóbr valley. The species may also appear in communities of *Phragmitetea*, *Bidentetea tripartiti* and *Isoëto-Nanojuncetea* classes (Tokarska-Guzik and Dajdok 2010 – B, Stosik 2014, Sobisz et al. 2015 – P). In the Karkonosze Mountains, it grows both along streams and in communities growing near seepages and springs (Czarniecka et al. 2011, Dajdok and Szczęśniak 2014, Misztal and Dajdok 2015 – P). In the lowlands (e.g. in Western Pomerania and Tuchola Forest), it grows on the banks of rivers, springs, lakesides and also in wet parts of meadows and pastures (Stosik 2014, Sobisz et al. 2015 – P). Economic problems resulting from the impact of the species on watercourse infrastructure, as reported by Gudžinskas (Tokarska-Guzik and Dajdok 2010 – B) papers, need to be confirmed both in terms of scale and relevance.

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
- high

aconf02.

Answer provided with a

low	medium	high X
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level of confidence

acomm06.

Comments:

Monkeyflower is fully established in the natural environment of Poland. In 2001, the number of its sites was estimated to be 326 in 128 squares of the 10×10 km ATPOL database squares (Tokarska-Guzik and Dajdok 2009, after Zajęc and Zajęc 2001 – P). The data collected for this

project show that the number of its sites already exceeds 340 and that the number of ATPOL squares exceeds 130. Monkeyflower reproduces both by light seeds (generative reproduction) spread via rivers and streams, by wind and by animals (deer, birds, cattle), and by easily rooting fragments (vegetative reproduction) of above-ground stolons capable of surviving winter (Truscott et al. 2006 – P, Matthews et al. 2012 – I).

Although the species is present in the territory of Poland (mainly in the south- and north-western parts), it is probable that it will migrate into Poland from the border areas on the Czech side, as well as from Germany (where it occurs frequently), with a participation of animals and water (especially during river flooding) (Tokarska-Guzik and Dajdok 2010 – B and the sources quoted there); this high probability of assessment results from the recommendation included in the procedure of assessing the risk of negative impact of invasive and potentially invasive alien species in Poland (*Harmonia*^{+PL} protocol).

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 X	level of confidence
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acomment07. Comments:
Given the nature of the habitats occupied by *Mimulus guttatus*, including e.g. ditches along roads and railways (Tokarska-Guzik and Dajdok 2009 – P), as well as the edges of anthropogenic dammed reservoirs (such as reservoirs in Sosnówka near Jelenia Góra (Dajdok 2010-2011 – A), or Niedów near Bogatynia (Skórski and Dajdok 2018 – P)), it should be assumed that accidental transfer of seeds or vegetative parts of the species is possible during earthworks related to their restoration, strengthening or dredging. Transport of seeds (rarely vegetative parts) of the plant into Poland as a result of unintentional human actions is probable; it is assumed that in the past this species could have been introduced in Pomerania in this way (Tokarska-Guzik and Dajdok 2010 – B); high probability of assessment is according to the recommendations included in the Procedure of risk assessment of negative impact of invasive and potentially invasive foreign species in Poland (*Harmonia*^{+PL} protocol).

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 X	level of confidence
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acomment08. Comments:
Monkeyflower entered the natural environment from cultivation in home gardens, in the present Polish territory, in the Kowary region or thereabouts (Tokarska-Guzik 2005 – P). Recently, Matthews et al. (2012 – I) have reported the spread of this species after its introduction with a seed mixture on the banks of streams in the Hague. In Poland Common monkeyflower is offered in Internet sales (e.g. on the on-line shops: Oczko wodne and Szuwarek – I) as well as ‘monkeyflower with spotted flowers’ (e.g. on the on-line shop Sklep-Nasiona – I). Analysis of the market in terms of the availability of invasive seeds and seedlings of plant species of alien origin (Mackiewicz 2015 – I), carried out on behalf of the ‘Man and Nature’ („Człowiek i Przyroda”) association for Podlaskie Voivodeship, did not indicate points of sale for monkeyflower, in contrast with other invasive species. However, it is difficult to determine if the same is true for other regions of the country. Monkeyflower was included

in the 'Horticulture for Invasive Plants of Alien Origin' Code of Good Practice prepared by the General Directorate for Environmental Protection (Kodeks dobrych praktyk „Ogrodnictwo wobec roślin inwazyjnych obcego pochodzenia”; 2016 – I). The species is included in Annex 3, which covers horticultural plants of invasive alien species for which special precautionary measures are recommended, and for which special information sheets should be provided if it is offered for sale. However, it should be stressed that following the above-mentioned Code is entirely voluntary.

