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. Teresa Nowak
2. Tadeusz Korniak
3. Czesław Hołdyński

acomm01. Comments:

| | degree | affiliation | assessment date |
|---|---|---|---|
| (1) | dr | Department of Botany and Nature Protection Faculty of Biology and Environmental Protection University of Silesia, Katowice | 02-05-2018 |
| (2) | prof. dr hab. | Department of Botany and Nature Protection Faculty of Biology and Biotechnology, University of Warmia and Mazury, Olsztyn | 16-04-2018 |
| (3) | prof. dr hab. | Department of Botany and Nature Protection Faculty of Biology and Biotechnology, University of Warmia and Mazury, Olsztyn | 20-04-2018 |

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

Polish name: Aster nowobelgijski

Latin name: ***Aster novi-belgii*** L.

English name: New York aster

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 name and its synonyms were given on the basis of the taxonomic database (The Plant List 2013 – B), the current valid name being *Symphyotrichum novi-belgii* (Go Botany 2018 – B, New York aster 2018 – I). The Polish name, along with the synonyms, was given for the Polish version of the study containing a critical list of vascular plants in Poland (Mirek et al 2002 – P). "New York aster" or "michaelmas-daisy" are common names in English (CABI 2018 – B, Flora of North America 2018 – I). Within the natural range (eastern part of North America), beyond the typical range, three varieties are distinguished (Flora of North America 2018 – I). The New York aster is known in Poland as a popular ornamental plant. In various sources you can find from a dozen to several hundred varieties on offer, and about 1000 have been bred (Polish Nurserymen Assotiation 2018, Royal Horticultural Society 2018, New York aster 2018 – I). Some varieties may escape from cultivation. Crossbreeding between the species and ornamental varieties is also likely. The taxonomic status of a species occurring in the natural environment is controversial. The species is very variable taxon, often confused with related species: *Aster novae-angliae* L., *A.* ×*salignus* Willd., *A. tradescanti* L. and *A. lanceolatus* Willd. (Wagenitz 1964, Rostański 1971, Nowak et al. 2009 – P). The need to conduct research in this area is to be emphasized. It has been proven that we can deal with a group of hybrids (Verloove 2014 – I). Some researchers describe them as the "Aster novi-belgii group" (Hetterscheid and van den Berg 1996 – P).

| | |
|---|---|
| Polish name (synonym I)<br>Aster wirginijski | Polish name (synonym II)<br>Marcinki wirginijskie |
| Latin name (synonym I)<br>*Symphyotrichum novi-belgii* | Latin name (synonym II)<br>– |
| English name (synonym I)<br>Confused Michaelmas-daisy | English name (synonym II)<br>Michaelmas-daisy |

**a03**. **Area** under assessment:

**Poland**

acomm03. Comments:

–

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

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

aconf01. Answer provided with a

| low | medium | high | level of confidence |
|---|---|---|---|
| | | **X** | |

acomm04. Comments:

The species has been included in the group of species of alien origin, established and invasive in the country (Tokarska-Guzik et al. 2012 – P, Projects of the General Directorate for Environmental Protection. 2018, Gatunki obce w Polsce – Alien species in Poland 2018 – I). It was brought to Poland in the mid-18th century from North America, as an ornamental plant for garden cultivation. However, it was soon established outside the gardens and now spreads in humid places: valleys and river banks (especially the Vistula and Oder), banks of reservoirs (Mirek and Pięknaoś-Mirkowa 1987, Żukowski et al. 1995, Ratyńska 2001 – P). It is often found on ruderal habitats such as: garbage dumps, near human dwellings, road wasteland and railway areas (e.g. Trzcińska-Tacik 1979 – P). Due to the large number of localities and the number of individual patches, as well as due to the rate of expansion, *Aster novi-belgii* has been included in category IV of invasive plant species, i.e. species whose occurrence in Poland is very important (Projects of the General Directorate for

Environmental Protection 2018 – I). It was recorded in 13 out of 42 surveyed Botanical Gardens or Arboretums. In two of them, the species spreads spontaneously, and in five, actions are taken to combat and / or to reduce its area (Employees of botanical gardens ... 2018 – N).

