Appendix A

Harmonia^{+PL} – procedure of 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

Barbara Sudnik-Wójcikowska
first name and family name

Elżbieta Melon
first name and family name

Barbara Tokarska-Guzik

acomm01. Comments:

degree	affiliation	assessment date
Assoc. Prof.	Faculty of Biology, and Biological and Chemical Research Centre, University of Warsaw	15.12.2017
degree	affiliation	assessment date
M.Sc.	University of Warsaw Botanical Garden	15.12.2017
degree	affiliation	assessment date
Prof.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	22.12.2017

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

Polish name
Tulejnik amerykański

Latin name
Lysichiton americanus Hultén & H.St.John

English name
American skunk cabbage

acomm02.	Comments: Latin name is provided according to The Plant List, (Version 1.1 2013 – B). In addition to frequently English names given below, there are many other synonyms: Meadow cabbage, Skunk cabbage, Skunk weed, Western skunk-cabbage, Yellow arum, Yellow skunk cabbage, Yellow skunk cabbage or Swamp lantern.

Polish name (synonym I)	Polish name (synonym II)
……..	……..
Latin name (synonym I)	Latin name (synonym II)
……..	……..
English name (synonym I)	English name (synonym II)
Western skunk cabbage	Swamp cabbage

a03. **Area** under assessment:

Poland

acomm03.	Comments: ……

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

native to Poland	
alien, absent from Poland	
alien, present in Poland only in cultivation or captivity	**X**
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: in „Comments" (questions acomm04-41) experts should provide **explanations for their answers and list sources of information**. In particular, Comments should explain the decision in cases when data is lacking, incomplete or uncertain, or if the available information is contradictory. Source of the information should also be provided here, with author and year of publication; data sources should be divided into P – published results of scientific research; B - databases; N – unpublished data; I - other; A – author's own data. Detailed information (including full bibliographic record) should be provided at the end of the questionnaire "Data sources". Guidance on data sources citation is available at the end of the *Harmonia*$^{+PL}$ – procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland. The American skunk cabbage is known in Poland only in cultivation, mainly in botanical gardens and arboretums. Based on the query conducted in autumn 2017 (in cooperation with E. Melon from the Botanical Garden of the University of Warsaw) cultivation of this *Species* was confirmed in nearly half of these institutions in Poland. We used unpublished materials (N) - information from curators of the collections from all over Poland (see References - The list of sources). The list of botanical gardens in which the survey was conducted and no cultivation was confirmed is also provided. The American skunk cabbage is also grown in private gardens, planted on the banks of small ponds, along watercourses or in humid depressions. However, the scale of cultivation is small and there are no signs of plants escaping outside gardens. Some knowledge about this *Species* is provided by the analysis of the sale offers in garden centres and comments from internet users interested in growing this plant. It seems that the supplies of his plant have been limited (perhaps since the *Species* was included into the list of invasive alien species in Poland). Difficulties associated with the cultivation of this plant are also mentioned by internet users.

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

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

acomm05.	Comments: The American skunk cabbage is grown in a dozen or so botanical gardens and arboretums throughout the country, also, which should be particularly emphasized, over restored watercourses within the botanical gardens. These are mostly closed facilities, therefore there is little chance that the *Species* will be intentionally released into the natural environment. Escape of the *Species* outside the garden is quite unlikely (though not impossible). Therefore, in future, some impact of the *Species* on the natural environment is possible. However, currently, this is not observed in Poland (N, A).

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 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	**X**
medium	
high	

aconf02. Answer provided with a

low	medium	high
		X

level of confidence

acomm06. Comments:

The *Species* occurs outside of Poland in cultivated in gardens. It also appears in natural habitats, e.g. in Germany, transferred there intentionally by man (König and Navrath 1992, Alberternst and Nawrath 2002 - P), or as an escapee from cultivation; for example in Ireland (Preston et al. 2002 - P), in Belgium (Source int. 3 - I), in Great Britain (Sanderson 2013 - P) or in Norway (Lid and Lid 1994 - P). It is worth noting that the American skunk cabbage, unlike most invasive alien species, enters directly into natural communities, not using anthropogenic habitats and synanthropic plant communities as stepping stones of the invasion.