The species is being planted in Poland at a few (9) botanic gardens, from where potentially (at three institutions they confirmed spontaneous proliferation) it can spread to surrounding areas (Employees of botanic gardens... 2018 – N).

Even though currently the probability of the species entering into the natural environment of Poland as a result of the intended activity of humans is difficult for an unambiguous estimate, according to the procedure of the risk assessment of the negative impact of invasive and potentially invasive alien species in Poland – *Harmonia*^{+PL}, for species which are already established in Poland, one should assume a high probability with a high degree of certainty.

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 X	level of confidence
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acommm09.	Comments:
	Monkeyflower comes from North America and its range covers the western part of the continent, from Alaska to Mexico (Tokarska-Guzik and Dajdok 2010 – B). The climatic conditions of Poland are similar (in 94-100%) to those of only a part of the western outskirts of North America. However, considering that monkeyflower is already present in Poland at numerous sites located in different regions, it should be assumed that the climatic conditions in the country are optimal for the species.

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 X	level of confidence
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acommm10.	Comments:
	In the western part of North America, there are two known varieties of monkeyflower in the area of natural occurrence: a perennial form in the Pacific coastal area and an annual form in inland areas. The perennial form (classified by some authors as a separate variety <i>M. guttatus</i> var. <i>grandis</i> or a subspecies <i>M. guttatus</i> ssp. <i>litoralis</i>) occupies coastal cliffs, sand dunes and coastal terraces where its populations are exposed to salt sea breezes which is why it is resistant to salinity. The annual inland form occupies the banks of springs, streams and lakes (Lowry et al. 2008 – P). The presence of both forms within the secondary range in

Europe was discussed by Matthews et al. (2012 – I) who suggest that both forms may be present in the Netherlands; this, however, needs to be verified. This issue is particularly important since it may indicate that in case of the presence of both forms in Europe the species could be much more adaptable to different habitat conditions. Considering the distribution of the existing monkeyflower sites in Poland, it can be assumed that appropriate habitat conditions exist in the entire country. From the perspective of altitudinal differences, the distribution of the species in the Sudetes and Carpathian Mountains differs considerably – in the Carpathians and their forelands monkeyflower is known only to grow in a dozen or so sites in the western part, while in the Sudetes the species is much more widespread. In the Karkonosze Mountains in the 1980s, most monkeyflower sites were described from higher mountain positions (Fabiszewski 1985 – P), which seems unlikely considering the regions from which the species started to spread (e.g. Kowary). According to the research conducted after the year 2000, sites of this species were found only in lower locations (Oprządek 2012, Misztal and Dajdok 2015 – P), mainly in the hill bases and the lower zone. More research is needed to identify the exact causes of these differences. Irrespective of the situation in the Karkonosze Mountains, one should regard habitat conditions (biotic and abiotic) in the majority of the area of Poland optimal for monkeyflower.

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 X
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 level of confidence

acomment11. Comments:
Dispersion from a single source (A type data):
Monkeyflower spreads spontaneously in Poland, mainly as a result of the transfer of light seeds that weigh less than 0.02 mg (a single shoot can produce about 7 000) (Truscot et al. 2006 – P) or fragments of rhizomes carried by water and by wind, although apart from these means other ways of spreading the species are suggested – e.g. the transfer of seeds by animals: deer, birds or cattle (Vickery et al. 1986, Truscot et al. 2006 – P, Matthews et al. 2012 – I). While the first two means are most effective at water margins, livestock feeding on wet pastures can also be a significant factor (as vectors of seed transfer), e.g. in West Pomerania. The species can spread diaspores across short and long distances. Short distance spread was estimated at 1-4.75 m by the wind and up to 1 km by animals (deer) (Vickery et al. 1986 – P). The maximum distance that the seeds can travel with river currents has been estimated at about 3 km/year, while vegetative fragments can travel approximately 4.5 km/hour (Truscott et al. 2006 – P). Assuming that the vegetative parts can float in water for more than an hour, the species can be classified as a member of the group of plants with a high dispersion from a single source (over 5 km/year).

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

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

aconf08.	Answer provided with a	low	medium	high	level of confidence
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acomment12. Comments:
Monkeyflower seeds (and also vegetative parts during the growing season) accumulated in sediments at the banks or bottom of streams and ditches can be moved by humans during shore strengthening or renovation works. This can also happen during dredging and transportation, storage and use in other, often remote locations. Theoretically, such relocations may also take place during mowing of the vegetation of ditches, pastures or meadows where monkeyflower grows, when the biomass is transported or seeds are transferred on the equipment used for such procedures. The species is available on sale online, however in home gardens it is being planted rarely, only by enthusiasts, on account of its specific water requirements.