**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 |
| | the domesticated animals domain |
| | the human domain |
| | the other domains |

acomm05. Comments:

The New York aster as a perennial with clonal growth contributes primarily to the reduction of species diversity. It is characterized by high competitive abilities (life strategy type C – displacement of co-occurring species by occupying the area). In the course of increase in density of shoots in the population, it eliminates co-occurring species, which leads to the formation of patches built exclusively by this species (Hejda et al. 2009 – P, Branquart et al. 2010 – I). It produces allelopathic substances (chemicals secreted by plants or fungi or from their decomposition, which may adversely or positively affect co-species) which adversely affect and enhance the species' competitiveness effect (Feher 2008 – P). The species poses a threat to natural and semi-natural communities, especially when open habitats appear in colonized habitats, e.g. after periodic river floods (Nowak et al 2009 – P, Branquart et al. 2010, Invázne druhy 2018 – I). The presence of the species has been detected in protected areas (eg Bomanowska et al 2014, Rymon-Lipińska 2016, Kwiatkowski 2017 – P). Among endangered natural habitats, hydrophilous tall herb fringe communities of plains and of montane to alpine levels are mentioned – code 6430 (Tokarska-Guzik et al. 2012 – P) There is insufficient information on the impact on typical crops, however, the overgrowth of grasslands and meadows by New York aster has been observed, which may cause a reduction in the available space for this type of community and the decrease in the value of hay harvested from such sites (Nowak 1995-2016 – A). Another type of impact of the species, which, however, does not fall into any of the above categories, is the strengthening of river banks by its underground parts, thus preventing their erosion, and consequently reducing the risk of flooding, as well as creating meanders (Branquart et al. 2010 – I).

## A1 | Introduction

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

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

| | |
|---|---|
| | low |
| | medium |
| **X** | high |

aconf02. Answer provided with a

| low | medium | high | level of confidence |
|---|---|---|---|
| | | **X** | |

acomm06. Comments:

*Aster novi-belgii* is reported from countries neighbouring Poland, where it also achieves the status of an invasive species on a national or local scale, e.g. in Germany, the Czech Republic, Lithuania, Belgium, France, Austria (Wagenitz 1964, Kowanda and Kubat 2004 – P, Branquart et al. 2010, Projects of the General Directorate for Environmental Protection

2018, Invázne druhy 2018 – I, NOBANIS 2018 – B). When spreading the species may use both vegetative and generative diasporas (Jedlička and Prach 2006 – P). Therefore, its independent expansion and the enrichment of previously recorded populations is very likely. Particular migration of the species may take place in the border areas from Germany in the Oder valley (there may be bilateral migration). Movement of vegetative diasporas (fragments of rhizomes) can be supported by rivers, while the movement of generative diasporas (achenes) can be supported by wind (Rostański 1971, Kowanda and Kubot 2004, Nowak et al. 2009 – 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 is one of the plants that is introduced unintentionally by humans. Fragments of rhizomes and achenes (generative diasporas) are often moved along with the soil in which they occurred, for example, during road construction or other developments (Nowak 1995-2016 – A).

**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 and its numerous cultivars are used for ornamental purposes. It is commonly offered for sale in garden stores, shopping centres and through internet portals. A specific advantage of the New York aster is its relatively late flowering season in comparison with other ornamental perennials (August – November), thus it is very often found in garden compositions. It can be released into the natural environment from cultivation or breeding (nurseries propagating cuttings, centres obtaining new varieties) spontaneously or with inappropriate utilization of gardening waste (Nowak 1995-2016 – A). Ornamental varieties may go wild and crosbreed outside the garden (Nowak et al. 2009, Sudnik-Wójcikowska 2011 – P). Despite a publication published by the General Directorate for Environmental Protection, disseminating good practices in horticulture, which also describes the threats from the *Aster novi-belgii* in cultivation (Więsyk et al. 2016 – P), the response is still too weak. Its spread is also connected with the lack of systemic solutions for the disposal of gardening waste, e.g. in garden plots in cities (Nowak 1995 – 2016 – 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 |
| | sub-optimal |
| **X** | optimal for establishment of *the species* |