The probability of spontaneous expansion of *Species* into the territory of Poland from abroad is very low. This is due to the fact that the species has a relatively narrow ecological amplitude, it occurs on specific (very humid) and dispersed natural habitats, and its seeds travel relatively small distances (see discussion - Sanderson 2013 - P). In the native range, they move mainly with water or are carried by animals. This was confirmed, among others in Great Britain - in the case of step migration - the role of birds cannot be excluded.

Although the *Species* occurs in Germany, the country neighbouring Poland, the populations there occur in areas far from the Polish borders (e.g. the Taunus Mountains; König and Navrath 1992 - P).

In principle, the "medium probability" condition is met: "The *Species* does not create (in a neighbouring country) populations whose expansion, associated with biological characteristics of the *Species* (based on previous knowledge), is fast enough to reach the Polish borders in the perspective of about 15 years." However, based on the expert knowledge, the probability of spontaneous expansion was assessed as "very low" here.

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

low	**X**
medium	
high	

aconf03. Answer provided with a

low	medium	high
		X

level of confidence

acomm07. Comments:

At this stage, it seems that in our climatic conditions the spontaneous appearance of the *Species* in the natural environment, without human assistance or as a result of unintentional actions (e.g. accidental spreading of diasporas during the transport) is unlikely (there is no such data in our literature so far).

Seeds or seedlings transported and accidentally spread during transport, will most probably land in anthropogenic habitats. There, their relatively small mobility and narrow ecological amplitude will probably not allow for further development.

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

low	
medium	**X**
high	

aconf04. Answer provided with a

low	medium	high
		X

level of confidence

acomm08. Comments:

The *Species* arrived to Poland in deliberate transport and trade in exotic plants, solely for the purpose of growing in gardens.

It is also worth noting that in Poland there is no data of any current or previous attempts to intentionally introduce this species into the natural habitats (e.g. to riparian forests, as it happened in Germany; König and Nawrath 1992- P) or in Great Britain (Sanderson 2013 - P).

There is still a relatively little level of awareness of the threat to the native wildlife from possible invasion of alien species among the Polish society. Until recently, seedlings and young specimens of the American skunk cabbage (imported to Poland probably from the Netherlands, and later re-distributed throughout the country), could easily be purchased at garden centers or via the Internet (A, N).

It seems, however, that recently, after the appearance of "black lists" of invasive alien species (2011, 2016, 2017), the situation has been changing. Our survey and interviews (A) conducted in the most important centres of cultivation and sales showed that at least in some of the centers the species was officially withdrawn from sale. In others, even if it appears in the sales offer, it is often annotated as "currently not available." There are also sellers who completely ignore the situation. On the other hand, some sellers (but not all) complain about low interest in this plant. The same holds true for the Internet sales, e.g. the last transaction in this *Species* by a well-known Internet company (of an individual plant) took place in April 2016 (A).

We hope that these institutions will, with time, take the ban on the sale of potentially invasive alien species seriously. Certainly, reliable information about these *Species* should be popularized so that no one claims ignorance. If attempts at intentional introductions of the species for cultivation in private gardens are stopped, the risk of its expansion will be significantly limited.

The cultivation of *Lysichiton* in botanical gardens and arboretums is a separate issue. These institutions exchange plant material among themselves. This *Species* has an interesting biology and it is worth cultivating and exhibiting in institutions authorised for this purpose. However, it is necessary to require "safe" cultivation there: in closed pools or in places where the spread of seeds through water can be "controlled". (e.g. in the University of Warsaw Botanical Garden) (A).

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	**X**
sub-optimal	
optimal for establishment of the *Species*	

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

acomm09. Comments:

The *Species* originates from the west coast of Canada and the United States. It occurs in a temperate climate (in a wide range of temperatures): from Alaska to northern California (Ze-Long et al. 2006 - P, Source int. 1, Source int. 2 - I). Due to the proximity of the Pacific, the local climate is much more humid than in Poland, with high humidity remaining unchanged throughout the year.

The similarity between the climate of Poland and the climate of the natural range of the *Species* is within the range of 0-45%, which means that the climate requirements of the *Species* are not met in Poland. This is confirms information from curators in the surveyed botanical gardens: in places slightly less damp and less shaded, the leaves of the *Species* are damaged by sun. Spring temperature fluctuations cause freezing of young shoots, which die and weaken development of subsequent buds. On the other hand, low or changing temperatures in winter seem less harmful.

