



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. Agnieszka Kolada
2. Maciej Gąbka – external expert
3. Alina Urbisz

acomment01.	Comments:	degree	affiliation	assessment date
(1)	dr hab.	Department of Freshwater Protection, Institute of Environmental Protection, National Research Institute	25-01-2018	
(2)	dr hab.	independent expert	10-05-2018	
(3)	dr hab.	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	10-05-2018	

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

Polish name: Moczarka kanadyjska
Latin name: ***Elodea canadensis*** Michx.
English name: Canadian waterweed

acommm02.

Comments:

The universally accepted name is *E. canadensis* Michx. (The Plant List 2013 – B). Historically, there has been much confusion in the classification of the species of the genus *Elodea*, but in the 1980s Cook and Urmi-Konig (1985 – P), in the latest revision of the genus, recognised five species of *Elodea*, including *E. canadensis*.

Latin synonyms (Josefsson 2011, CABI 2018 – B): *Anacharis canadensis* (Michx.) Planch., *Anacharis alsinastrum* Bab., *Elodea ioensis* Wylie, *Elodea planchonii* Casp., *Elodea brandegeae* St. John, *Elodea latifolia* Caspa, *Udora canadensis* (Michx) Nutt.

Polish name: moczarka kanadyjska (Mirek et al. 2002).

English name: Canadian waterweed; other names: Canadian elodea, American duckweed, common elodea, ditch weed, waterweed

Polish name (synonym I)

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Polish name (synonym II)

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Latin name (synonym I)

Anacharis canadensis

Latin name (synonym II)

Elodea brandegeae

English name (synonym I)

Canadian pond weed

English name (synonym II)

Waterweed

a03. Area under assessment:

Poland

acommm03.

Comments:

–

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

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

aconf01.

Answer provided with a

low

medium

high

X

level of confidence

acommm04.

Comments:

E. canadensis is an aquatic vascular monocotyledonous plant from the family Hydrocharitaceae, sometimes grown in aquariums and garden ponds. It is native to North America, and occurred in Europe in the first half of the 19th century. Accidentally introduced and established in most regions of Europe, India and Australia, it has become a typical example of an ‘escapee’ from botanical gardens. *E. canadensis* was first reported in Europe in 1836 from Great Britain (Moore and More 1866, quoted after Simpson 1984 – P), and since then the species has spread very rapidly and formed populations in flowing and standing waters in most European countries. Currently, it is one of the most common alien species in European waters (Hilt and Gross 2008, Hussner et al. 2010 – P), reported from 41 European countries (Hussner 2012 – P).

In Poland, *Elodea canadensis* was first reported in 1866 and 1867 from the region of the lower Oder river and Gdańsk (Abromeit et al. 1898, quoted after Kucharski 1992, Tokarska-Guzik 2005 – P), and in 1872 it was found near Kraków (Raciborski after Gawłowska 1983 – P). Since then, the species has spread throughout the whole country (with the exception of mountain areas), colonizing all types of surface waters (Zajęc and Zajęc 2001, Tokarska-Guzik 2005 – P). Since the beginning of the 1950s, *Elodea canadensis* has been a permanent component of aquatic flora in Poland (Kornaś and Medwecka-Kornaś 1957, Bernatowicz 1960, Rejewski 1984, Zajęc and Zajęc 2001, Kłosowski 2006, Jabłońska and Kłosowski 2015, Zajęc and Zajęc 2015 – P) and now it is regarded as an established species in Poland.

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

<input checked="" type="checkbox"/>	the environmental domain
<input type="checkbox"/>	the cultivated plants domain
<input type="checkbox"/>	the domesticated animals domain
<input type="checkbox"/>	the human domain
<input checked="" type="checkbox"/>	the other domains

acom05.

Comments:

E. canadensis is an aquatic plant species (hydrophyte) occurring in natural and man-made water bodies, both running and standing, i.e., lakes, ponds, old river beds, water-filled exploitation hollows, slow and fast moving rivers and canals. It also grows in coastal lakes and sea bays. Because of its abundant growth, it can affect local populations of aquatic plants and animals, although the behaviour of *E. canadensis* in the waters of various areas of Europe is not the same (Mjelde et al. 2014 – P). For example, in Germany, France and Norway the replacement of native aquatic plants due to the abundant growth of *E. canadensis* has been reported (Thiébaud 2005, Hilt and Gross 2008, Hussner 2012, Mjelde et al. 2012, Zehnsdorf et al. 2015 – P), while in other countries, in Italy or Slovenia, the species remains non-aggressive, and has no negative impact on native flora (Greulich and Trémoières 2006, Kuhar et al. 2010, Mjelde et al. 2014 – P). The non-aggressive behaviour of *E. canadensis* was also reported in Polish lakes (Kolada and Kutyla 2016 – P). In slow-moving waters, however, such as canals or drainage ditches, *E. canadensis* can locally create large populations, which can cause real problems and the need for maintenance work. The abundant growth of this plant may also create difficulties in the recreational use of lakes and rivers, as well as reduce the aesthetic value of water bodies. It can also create problems for the fishing industry in fishponds because of abundant growth and its secondary effects, such as limitation of space or excessive water oxygenation.