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

acomm09. Comments:

The climate of Poland is very similar to the climate of the natural occurrence of the species in eastern North America (Canada and the USA) (Flora of North America 2018 – I). Against the background of the species' occurrence in Europe (Meusel et al. 1992 – P) – from Italy to Scandinavia, Great Britain and France – the area of Poland seems to be the most optimal. The species is hardy; it tolerates the temperature of -25°C (New York aster 2018 – I). A certain limitation may be the lower air humidity in the eastern part of our country.

**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 natural range, the species occurs on wet meadows and thickets (Plants of southern New Yersey 2018 – I) but also on anthropogenic habitats such as escarpments and roadsides (Weldy et al. 2018 – I). In its secondary range, New York aster can form small patches on open, moderately disturbed and shady habitats (Booth et al 2010 – P). In Poland, the habitat conditions are optimal for the species. The species prefers fertile, permeable, moderately moist to moist soils. It grows best in well-lit or semi-shaded positions. In Poland, the most favourable habitat conditions prevail in the Vistula and Oder valleys and their tributaries (Nowak et al. 2009 – P). Apart from river valleys, it is found on lake shores and other water reservoirs, also meadows; in the habitat range of the species there are also former agricultural land, ruderal habitats, both in urban areas and beyond, for example, wastelands, fallow, rubbish tips, roadsides, railway areas, etc. (e.g. Rostański 1971, Kowanda and Kubot 2004, Witosławski 2006, Nobis 2007, Żarnowiec et al. 2010, Denisow et al. 2017 – P).

## A3 | Spread

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

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

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

| | |
|---|---|
| | very low |
| | low |
| **X** | medium |
| | high |
| | very high |

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

acomm11. Comments:

After analyzing the available information, the ability of the species to spread without human participation based on population expansion (type B data) has been assessed. A comparison was made between studies carried out at different times in the same research squares (Nowak 1999, Nowak et al. 2011 – P) and it was found that previously recorded populations could have spread to a maximum distance of 4 km, which transltes to about 400m/year, which determines the ability of the species to spread without human participation as "medium".

In studies on local vascular floras, the species is described as occurring at different frequencies depending on the region and the frequency scale adopted. There are areas where it is treated as an unstable element of the flora (e.g. Paul 2013 – P). Usually, however, there is no specific data on the rate of spread of the species. It appears to depend on habitat conditions, e.g., in a meadow community, about 20 cm per year (Nowak et al 2009 – P). The species produces a large number of small achenes, with pappus (Rostański 1971 – P). These fruits can be spread over long distances by wind (anemochory), animals (epizoochory), as well as by water (hydrochory) (Jedlicka and Prach 2006, Nowak et al. 2009 – P).

Analyzing the map of the species distribution in Poland prepared for the needs of the present study in relation to the date of the first analysis, it can be concluded that the establishment phase lasted for a very long time. An additional difficulty in estimating the ability of the species to spread is the probability of human participation in its spread. Some researchers have rated the species in terms of dynamics. In the study on *Aster novi-belgii* from Greater Poland it was defined as a "species with balanced dynamics" (Czarna 2009 – P). Most likely, the rate of expansion depends on the conditions in which the species occurs, that is, on the type of substrate and vegetation. In the case of clonal plants, in nutritionally heterogeneous habitats, genets can be split off, but they are much smaller than in habitats with a constant content of nutrients (Booth et al 2010 – P). Open areas are much faster settled than those already occupied (Nowak 1995-2016 – A). Assuming that the plant uses both vegetative and generative methods of breeding, it can be assumed that it will cover several kilometres within a year. Jedliczka and Prach (2009 – P) provide information on the production of up to 10,000 achenes by a single plant, which sometimes germinate all at once. In Belgium, on the other hand, the plant probably does not produce viable achenes and reproduces almost exclusively vegetatively (Branquart et al. 2010, Verloove 2014a – I). There is no confirmed, up-to-date data on the participation in the propagation of generative New York aster reproduction occurring in the natural environment, outside cultivation.