Within the secondary range in Europe, the values of climatic similarity of Poland and other European countries, where the *Species* was found, are mainly in the range of 94-100%, and further to the west – in the range of 45-94%. Here, the influence of the Atlantic is stronger and conditions for occurrence of the *Species* much more favourable than in Poland, although the "climate niche" of the *Species* may be slightly different from that in its native range.

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

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

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

acomm10. Comments:

In the native range the *Species* prefers moist habitats: riverside (alluvial) forests, bog forests, wetlands, peat bogs, wet meadows (CABI 2017 – B). Such habitats suitable for the survival and reproduction of the *Species,* are still abundant in Poland, although many of them have been drained. However, the air humidity, mentioned above, is probably lower, which is an important factor for a plant with such large leaves.

So far, there have been no records of release of the *Species* outside of the places of its cultivation (gardens). At the moment, there is also no information about animals that pollinate flowers and spread seeds of the American skunk cabbage in Poland.

A3 | Spread

Questions from this module assess the risk of the *Species* to overcome dispersal barriers and (new) environmental barriers within Poland. This leads 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 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	**X**
low	

medium	
high	
very high	

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

acomm11. Comments:

Data on the expansion from a single source (Type A)
There is little information from the curators of the botanical garden/arboretum collections about dispersion along watercourses in gardens (N). *Lysichiton* creates fertile fruits which mostly fall near the mother plant. They germinate, sometimes quite abundantly, but very few seedlings survive. This species does not tend to expand, growing only in places where it was planted. Only in the Forest Arboretum in Syców and Arboretum in Przelewice, individuals of the species have been found growing 50 m from the maternal plant; in both cases, however, the seedlings have not escaped out of the garden; therefore dispersion is very small.

Data on the population expansion (Type B)
Currently there is little data to consider population expansion (N) - only a few individuals were found within 50 m of the planted plants; very small expansion.

Data on estimation of the biological mobility of the species (Type C) (N)
- the *Species* is a perennial herb with strong rhizome, deeply rooted, "set" to persist in its habitat;
- the rhizome grows poorly, the plant does not tolerate transplanting well, hence vegetative reproduction is not very effective. In some gardens the *Species* requires protection in winter time;
- the *Species* produces fertile seeds, but does not have any specific mechanisms to facilitate the further transport of seeds;
- lack of clear adaptations to anemo- and anthropochory;
- zoochory seems unlikely in our country; there have been no records so far of animals feeding on fruit of the species (it seems that some birds could play this role in Europe);
- hydrochory is probable, which is confirmed by American and European authors (e.g. Source int. 3 - I, Sanderson 2013 - P). The range of hydrochory in western Europe is debatable, most often from several dozen to several hundred meters;
- the sprouting capability of the species is estimated differently in the surveyed gardens – from 30 to even 100% (30-50%, - (N) - information from the curator of the Arboretum in Przelewice, close to 100% - (N) - information from the curator of the Arboretum in Bolestraszyce);
- seedlings, appearing in large numbers, mainly in the vicinity of the mother plant, are very strongly drowned out and cannot survive without human help;
- the curators of the collections point out that some seedlings freeze and they require additional protection;
- some plant breeders indicate that seedlings are attacked by fungal diseases – then spraying with fungicides is necessary, biological mobility of the *Species*: low.

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

low	**X**
medium	
high	

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

acomm12. Comments:
Up to now no populations of the species have been found outside gardens in Poland. Therefore, human-mediated dispersal does not take the population already present in Poland, into new areas. Therefore, it is not possible to estimate “the frequency of transfer of seedlings or seeds at distances greater than 50 km”. If such events were to occur, their frequency should be described as "low". However, it is obvious that botanical gardens exchange seedlings and young specimens over long distances, albet in controlled conditions (A).

A4a | Impact on 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. 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 on the local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as a (near) extinction. Similarly, limited ecosystem change is considered as transient and easily reversible; severe change is considered as persistent and hardly reversible.

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

inapplicable	**X**
low	
medium	
high	

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

acomm13. Comments:
Plant species, non-parasitic.