A1 | Introduction

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

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

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

aconf02.

Answer provided with a

low	medium	high X
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level of confidence

acom06.

Comments:

E. canadensis is an aquatic plant species. It spreads primarily through fragment stems and winter turions (short stem fragments with dormant winter buds resistant to low temperatures) floating in water along the watercourses. The hydrological parameters of the river network have a significant impact on the rate of spread of the species, and hydrological connectivity facilitates the colonization of watercourses (including tributaries and neighbouring waters), while more isolated ecosystems are less susceptible to invasion. Fragments of plants can also be locally dispersed by aquatic animals, mammals, fish and birds.

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:
The species occurs in countries neighbouring Poland (Germany, the Czech Republic, Slovakia) (Hussner 2012 – P, EPPO 2015, CABI 2018 – B). Propagules of *E. canadensis* (fragments of plants) could have been (and still may be) unintentionally introduced into Poland, e.g., on watercraft and fishing equipment.

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:
E. canadensis is a typical example of an ‘escapee’ from botanical gardens. The species has been grown in many botanical gardens in Europe, including in Poland. For example, in Finland it was intentionally introduced to the Botanical Garden of the University of Helsinki (Hintikka 1917 – P), and from there it spread and was accidentally introduced in other regions of the country by birds and further by water currents. *E. canadensis* is also a common and popular plant grown in aquariums (cold-water aquariums) and in garden ponds. It is also commercially available, but rather rare on the market (it is often acquired from natural sites). Information obtained from a survey carried out in Arboreta and Botanical Gardens in Poland have shown that *E. canadensis* is cultivated or present in nine of them, throughout the territory of the whole of Poland (Employees of botanical garden ... 2018 – N). The oldest specimens date back to before 1945, and the last reports are from the 2000s.

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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acomment09. Comments:
The species is native to North America, where it grows in a relatively wide range of climate conditions, from Alaska to Puerto Rico (CABI 2018 – B). *E. canadensis* prefers a moderately warm or continental climate, but *Elodea* species are known for their high adaptability to a wide spectrum of climate (Greulich and Trémolieres 2006 – P, Josefsson 2011 – B, Riis et al. 2012, Zhang et al. 2015 – P). According to the global map showing areas of climate similarity, prepared by modelling with an emphasis on Mahalanobis distances, climate

conditions in Poland have 100% similarity with those in the natural range of *E. canadensis* (CABI 2018 – B). A literature review indicates that the climate in Poland ranges from sub-optimal to optimal for *E. canadensis*. Studies by Kolada and Kutyla (2016 – P) carried out in Poland indicate a shift in the habitat preferences of this species towards waters with lower seasonal temperatures and harsher climate than commonly believed. Some authors also point to the attachment of this plant to waters with lower temperatures than in the habitats of other *Elodea* species, Nuttall’s waterweed *E. nuttallii* and *E. ernstiae* (*E. callitrichoides*, syn. *E. ernstiae*) (Greulich and Trémolieres 2006 – P), which may suggest negative effects of global warming on the further spread and development of the species population, and may to a certain extent explain the inhibition of species invasion, and even its slow decline, reported from many countries (Mjelde et al. 2012, Hussner 2012 – P).

a10. Poland provides **habitat** that is

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

aconf06. Answer provided with a

low	medium	high
		X

 level of confidence

acommm10. Comments:
E. canadensis is regarded as a species with a broad ecological amplitude, and it grows in waters ranging from meso- to eutrophic, fresh as well as brackish, flowing and standing (Pokorny et al. 1984, Madsen et al. 1991, Thiébaud 2005, Kolada and Kutyla 2016, Cegłowska et al. 2017 – P). In Poland, it grows in all types of water bodies in lowlands and lower mountain regions. It is found in waters of neutral to alkaline pH, moderately rich in minerals, generally clear, or very clear (the species has a relatively high demand for light); it prefers sites with standing and relatively slow moving water, without strong turbulence or exposure to tidal movements; it prefers a substrate with coarser grain size, sand, sand with gravel, without a significant proportion of fine fractions and organic muds (Kolada and Kutyla 2016, Cegłowska et al. 2017 – P). In the last decade, *E. canadensis* in Poland has most frequently been found in fast-moving lowland rivers, clear-water oxbow lakes and fish ponds. It is less common in mesotrophic and eutrophic lakes.