A4a | Impact on the environmental domain

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

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

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

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

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

aconf09.	Answer provided with a	low	medium	high	level of confidence
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acomment13. Comments:
Monkeyflower is a green and autotrophic plant.

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

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

aconf10.	Answer provided with a	low	medium	high	level of confidence
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acomm14.

Comments:

The impact on the species composition of the communities affected by monkeyflower is assessed to be minor compared with other invasive species. Such an approach is represented, e.g. by Czech authors (Hejda et al. 2009 – P). This impact is perceived in a similar way in the United Kingdom (e.g. Lansdown 2011 – B) and the Netherlands (Matthews et al. 2012 – I). Only a few authors, e.g. Truscott et al. (2008 – P) have demonstrated negative impact of this species even with a low coverage of the patches. They have shown that *Mimulus guttatus* changes the structure of plant communities on the banks of watercourses. According to these authors, the impact of the species involves the production of erect shoots (50-100 (150) cm high) and a rapid growth of seedlings leading to shading of neighbouring plants and changing the structure of the community. In addition, the high pressure of propagules and the rapid germination of seeds, combined with the high survival, regeneration and colonisation capacity of vegetative fragments, lead to effective short- and long-term spread. In addition, the species can tolerate a wide range of habitat conditions, including of shade and temperature. The most important negative effects of the invasion of this species on native plants are competition for space, water, nutrients and light (Truscott et al. 2008 – P). The authors also emphasize that *Mimulus guttatus* colonizes the banks of watercourses up to 1 m wide most numerously. In the conditions of the Karkonosze Mountains, this species was most frequently observed within the channels of watercourses, as well as on their banks (Misztal and Dajdok 2015 – P). In addition, Truscot et al. (2008 – P) classified monkeyflower as one of the species whose invasion depends on the disturbance regime – e.g. the establishment of monkeyflower is hampered by snails feeding on it. According to the authors, the species is capable of colonising disturbed communities along small streams, resulting in the loss of native species. In addition, it may affect invertebrate groups due to poor production of nectar by its flowers, which can have negative consequences in places where it substitutes native species that are more efficient in this respect. Truscott et al. (2008 – P) mention that *Mimulus guttatus* is able to compete for habitat resources, light and water, especially in small streams communities, although it mainly affects native plant species that are still widespread. However, this impact needs to be assessed more thoroughly considering its competition with seepage and spring plants. For these habitats, monkeyflower is sometimes indicated as a species competing with water blinks *Montia fontana* – a species classified as endangered in Poland – the VU category on the Polish red list of fern and flower plants (Kaźmierczakowa et al. 2016 – P) and a species under strict protection (Sotek et al. 2003, Tokarska and Dajdok 2009, Dajdok and Szczyński 2014 – P).

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
		X

level of confidence

acomm15.

Comments:

In Poland, there are no known crossbreeds between monkeyflower and native plant species; in Great Britain, a hybrid taxon – *Mimulus xrobertsii* – is widespread. It is a crossbreed of *M. guttatus* and *M. luteus* which is another ornamental species of alien origin (Stace and Crawley 2015 – P). This crossbreed is widespread in the upland areas of Great Britain, but it is sterile. Recently, a hybrid taxon, *M. peregrinus*, with an increased number of chromosomes has been observed (hexaploid 2n = 92) (Stace and Crawley 2015, after Vallejo-Marin 2012 – P). After autopolyploidization was recently described within the population of *Mimulus guttatus* in Great Britain (Violeta et al. 2017 – P), it seems that in Poland the possibility of crossbreeding of monkeyflower with another alien species of this type – *M. moschatus* which grows outside cultivation in Poland – described more extensively by Piękoś (1972 – P) is worth investigating.

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

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

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

acomm16. Comments:
In the modern scientific literature it is assumed that *Mimulus guttatus* does not transmit pathogens harmful to native plants.

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

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

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

acomm17. Comments:
Monkeyflower impact assessments do not address abiotic disturbance issues.

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

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

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

acomm18. Comments:
In most contemporary studies in which the impact of monkeyflower on ecosystems is considered, its significance is assessed as low (e.g. Hejda et al. 2009 – P, Lansdown 2011 – B, Matthews et al. 2012 – I). On the other hand, studies recognising competition for habitat resources and on the impact of decreasing the nutrient supply for insects as a result of replacing plants with higher production, e.g. of nectar (e.g. Truscott et al. 2008 – P), emphasise that this impact is of temporary nature, and in river channel peripheries affected by vegetation disturbance, e.g. as a result of temporary flooding and exposure of parts of the shore. When phytocenoses with perennial plants (e.g. grasses) develop in such places, the percentage of monkeyflower individuals decreases.