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

low	**X**
medium	
high	

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

acomm14. Comments:

For now, the impact on native species through competition has not been found (A). However, it cannot be ruled out that the species occurring, for example, along a restored watercourse flowing through the botanical garden area, will with time appear in the neighborhood, in most suitable natural habitats , e.g. in riparian forests near watercourses. An example is the Arboretum in Przelewice (N). Restoration of the watercourse on which the *Species* is located has begun here. However, as the collection's curator recalls, water transport of seeds is still very difficult. It should be particularly emphasized that the Arboretum is located in the region of Poland, where the influence of the Atlantic climate is greatest. With time, it may turn out that the *Species* after escaping the Arboretum will become a competitor for some native species.

Assuming (completely theoretically) that the species spreads throughout Poland, it could, through competition, mainly for light and resources, influence native species in wet habitats. However, this impact would be weakened due to climatic conditions, e.g. too low humidity, spring frosts, and unfavourable winter temperatures.

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

no / very low	**X**
low	
medium	
high	
very high	

aconf11. Answer provided with a

low	medium	high
		X

level of confidence

acomm15. Comments:

In Poland, there are no native species of the genus *Lysichiton*, so there is no interbreeding in natural conditions.

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

very low	**X**
low	
medium	
high	
very high	

aconf12. Answer provided with a

low	medium	high
	X	

level of confidence

acomm16. Comments:

No data; curators of collections in the surveyed botanical gardens in Poland (N) notice that the *Lysichiton* is not usually attacked by pathogens, therefore its role in carrying them is negligible. In turn, some breeders mention (N) that the plant at the seedling stage is sometimes attacked by fungal diseases and requires spraying with fungicides; in this situation it is difficult to say whether it plays a role in the transmission of pathogens.

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

low	**X**
medium	
high	

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

acomm17. Comments:
Until now, no effect of the *Species* has been found on ecosystem integrity, by affecting its abiotic properties. On the assumption that the *Species* spread throughout Poland, in our climatic conditions its influence would be limited to the most boggy habitats. However, it does not seem so this could lead to any changes in abiotic factors.

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 **X**	medium	high	level of confidence

acomm18. Comments:
Until now, no effect of the *Species* has been found on biotic factors. On the assumption that the species spread in entire Poland, in our climatic conditions its influence would be limited to the most humid forests and in that habitat this impressive plant could displace native species, limiting the floristic diversity (CABI 2017).

A4b | Impact on cultivated plants domain

Questions from this module qualify the consequences of the *Species* on 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 plants targets through **herbivory or parasitism** is:

inapplicable	
very low	**X**
low	
medium	
high	
very high	

aconf15.	Answer provided with a	low	medium	high **X**	level of confidence

acomm19. Comments:
Plant species, non-parasitic. The chance for the *Species* to interfere with crops is practically zero.

a20. The effect of the *Species* on cultivated plants targets through **competition** is:

inapplicable	
very low	**X**
low	
medium	
high	
very high	

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

acomm20. Comments:
The *Species* has no effect on the cultivation of plants that are important from an economic point of view.

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

inapplicable	
no / very low	**X**
low	
medium	
high	
very high	

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

acomm21. Comments:
In Poland there are no crops related to the genus *Lysichiton*, so the *Species* has no effect on the cultivation of plants that are important from the economic point of view.

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

very low	**X**
low	
medium	
high	
very high	

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

acomm22. Comments:
The *Species* does not affect crop integrity.

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

very low	**X**
low	
medium	
high	
very high	

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

acomm23. Comments:
So far, no relevant data has been published.

A4c | Impact on 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	**X**
very low	
low	
medium	
high	
very high	

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

acomm24. Comments:
Plant species.

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

very low	**X**
low	
medium	

high	
very high	

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

acomm25. Comments:
Until now, the *Species* has not been found outside gardens, hence there is practically no chance of contact with farm animals. If this problem arises in future, for example in riparian habitats, it would be necessary to examine whether the high content of oxalates in the leaves of the *Lysichiton* will be harmful to animals.

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	**X**
very low	
low	
medium	
high	
very high	

aconf22.	Answer provided with a	low	medium	high	level of confidence

acomm26. Comments:
So far, no relevant data has been published.