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

 level of confidence

acommm11. Comments:
 Dispersal from a single source (Data type A):
 The capacity of *Elodea canadensis* to disperse without human assistance is very high: more than 50 km per year.

E. canadensis is a dioecious aquatic plant reproducing mostly asexually through fragments of stems. Sexual reproduction in the native regions of the species (North America) is rarely observed, and in Europe there are only female specimens, so sexual reproduction is impossible (CABI 2018 – B). Floating fragments of stems and winter turions of this species are dispersed by water currents along watercourses. Dispersal of vegetative fragments of plants by river currents, connectivity with canals in river valleys and the natural dynamics of the main river (flood) are the basic factors facilitating the colonization of new areas by this species (Tokarska-Guzik et al. 2015 – B). Therefore, running waters are usually at higher risk of spontaneous invasion than lakes, especially those, which are more isolated, or located on the outskirts of a catchment area. Fragments of plants can also be locally dispersed by aquatic animals, mammals, fish and birds.

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
				<input checked="" type="checkbox"/>	

acomment12. Comments:
 Dispersal of the species with human assistance is usually unintentional and accidental, and results, for example, from the transport of plant fragments by watercraft, or repair works at ports, maintenance works of navigation canals and other watercourses (authors' own observations). Other important local vectors of dispersal are anglers and fishermen. This species is relatively rarely offered on the market, and expansion from this source is rather local.

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

acomment13. Comments:
Elodea canadensis is an aquatic plant and has no effect through predation, parasitism or herbivory.

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 X	level of confidence
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acom14. Comments:
E. canadensis can form dense monocultures, often occupying the whole or a part of the water column. Abundant populations of *E. canadensis* have a negative effect on other aquatic plant species through competition for light and nutrients, and this can lead to the replacement of native species and loss of species diversity of aquatic flora. However, in Poland and other countries (CABI 2018 – B) abundant growth of *E. canadensis* is mainly observed in small watercourses, drainage channels and small ponds. In larger water bodies abundant growth is not observed, and *E. canadensis* tends to integrate into natural plant communities as an additional, non-aggressive element of flora.
E. canadensis is a pioneer species, rapidly colonizing new areas; however, it is often later replaced by other more aggressive species, such as *Elodea nuttallii*. *E. nuttallii* is characterized by faster growth and greater ability to regenerate from fragments of stems compared to *E. canadensis*, which it effectively replaces (Barrat-Segretain et al. 2002 – P). Currently, the regression of *E. canadensis* and its replacement on a large scale by other alien species, mainly *E. nuttallii*, less often by the African elodea *Lagarosiphon major* (National Biodiversity Data Centre 2009 – B), has been observed in many European countries (Simpson 1990, Thiebaut et al. 1997, Barrat-Segretain 2001, Larson 2007 – P).

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

<input checked="" type="checkbox"/>	no / very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf11.	Answer provided with a	low	medium	high X	level of confidence
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acom15. Comments:
E. canadensis is a dioecious aquatic plant reproducing mostly asexually through fragments of stems. Sexual reproduction in the native regions of the species (North America) is rarely observed, and in Europe there are only female specimens, so sexual reproduction is impossible (CABI 2018 – B). In addition, in Poland and other European countries there are no native species from the genus *Elodea* with which *E. canadensis* could interbreed. There are no reports on the possibility of interbreeding with native species, although there are some reports on the interbreeding of *E. canadensis* with *E. nuttallii* (Josefsson 2011 – B).

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 X	high	level of confidence
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acom16. Comments:
The hosting of pathogens or parasites by *E. canadensis* has not been reported.

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	

acomment17. Comments:
 Abundant growth of the species in standing water bodies can significantly limit access of other plant species to light, and limit or block water movement. Sudden breakdowns of *Elodea* populations, observed every few years, for example in Sweden (Sand-Jensen 2000 – P), and associated with this decay of large amounts of biomass, release significant amounts of biogenic substances and organic matter into the environment, causing oxygen depletion and a decrease in pH, which promotes greater eutrophication. However, abundant populations of *E. canadensis* are formed in small water bodies and are not common, so the risk from such phenomena is low.