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:

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

- low
- medium
- high
- very high

aconf15. Answer provided with a

low	medium	high X
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 level of confidence

acomm19. Comments:
Monkeyflower is a green and 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 X
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 level of confidence

acomm20. Comments:
Monkeyflower does not occupy any habitats where it could pose a threat to crops. Exceptions may include meadows and pastures, where it occupies the wettest patches. However, due to the small scale of such cases, they are not of significant economic importance.

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
- high
- very high

aconf17. Answer provided with a

low	medium	high X
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 level of confidence

acomm21. Comments:
Apart from the many varieties with spotted flowers currently popular in Poland, *M. luteus*, which crossbreeds with monkeyflower, is also cultivated as an ornamental plant. The hybrid taxon, *M. xrobertsii*, is the most common taxon of the genus *Mimulus* in the highlands of Great Britain (Stace and Crawley 2015 – P). No hybrids of *Mimulus guttatus* have been found in Poland so far, although there is a possibility that *M. guttatus* will crossbreed with *M. moschatus*. Thus, the impact of the species on plant crops through crossbreeding with related species has to be assessed as very low.

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

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

aconf18. Answer provided with a

low	medium	high X
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 level of confidence

acomm22. Comments:
As for crop cultivation in the broad sense, monkeyflower has the potential to influence only meadow or pasture communities. However, due to the small scale of such cases, it is not considered that they have an impact on the integrity of the crops.

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

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

aconf19. Answer provided with a

low	medium	high X
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 level of confidence

acomm23. Comments:
In modern scientific literature it has been assumed that *Mimulus guttatus* does not transmit pathogens harmful to other plants, including cultivated plants.

A4c | Impact on the domesticated animals domain

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

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

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

aconf20. Answer provided with a

low	medium	high
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 level of confidence

acomm24. Comments:
Monkeyflower is a green and autotrophic plant.

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

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

aconf21. Answer provided with a

low	medium	high X
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 level of confidence

acomm25.

Comments:

No known negative effects due to direct contact between monkeyflower and livestock are known at present.

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
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level of confidence

acomm26.

Comments:

Mimulus guttatus is not a host or vector of animal parasites or pathogens.

A4d | Impact on the human domain

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

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

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

aconf23.

Answer provided with a

low	medium	high
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level of confidence

acomm27.

Comments:

Monkeyflower is a green and autotrophic plant.

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

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

aconf24.

Answer provided with a

low	medium	high X
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level of confidence

acomm28.

Comments:

Any negative impacts of the monkeyflower on human health, due to properties that pose danger when in direct contact with the plant, are not known at present.

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

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

aconf25. Answer provided with a

low	medium	high
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 level of confidence

acomm29. Comments:
Mimulus guttatus is not a host or vector of human parasites or pathogens

A4e | Impact on other domains

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

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

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

aconf26. Answer provided with a

low	medium	high X
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 level of confidence

acomm30. Comments:
At present, no negative impact of monkeyflower on the infrastructure is observed.

A5a | Impact on ecosystem services

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

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf27. Answer provided with a

low	medium	high X
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 level of confidence

acomm31. Comments:
According to Truscot et al. (2008 – P) one of the effects of monkeyflower on ecosystems may be its impact on invertebrate communities, mainly because its flowers are a poor source of

nectar. Therefore, in places where this species begins to play a greater role than native plants producing larger amounts of nectar, there may be, at least temporarily, a decline in food resources for invertebrates.

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf28. Answer provided with a

low	medium	high X
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 level of confidence

acomment32. Comments:
According to Samecka-Cymerman and Kempers (1999 – P), monkeyflower can be used in environmental monitoring as an indicator of potential metal contamination and can accumulate nutrients from both water and soil. According to the above-mentioned authors and Mróz et al. (1994 – P), monkeyflower can be used in biological wastewater treatment plants in mountain conditions. However, it should be noted that its cultivation for such purposes may increase the risk of its spread in those areas.

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf29. Answer provided with a

low	medium	high X
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 level of confidence

acomment33. Comments:
Monkeyflower is a species that attracts the attention of enthusiasts for unusual plants that can be introduced to the gardens as the flowers are relatively large, their shape is unique and their colour is distinctive. This is reflected, i.a., in the approach to the species adopted in the preparation of the Code of Good Practice for Horticulture (2016 – I), in which it is not listed as a prohibited plant for sale but is included in Annex 3, which contains species authorised for commercial sale, provided that a leaflet with appropriate information is included.