A4d | Impact on 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	**X**
very low	
low	
medium	
high	
very high	

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

acomm27.	Comments: There is no such effect; this is a non-parasitic plant.

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

very low	**X**
low	
medium	
high	
very high	

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

acomm28.	Comments: So far, no relevant data has been published. Even if the *Species* spreads throughout Poland in future, is unlikely to pose any danger in direct contact with humans.

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

inapplicable	**X**
very low	
low	
medium	
high	
very high	

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

acomm29.	Comments: So far, no relevant data has been published.

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: So far, no relevant data has been published.

A5a | Impact on ecosystem services

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

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

significantly negative	
moderately negative	
neutral	**X**
moderately positive	
significantly positive	

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

acomm31.	Comments: Biology of the *Species* and its habitat requirements indicate that it has no influence on provisioning services, as: ensuring food, materials or energy (B).

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

significantly negative	
moderately negative	
neutral	**X**
moderately positive	
significantly positive	

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

acomm32.	Comments: The *Species*, on account of its rarity, biology and ecology (B) has no impact on the climate, regulation of composition of air, extreme phenomena, biological processes or soil. One should consider, whether possible more frequent occurrence could influence the process of water self-purification.

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

significantly negative	
moderately negative	
neutral	**X**

moderately positive	
significantly positive	

aconf29. Answer provided with a

low	medium	high
		X

level of confidence

acomm33. Comments:
The *Species*, in principle, does not influence cultural services: learning, education, spiritual or artistic sphere. Cultivation at a wider scales could influence the intrinsic appeal of the area (aesthetic functions).

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

Below, each of the Harmonia+ modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest to take into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes of atmospherical 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:
Assuming that in future temperatures will increase by 1-2°C, two scenarios should be considered:
- air humidity drops: the probability of introduction, establishment and spread of the *Species* will decrease;
- air humidity increases: the probability of introduction, establishment and spread of the *Species* may increase (however, this scenario seems less likely).

a35. ESTABLISHMENT – Due to climate change, the probability for the *Species* to overcome barriers that 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:
See acomm34 above.

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

decrease significantly	
decrease moderately	**X**
not change	
increase moderately	
increase significantly	

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

acomm36. Comments:
See acomm34 above.

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

decrease significantly	
decrease moderately	**X**
not change	
increase moderately	
increase significantly	

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

acomm37. Comments:
See acomm34 above.

a38. IMPACT ON 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	**X**
increase moderately	
increase significantly	

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

acomm38. Comments:
The *Species* is not affecting cultivation of plants and the predicted change of climate will not result in any change in this respect.

a39. IMPACT ON 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	**X**
increase moderately	
increase significantly	

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

acomm39. Comments:
The *Species* is not affecting domesticated animals and animal production and the predicted change of climate will not result in any change in this respect.

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

decrease significantly	
decrease moderately	
not change	**X**
increase moderately	
increase significantly	

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

acomm40. Comments:
The *Species* is not affecting human and the predicted change of climate will not result in any change in this respect.

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

decrease significantly	
decrease moderately	
not change	**X**
increase moderately	
increase significantly	

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

acomm41. Comments:
The *Species* is not affecting other domains in Poland and the predicted change of climate will not result in any change in this respect.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.17	1.0
Establishment (questions: a09-a10)	0.25	0.5
Spread (questions: a11-a12)	0.0	1.0
Environmental impact (questions: a13-a18)	0.1	0.6
Cultivated plants impact (questions: a19-a23)	0.0	1.0
Domesticated animals impact (questions: a24-a26)	0.0	0.5
Human impact (questions: a27-a29)	0.0	0.5
Other impact (questions: a30)	0.0	1.0
Invasion (questions: a06-a12)	0.14	0.83
Impact (questions: a13-a30)	0.1	0.72
Overall risk score	0.01	
Category of invasiveness	non invasive alien species	

A6 | Comments

This assessment is based on information available at the time of its completing. It has to be taken into account, however, that biological invasions are, by definition, very dynamic and unpredictable. This includes introductions of new alien species and detection of 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.