**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 | level of confidence |
|---|---|---|---|
| | | **X** | |

acomm12. Comments:

The species is often offered as an ornamental plant (eg, Byliny. Dąbrowscy 2018 – I, Korniak 2005-2017 – A) and this is the main method by which it spreads with the participation of man. The popularity of the plant suggests a high frequency. The exchange of seedlings of varieties is also one of the ways of moving the species (Nowak 1995-2016 – A). Very often, overgrown or less attractive clusters of plants are removed to places outside the gardens where they settle periodically in ruderal habitats. There is no detailed data on the frequency of movement of the species with an unconscious human participation over a distance greater than 50 km.

However, taking into account the numerous construction work currently carried out in Poland (which may contribute to spread of the species rhizomes with the soil), and the exchange of plants between amateur gardeners, the assessment of "high" frequency with which the species spreads with human participation is justified.

## A4a | Impact on the environmental domain

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

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

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

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

- [X] inapplicable
- [ ] low
- [ ] medium
- [ ] high

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

acomm13. Comments:

The species is a plant, it does not affect native species through predation, parasitism and 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:

New York aster, as a perennial herb with clonal growth, contributes primarily to the reduction of species diversity. In the course of the increase of density of shoots in the population, it eliminates co-occurring species, which leads to the formation of patches built exclusively by this species (Hejda et al. 2009 – P, Branquart et al 2010 – I). The allelopathic substances produced strengthen the competitive effect of the species (Feher 2008 – P). The species is described as present in protected areas (e.g. Piotrowska et al 1997, Żukowski et al 1995, Bomanowska et al 2014, Rymon-Lipińska 2016, Kwiatkowski 2017 – P). Among endangered natural habitats, hydrophilous tall herb fringe communities of plains and of montane to alpine levels have been mentioned – code 6430 (Tokarska-Guzik et al. 2012 – 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:

So far, there is no data on the crossbreeding of the *Aster novi-belgii* with native species. On the other hand, the hybrid of the species is confirmed with *Aster lanceolatus Willd*. (Wagenitz 1964, Rostański 1971 – P), which is also foreign and is also established in Poland. In gardens, hybrids are also formed with the more bushy *Aster dumosus* L. (Rostański 1971 – P). It is possible to crossbreed between numerous breeding varieties of the species (cultivars). So far, the ecological effects of this process are unknown.

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

| | |
|---|---|
| | very low |
| | low |
| **X** | medium |
| | high |
| | very high |

aconf12. Answer provided with a

| low | medium | high |
|---|---|---|
| | | **X** |

level of confidence

acomm16. Comments:

12 species of pathogens / parasites have been identified that can be transmitted by the species which affect or potentially affect native plant species. However, all are of little importance for the species itself (EPPO 2018 – B). These are insects, fungi, bacteria and viruses that cause diseases. They are usually found on representatives of the *Asteraceae* family but mostly on species from a dozen to several dozen botanical families.

The list includes the following viruses:
- Beet curly top virus – not reported in Poland (Beet curly top virus 2018 – B);
- Potato yellow dwarf nucleorhabdovirus – a species included on the EPPO A1 list; it does not exist in EU countries (Potato yellow dwarf nucleorhabdovirus 2018 – I);
- Tomato spotted wilt orthotospovirus – species included in the EPPO A2 list; no data on its occurrence in Poland (EPPO 2018 – B).