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

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

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

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

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

aconf30. Answer provided with a

low	medium X	high
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 level of confidence

acomm34. Comments:
 In some earlier studies (e.g. Zając and Zając 2015 – P), it is predicted that monkeyflower will not expand its range rapidly. If the assumption of these authors that the species requires a humid climate and rather cooler habitats is accepted, then considering the expected temperature increase, it may be assumed that changing climatic conditions will not favour monkeyflower growth in new areas. However, considering also the intensity of extreme events and the species assessments conducted by Elderd (2003 – P), another conclusion is possible. On the one hand these changes will be unfavourable for the species, as they do not withstand well the changes in soil moisture caused, for example, by changes in humidity and flows in watercourses; these negative factors may be particularly visible for populations developing in meadows and pastures and in the vicinity of excavations and springs. On the other hand, increased water flow in streams after heavy rainfall may be a factor destroying existing vegetation patches, which may favour the development of monkeyflower in pioneering conditions, and at the same time may cause its seeds to be spread to places not colonized before. Considering that in Poland the most numerous populations of the species are formed on the banks of watercourses, it might be assumed that in this type of habitat the second of mentioned factors will be more significant, i.e. periodic intensified rainfall, conducive to the creation of pioneer conditions. As a consequence, this may lead to a moderate increase in the possibility of overcoming geographic barriers and colonizing new areas (especially new sections of river valleys) by this 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
- not change
- increase moderately
- increase significantly

aconf31. Answer provided with a

low	medium	high X
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 level of confidence

acomm35. Comments:
 In Poland, monkeyflower is known to have over 300 sites. They are located mainly in the western part of the country, and are also dispersed in the eastern and northern parts. This distribution may indicate that at the present stage of establishment of the species in Poland the barriers preventing its survival and reproduction no longer exist – this is not expected to change as a result of climate change.

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 X	level of confidence
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acomm36. Comments:
The sites of monkeyflower are dispersed over a larger area of Poland. Therefore, it does not seem probable that climate change will have a significant impact on the barriers that have prevented this species from spreading in the country so far. The possible entry of the species into higher mountainous locations is debatable. In the Carpathian mountains and their forelands, monkeyflower is not yet widespread and the authors of the study on neophytes of Polish Carpathian mountains and their forelands (Zajac and Zajac 2015 – P) do not expect a significant extension of the range of the species. In the Sudetes, and more specifically in the Karkonosze Mountains, the species was originally located in the higher altitudes of the Karkonoski National Park (Fabiszewski 1985 – P), but this has changed in the last decades, and now its sites are located mainly at the outskirts of the Park. The issue of determining the reasons for the withdrawal of a species to lower sites needs to be thoroughly studied.

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

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

aconf33.	Answer provided with a	low	medium X	high	level of confidence
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acomm37. Comments:
In many places in Europe, including Poland, monkeyflower forms populations with a high density of individuals. However, this impact is assessed to be minor in most studies. This is not expected to change drastically after climate change. The authors of the risk analysis report of the species prepared for the Netherlands (Matthews et al. 2012 – I) also reached such conclusions. The situation may be different in spring and mountain ecosystems, where this species can compete with (and most likely oust) the endangered *Montia fontana*. However, this aspect requires a detailed studies.

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

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

aconf34.	Answer provided with a	low	medium	high X	level of confidence
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acomm38. Comments:
The current minor effect of monkeyflower on plant crops is limited only to wet fragments of meadow and pastures. Climate change can eliminate this impact in areas where rainfall will decrease and temperatures will rise. However, in areas where rainfall is expected to increase (e.g. in the south-western part of the country), this factor may favour the species maintaining its sites, but it is not expected to affect the amount of grazing areas or biomass extracted from meadows significantly.

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

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

aconf35. Answer provided with a

low	medium	high X
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 level of confidence

acomm39. Comments:
Monkeyflower does not affect animal husbandry and this is not expected to change as a result of predicted climate change.

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 X
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 level of confidence

acomm40. Comments:
Monkeyflower does not affect animal or humans and this is not expected to change as a result of predicted climate change

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 X
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 level of confidence

acomm41. Comments:
Monkeyflower is not a species that currently affects infrastructure and this is not expected to change as a result of projected climate change.

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)	0.20	0.90

Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.00	1.00
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	0.88	1.00
Impact (questions: a13-a30)	0.20	0.98
Overall risk score	0.18	
Category of invasiveness	noninvasive 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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