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	

acomment18. Comments:
E. canadensis is a well-established species in Poland, and at the current stage of expansion, it has a moderate effect on biotic properties. The species sometimes forms dense monocultures, especially in lowland rivers and shallow standing waters, i.e. old riverbeds and fish ponds, often occupying the whole or a part of the water column, outcompeting native species and contributing to the loss of species diversity of aquatic flora. The negative effect of *E. canadensis* on the populations of native plant species in mesotrophic lakes is rare. *E. canadensis* should be regarded as a species having a positive effect on the populations of aquatic animals, i.e., fish, zooplankton and benthic macroinvertebrates (review of this problem in Simpson and Duenas 2011 – B, and Erhard et al. 2007, Schulz and Dibble 2012 – P). *E. canadensis* is an important species providing shelter for macrozoobenthos in running waters.

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

aconf15. Answer provided with a

low	medium	high X
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 level of confidence

acomm19. Comments:
E. canadensis is an aquatic non-parasitic plant species.

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:
E. canadensis grows in water and does not interact with cultivated plants.

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:
E. canadensis grows in water and does not interact with cultivated plants. In Europe, only female individuals have been found, so the plant reproduces only asexually from small fragments of rooted stems (Cook and Urmi-König 1985 – P), and therefore interbreeding with related species is impossible. However, interbreeding of *E. canadensis* with *E. nuttallii* has been reported (Josefsson 2011 – B).

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:
E. canadensis grows in water and does not interact with cultivated plants. Locally abundant populations of *E. canadensis* in drainage channels may affect pastures and meadows by slowing down water flow and eventually blocking irrigation channels. However, these problems are much more likely to be caused by *Elodea nuttallii* (which is a clearly expansive species) rather than *E. canadensis* (which is generally in decline throughout Europe).

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
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 level of confidence **X**

acomment23. Comments:
The transmission of pathogens or parasites that are harmful to plants or animals by *E. canadensis* has not been reported.

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

acomment24. Comments:
E. canadensis is an aquatic non-parasitic 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
- low
- medium
- high
- very high

aconf21. Answer provided with a

low	medium	high
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 level of confidence **X**

acomment25. Comments:
The species has no properties that are hazardous to animals upon 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:

- 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:
E. canadensis is not a host or vector of animal pathogens/parasites.

A4d | Impact on the human domain

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

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

- 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:
E. canadensis is a non-parasitic plant species.

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:
E. canadensis is an aquatic plant species and has no properties that are hazardous to human health upon direct contact.

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:
E. canadensis is not a host or vector of human pathogens/parasites.

A4e | Impact on other domains

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

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

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

aconf26.	Answer provided with a	low	medium	high X	level of confidence
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acomm30.	Comments: Locally abundant populations of <i>E. canadensis</i> have a negative effect on water infrastructure, causing problems with their use, e.g., by blocking pipes, disturbing the operation of boat engines, overgrowing submerged elements of hydraulic engineering structures, river dams, and power plants. However, these examples have been rarely observed or documented (authors' own observations). <i>E. canadensis</i> can also block pipes used for water intake for industrial and municipal purposes, effectively reducing water intake (Sand-Jensen 2000 – P, Josefsson 2011 – B). This problem, however, occurs only in smaller water bodies (canals, drainage ditches, fish ponds) and is not common in larger reservoirs, where <i>E. canadensis</i> does not show aggressive character through abundant growth.
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A5a | Impact on ecosystem services

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

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

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

aconf27.	Answer provided with a	low	medium	high X	level of confidence
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acomm31.	Comments: Abundant growth of <i>E. canadensis</i> in rivers, etc. may cause problems with the supply of water for human consumption and other uses, and have a negative effect on the water intake infrastructure and operation of damming structures. Abundant growth of <i>E. canadensis</i> in fish ponds (fish farms) has a negative effect on fishery. The species has to be removed from rivers that are a part of flood control and/or drainage networks because the abundant growth of <i>E. canadensis</i> shallows the riverbed (authors' own observations).
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a32. The effect of *the species* on **regulation and maintenance services** is:

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

- moderately positive
- significantly positive

aconf28. Answer provided with a

low	medium	high X
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 level of confidence

acommm32. Comments:
E. canadensis growing in smaller populations or in the initial stage of invasion of the site may contribute to the improvement of water quality, just like other/native species of macrophytes colonizing water bodies (by uptake of nutrients from sediments, allelopathic effect on cyanobacteria, competition with phytoplankton, stabilization of clear-water state dominated by macrophytes). Large biomass of *E. canadensis* has to be removed from fish ponds (fish farms) and rivers that are a part of flood control and/or drainage networks because it overgrows and shallows the bed (authors' own observations).