The list includes the following bacteria:
- *Phytoplasma solani* – species included on the EPPO A1 list; only related species have been found in Poland (Fránová et al. 2014 – P);

The list includes the following fungi:
- *Plasmopara halstedii* – previously listed in Poland, currently not found (*Plasmopara halstedii* (downy mildew of sunflower 2018 – B);
- *Golovinomyces cichoracearum* (powdery mildew) – occurs on numerous wild species from the Asteraceae family, e.g. yarrow, dandelion, daisy, and also on cultivated plants (Powdery mildew 2018 – I);
- *Botrys cinerea* (Noble rot) – attacks strawberries, sunflower, dahlias, roses (no information whether it can also attack wild native rose species);

Insects are the most numerous group:
- *Bemisia tabaci* – species included in the EPPO A2 list; occurs in EU countries (*Bemisia tabaci* 2018 – I);
- *Liriomyza trifolii* – species included in the EPPO A2 list; listed in Poland in the past, currently not found here (*Liriomyza trifolii* (American serpentine leafminer 2018 – B);
- *Liriomyza sativae* – *Liriomyza maculosa*;
- *Nemorimyza maculosa* – species included on the EPPO A1 list; species not listed in Poland (Chrysanthemum leaf miner (*Nemorimyza maculosa*) 2018 – B);
- *Margarodes vitis* – species not listed in Poland (*Margarodes vitis* 2018 – B.

Most of the above-mentioned species have not been registered as present in Poland. Only *Bemisia tabaci* (EPPO A2) can be counted among the most important ones, for which *Aster novi-belgii* may be a vector. However, it cannot be ruled out that the others will be registered here in the future.

The species can also be attacked by aphids and snails (New York aster 2018 – I).

**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:

Allelopathic compounds certainly (Feher 2008 – P) bring about the disturbance of abiotic factors. In addition, the overgrowing of the substrate by rhizomes, the shading of the surface of the substrate and the retention of necrotic tissues after the end of the growing season are among the most important disturbing factors, which are all however reversible (Nowak 1995-2016 – A).

**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:

As a result of its expansion, the species completely rebuilds phytocoenoses (Hejda et al 2009 – P), and thus largely disturbs biotic factors in the relevant habitats. Due to its time of flowering, the food availability period for pollinators is changed (Nowak 1995-2016 – A). This is potentially particularly dangerous in protected areas (Nowak et al 2009 – P, Branquart et al. 2010, Projects of the General Directorate for Environmental Protection 2018, Foreign species in Poland 2018, Invázne druhy 2018 – I) where negative impact on Natura 2000 habitats and threat to native species (including protected by law) can be observed. The species also spreads on ruderal habitats, as well as on meadows and post-agricultural wasteland, which it can come to dominate together with the goldenrods *Solidago* spp., creating essentially bi-species clusters (Projects of the General Directorate for Environmental Protection 2018 – I).

## 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:<br>The species is a plant, also it has no parasitic properties. |

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

| | |
|---|---|
| | inapplicable |
| | very low |
| **X** | low |
| | medium |
| | high |
| | very high |

| | | | | | |
|---|---|---|---|---|---|
| aconf16. | Answer provided with a | low | medium<br>**X** | high | level of confidence |

| | |
|---|---|
| acomm20. | Comments:<br>In crops of useful plants (agricultural, horticultural) on arable land the probability of the occurrence and competition with this species is very low with a small chance of it becoming a permanent occurrence. This also applies to permanent grasslands (meadows, pastures) with intensive management. In the case of the occurrence of the species on extensively used grasslands, the phenomenon of species expansion occurs at the expense of native species (Nowak 1995-2015). As a result, the species will hinder agrotechnical operations and contribute to the decline in the quality and productivity of such grassland. Low likelihood x medium effect. |

**a21**. The effect of *the species* on cultivated plant 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<br>**X** | high | level of confidence |

| | |
|---|---|
| acomm21. | Comments:<br>In gardens it creates hybrids with the cultivated decorative *Aster dumosus* L. (Rostański 1971 – P). However, there is no detailed data on the extent of the effects of this process. medium probability x effect is small. |