Below you can include your own comments on the assessment.

acomm42. Comments :

Lysychiton americanus has been classified as non invasive alien species in Poland. It has not been found in the wild in Poland and its importance for import and trade is restricted, thus the risk of its introduction in future is low. Its ability to spread is moderate and its habitats are very restricted, thus the risk of spread is also low. Also elsewhere in Europe its impacts have been recorded very rarely.

Data sources

1. Published results of scientific research (P)

Alberternst B, Nawrath S. 2002. *Lysichiton americanus* Hultén and St. John neu in Kontinental-Europa. Bestehen Chancen für die Bekämpfung in der Frühphase der Einbürgerung? Neobiota 1:91-99.

Klingenstein F, Alberternst B. 2010. NOBANIS – Invasive Alien Species Fact Sheet – *Lysichiton americanus*. – In: Online Database of the European Network on Invasive Alien Species - NOBANIS www.nobanis.org, 7.12.2017.

König A, Nawrath S. 1992. *Lysichiton americanus* Hultén & St. John (Araceae) im Hochtaunus. Botanik und Naturschutz in Hessen, 6:103-107.

Lid J, Lid DT. 1994. Norsk Flora. Det norske samlaget, Oslo.

Preston CD, Pearman DA, Dines TD. 2002. New Atlas of the British and Irish Flora. An Atlas of the Vascular Plants of Britain, Ireland, the Isle of Man and the Channel Islands. Oxford, UK: Oxford University Press, 928 pp.

Sanderson N. 2013. Research of the impact of American skunk cabbage *Lysichiton americanus* on native vegetation. Report commissioned by Hampshire & Isle of Wight Wildlife Trust on behalf of The New Forest Non-Native Plants Project.

Ze-Long N, Hang S, Heng L, Jun W. 2006. Intercontinental biogeography of subfamily Orontioideae (*Symplocarpus*, *Lysichiton*, and *Orontium*) of Araceae in eastern Asia and North America. Molecular Phylogenetics and Evolution 40: 155–165.

2. Databases (B)

Online Database of the European Network on Invasive Alien Species - NOBANIS www.nobanis.org, 7.12.2017.

CABI. 2017. Online Database: http://cabi.org/isc/datasheet/31580, 20.12.2017.

3. Unpublished data (N)

Oral and written information about the cultivation of the American skunk cabbage obtained from curators of the collection in botanical gardens and arboretums:
Bolestraszyce – Arboretum i Zakład Fizjografii,
Łódź – Miejski Ogród Botaniczny,
Mierzęcin – park pałacowy,
Poznań – Ogród Botaniczny Uniwersytetu Adama Mickiewicza,
Przelewice – Ogród Dendrologiczny,
Rogów – Arboretum SGGW,
Syców – Arboretum Leśne,
Warszawa-Powsin – Ogród Botaniczny PAN,
Warszawa – Ogród Botaniczny Uniwersytetu Warszawskiego,
Wrocław – Ogród Botaniczny Uniwersytetu Wrocławskiego,
Wojsławice – Arboretum, Filia Ogrodu Botanicznego Uniwersytetu Wrocławskiego.

Botanical gardens and arboreta in which the cultivation of the American skunk cabbage was not confirmed:
Bydgoszcz – Ogród Botaniczny Uniwersytetu Kazimierza Wielkiego,
Kielce – Geopark,
Koryciny, Podlaski Ogród Botaniczny,
Kórnik – Arboretum Instytutu Dendrologii PAN,
Kraków – Ogród Botaniczny Uniwersytetu Jagiellońskiego,
Lublin – Ogród Botaniczny Uniwersytetu Marii Curie-Skłodowskiej,
Marszewo – Arboretum Uniwersytetu Gdańskiego,
Mikołów – Śląski Ogród Botaniczny,
Olszyn-Kudypy – Leśne Arboretum Warmii i Mazur,
Poznań – Ogród Dendrologiczny Uniwersytetu Przyrodniczego,
Racibórz-Obora – Arboretum Bramy Morawskiej,
Zabrze – Miejski Ogród Botaniczny.

4. Other (I)

Websides:

1. http://plants.usda.gov/java/profile?symbol=LYAM3.

2. http://cabi.org/isc/datasheet/31580.

3. http://ias.biodiversity.be/species/show/13.

5. Author's own data (A)

Observations made by experts: Barbara Sudnik-Wójcikowska and Elżbieta Melon.