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

acommm33. Comments:
 Abundant growth of *E. canadensis* may create problems with the recreational use of waters, i.e., canoeing, swimming, navigation, operation of motor boats, and angling. In general, it may also improve the aesthetic value of water bodies, e.g., when plants are abundantly flowering (authors' opinion).

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	high X
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 level of confidence

acomm34.

Comments:

The climate in Poland is similar to that in the native region of the species (North America) and is optimal for its development (cf. Sand-Jensen 2000 – P, Josefsson 2011 – B). At present, there are no geographical barriers related to climate; in Poland, however, this species is gradually declining in meso-eutrophic lakes irrespective of climate (Kolada and Gąbka 2018 – A).

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:

The climate in Poland is similar to that in the native region of the species (North America) and is optimal for its development (cf. Sand-Jensen 2000 – P, Josefsson 2011 – B). At present, there are no geographical barriers that would prevent the survival and reproduction of this species. The expected climate change will have no effect in this regard.

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
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level of confidence

acomm36.

Comments:

E. canadensis is well-established in Poland, and the local climate is similar to that in the native region of the species (North America) and is optimal for its development. At present, there are no geographical barriers related to climate. Our own observations indicate a low tolerance of *E. canadensis* to warming, e.g., in thermally altered (heated) ecosystems. *E. canadensis* is a species of the temperate zone, and the expected climate changes, although they may stimulate invasive success, will not have a radical effect on its behaviour (Kolada and Gąbka 2018 – A).

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	high X
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level of confidence

acommm37.

Comments:

Studies on the influence of temperature on the growth and development of *E. canadensis* reported by various authors have provided inconclusive results. Riis et al. (2012 – P) and Zhang et al. (2015 – P) indicate intensified growth of *E. canadensis* at higher temperatures, which can be explained by the higher invasiveness of this species in waters in Germany and France, and may suggest increased invasiveness of *E. canadensis* along with the temperature increase due to global warming (Zhang et al. 2015 – P). On the other hand, in France, *E. canadensis* was found in water at temperatures lower than other alien species (Greulich and Trémolieres 2006 – P). Analyses by Kolada and Kutyla (2016 – P) demonstrated a shift in the habitat preferences of *E. canadensis* towards larger and deeper lakes with a longer water retention time, lower mean seasonal temperature and better quality of water compared to lakes that are not colonized by this plant. Our own observations (Kolada and Gąbka 2018 – A) carried out in thermally altered (heated) lakes indicate a low tolerance of *E. canadensis* to warming and its low competition with other aquatic plants. Presumably, global warming and increased eutrophication will cause a decline of *E. canadensis* in Europe, which has already been observed in the lakes of western Poland (Kolada and Gąbka 2018 – A).

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

acommm38.

Comments:

The species has no impact on cultivated plants – this is an aquatic plant that does not interact with cultivated plants.

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

level of confidence

acommm39.

Comments:

The abundant growth of *E. canadensis* in water bodies can have a negative effect on fish farming; it may cause increased costs of maintaining fish ponds, but this problem is not associated with climate change and should not affect the current situation.

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:
The abundant growth of the species has a negative effect on recreation, the maintenance and use of water facilities, etc. The species does not have a direct negative impact on human health; this is not expected to change as a result of global changes in temperature.

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:
Climate warming is not expected to cause the abundant growth of *E. canadensis*. Currently, the species may cause small additional problems to humans using waters. The abundant growth of the species has a negative effect on recreation, the maintenance and use of water facilities, etc. (e.g., Sand-Jensen 2000 – P, Josefsson 2011 – B). Considering the currently observed decline of this species in Europe, we can expect that its impact, which is small today, may decrease.

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)	0.20	1.00
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)	0.50	1.00
Invasion (questions: a06-a12)	0.92	1.00
Impact (questions: a13-a30)	0.50	1.00
Overall risk score	0.46	
Category of invasiveness	potentially 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, it should be noted that biological invasions are, by definition, very dynamic and unpredictable phenomena. 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 the assessment is regularly repeated.

acomm42. Comments:
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Data sources

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3. Unpublished data (N)

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4. Other (I)

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5. Author's own data (A)

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