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

| | |
|---|---|
| | very low |
| **X** | low |
| | medium |
| | high |
| | very high |

| | | | | | |
|---|---|---|---|---|---|
| aconf18. | Answer provided with a | low | medium | high<br>**X** | level of confidence |

| | |
|---|---|
| acomm22. | Comments:<br>New York aster can penetrate into meadows or grasslands from adjacent riverside communities or even anthropogenic communities such as roadsides, which disrupts the integrity of this type of agricultural development area. Displacing native species causes soil moisture changes and disorders of the trophic network of meadow agrophytocoenoses. |

| | |
|---|---|
| | There is no more data in this respect, the assessment was based on own observations (Nowak 1995-2016 – A). Low likelihood x medium effect. |

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

| | |
|---|---|
| | very low |
| | low |
| **X** | medium |
| | high |
| | very high |

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

| | |
|---|---|
| acomm23. | Comments:<br>The species may be the host of powdery mildew (*Golavinomyces cichoracearum*) and Noble rot (*Botrys cinerea*). The first fungus can infest ordinary sunflower crops, and the second one also attacks sunflower, as well as strawberries, dahlias and roses (Foreign species in Poland 2018 – I). The species can also be a vector for aphids and snails (Weldy et al. 2018 – I). The list of identified pathogens for *Aster novi-belgii* (EPPO 2018 – B) is given in section a16. |

## 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:<br>New York aster has no parasitic properties. |

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

| | |
|---|---|
| **X** | very low |
| | low |
| | medium |
| | high |
| | very high |

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

| | |
|---|---|
| acomm25. | Comments:<br>So far, there is no evidence of a negative impact of the species on animals during direct contact. |

**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 plant species is neither a host, nor does it carry pathogens and parasites that are harmful to 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 has no parasitic properties.

**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:

No information was found about the properties of *Aster novi-belgii*, which could be dangerous during direct contact.

**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:<br>The species has no effect on 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:

| | |
|---|---|
| **X** | very low |
| | low |
| | medium |
| | high |
| | very high |

| | | | | | |
|---|---|---|---|---|---|
| aconf26. | Answer provided with a | low | medium | high<br>**X** | level of confidence |

| | |
|---|---|
| acomm30. | Comments:<br>No information on the harmful impact of the species on infrastructure. |

## 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 |
| **X** | moderately negative |
| | neutral |
| | moderately positive |
| | significantly positive |

| | | | | | |
|---|---|---|---|---|---|
| aconf27. | Answer provided with a | low | medium<br>**X** | high | level of confidence |

| | |
|---|---|
| acomm31. | Comments:<br>The massive appearance of the species may affect the quantity and quality of hay harvested from meadows and grasslands (Nowak 1995-2016 – A). As a positive impact on supply services, the melliferous potential of plants supplying food to insects in autumn should be mentioned (e.g., Sadowniczy.pl 2018 – I, Korniak 2005-2017 – A). |

**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:

As an aspect of regulatory services, its role in reducing flood risk as a result of its method of growth and its construction of underground bodies that stabilize river banks (Branquart et al. 2010 – I) can be mentioned.

**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:

On one hand, the New York aster has positive effect on cultural services, increasing the aesthetic values of the landscape during flowering, especially on ruderal habitats. However, on the other hand, after a period of vegetation, the necrosic remains in the form of hard shoots lowers these values and makes it difficult to navigate around such areas (Nowak 1995-2016 – A).

## 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 already established and present almost everywhere in Poland (Tokarska-Guzik et al. 2012 – P). More appropriate climatic conditions, especially longer and warmer autumn, will allow for the production of more mature seeds (achenes) (Jedlicka and Prach 2006 – P).

**a35**. ESTABLISHMENT – Due to climate change, the probability for *the species* to overcome barriers that have prevented its survival and reproduction in Poland will:

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

| | | | | | |
|---|---|---|---|---|---|
| aconf31. | Answer provided with a | low | medium | high **X** | level of confidence |

acomm35. Comments:

The species is established in Poland (Tokarska-Guzik and in 2012 – P) and has a relatively wide range of climate tolerance. Thus, increasing the temperature by 1-2$^{o}$C will not affect the process of 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 |
| | decrease moderately |
| | not change |
| **X** | increase moderately |
| | increase significantly |

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

acomm36. Comments:

Assuming a slight increase in temperature, it can be assumed that the growing season will be longer and the species may increase the proportion of generative propagation in its spread. There are no tests confirming this thesis. This problem should be analyzed comprehensively. The results of modelling carried out for Germany often indicate the potential withdrawal of some other species (Pompe et al 2008 – 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 |
| | decrease moderately |
| | not change |
| **X** | increase moderately |
| | increase significantly |

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

acomm37. Comments:

Assuming that there will be a larger New York aster population (see point a36), there may be a moderate increase in the impact of the species on the natural environment. This will probably translate into an increase in the competitiveness of *Aster novi-belgii* relative to native plant species.

**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 |

| | |
|---|---|
| **X** | increase moderately |
| | increase significantly |

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

acomm38. Comments:

To date, the species has not posed a threat to cereal and root crops. However, it appears more and more often in meadows and pastures. A higher production of seeds (achenes) with more favourable climatic conditions may result in a faster overgrowing of new areas, and thus contribute to lower productivity of affected grassland.

**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 | high **X** | level of confidence |

acomm39. Comments:

The species has no impact on animal husbandry (see points a24 – a26). Thus, the impact of climate change will not contribute to changing the impact in the examined range.

**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:

The species has no impact on humans (see points a27 – a29). Thus, the impact of climate change will not contribute to changing the impact in the examined range.

**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 | high **X** | level of confidence |

acomm41. Comments:

There is no information on the harmful effects of the species on infrastructure. Thus, climate change should not affect changes in this area.

## Summary

| Module | Score | Confidence |
|---|---|---|
| Introduction (questions: a06-a08) | 1.00 | 1.00 |
| Establishment (questions: a09-a10) | 1.00 | 1.00 |
| Spread (questions: a11-a12) | 0.75 | 1.00 |
| Environmental impact (questions: a13-a18) | 0.60 | 1.00 |
| Cultivated plants impact (questions: a19-a23) | 0.25 | 0.80 |
| 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) | 0.92 | 1.00 |
| Impact (questions: a13-a30) | 0.60 | 0.96 |
| Overall risk score | 0.55 | |
| 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:

The obtained result allows to classify the analyzed species as a member of the group of "medium invasive alien species" (the negative effect has reached the value of 0.60). The New York aster received the highest marks – 1 – in the modules 'Introduction' (questions: a06-a08) and 'Establishment' (questions: a09-a10). An average value was obtained in the module 'Impact on the natural environment' (questions: a13-a18) – 0.60. However, in the 'Spread' module (questions: a11-a12), the species obtained a relatively high score of 0.75. At the same time, there was no impact – result 0 – in the modules 'Influence on animal husbandry' (questions: a24-a26), 'Impact on people' (questions: a27-a29) and 'Impact on other objects'. A relatively small impact was demonstrated in the module 'Impact on crops' (questions: a19-a23) – 0.25. Almost all grades have been given with a high degree of certainty.

New York aster is a species requires more detailed research on its biology in Poland. Data concerning its deployment also needs to be supplemented. However, already on the maps prepared so far (Zając and Zając 2015 – P, the map prepared as part of this study), there is a clear relationship between the species occurrence and river valleys and urbanized (disturbed) areas. It seems that the result of the assessment is adequate for the assessment of the actual threat from the species. In the earlier assessment of the degree of threat (Tokarska-Guzik et al. 2012 – P) the New York aster was classified as a "species which occurrence in Poland is very important – both a large number of positions and a large number of individuals in the populations are known; the majority are still increasing the number of positions or the area occupied." However, it was analyzed as a invasive species in some regions of Poland. Undoubtedly, the greatest attention should be directed to its population dynamics within protected areas, and actions should be taken to remove it. The

second, key element in the treatment of the species in question is control in the area of horticulture activities and drawing attention to the desirability that plants from cultivation and breeding should not get into the natural environment.

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

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