

## Risk Assessment of *Elodea canadensis*

<b>Name of Organism:</b>	<i>Elodea canadensis</i> Michaux – Canadian Pondweed
<b>Objective:</b>	Assess the risks associated with this species in Ireland
<b>Version:</b>	Final 15/09/2014
<b>Author(s)</b>	Michael Millane and Joe Caffrey
<b>Expert reviewer</b>	Catherine McGavigan

### Stage 1 - Organism Information

### Stage 2 - Detailed Assessment

Section A - Entry  
Section B - Establishment  
Section C - Spread  
Section D - Impact  
Section E - Conclusion  
Section F - Additional Questions

### ***About the risk assessment***

This risk assessment is based on the **Non-native species APplication based Risk Analysis (NAPRA)** tool (version 2.66). NAPRA is a computer based tool for undertaking risk assessment of any non-native species. It was developed by the European and Mediterranean Plant Protection Organisation (EPPO) and adapted for Ireland and Northern Ireland by Invasive Species Ireland. It is based on the Computer Aided Pest Risk Analysis (CAPRA) software package which is a similar tool used by EPPO for risk assessment.

**Notes:** Confidence is rated as low, medium, high or very high.  
Likelihood is rated as very unlikely, unlikely, moderately likely, likely or very likely.  
The percentage categories are 0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%.  
N/A = not applicable.

This is a joint project by Inland Fisheries Ireland and the National Biodiversity Data Centre to inform risk assessments of non-native species for the European Communities (Birds and Natural Habitats) Regulations 2011. It is supported by the National Parks and Wildlife Service.

## DOCUMENT CONTROL SHEET

<b>Name of Document:</b>	Risk Assessment of <i>Elodea canadensis</i>				
<b>Author (s):</b>	Dr Michael Millane and Dr Joe Caffrey				
<b>Authorised Officer:</b>	Dr Joe Caffrey				
<b>Description of Content:</b>	Non-native species risk assessment				
<b>Approved by:</b>	Dr Cathal Gallagher				
<b>Date of Approval:</b>	15/09/2014				
<b>Assigned review period:</b>	n/a				
<b>Date of next review:</b>	n/a				
<b>Document Code</b>	n/a				
<b>This documents comprises</b>	TOC	Text	List of tables	List of Figures	No. Appendices
	n/a	YES	n/a	n/a	0

### Version Control Table

Version No.	Status	Authors(s)	Reviewed by	Approved by	Date of issue
Draft 1	Complete	Dr Michael Millane	Dr Joe Caffrey		03/07/2014
Expert review	Complete	Dr Michael Millane	Dr Catherine McGavigan	Dr Joe Caffrey	08/07/2014
Public Consultation	Complete	Dr Michael Millane	Dr Joe Caffrey		31/07/2014
Final	Complete	Dr Michael Millane	Dr Joe Caffrey	Dr Cathal Gallagher	15/09/2014

<b>Stage 1 - Organism Information</b>			
<i>The aim of this section is to gather basic information about the organism.</i>			
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>COMMENT</b>
1	What is the reason for performing the risk assessment?		A risk assessment is required as this species is listed as a "Non-native species subject to restrictions under Regulations 49 and 50" in the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011, SI 477/2011.
2	Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES	<i>Elodea canadensis</i> Michx. Hydrocharitaceae, Horticultural and vernacular names: Canadian waterweed, Canadian pondweed, Linne-lus Canèidianach (Gaelic), Tím uisce (Irish), (GB Non-native Species Secretariat 2014).  The plant has sometimes been incorrectly labelled as <i>Elodea crispus</i> (as have some other Hydrocharitaceae) in the ornamental / aquarium trade.  <i>Elodea canadensis</i> can hybridise with <i>Elodea nuttallii</i> (Cook and Urmi-König 1985). <i>Elodea canadensis</i> displays plastic characteristics in response to varying environmental factors such as light and temperature, and this can cause some taxonomic confusion when distinguishing between species (Simpson 1983 as cited in Simpson 1986).
3	If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)	N/A	
4	Describe the organism.		<i>Elodea canadensis</i> is a perennial submerged plant, which has small trifoliate leaf whorls and a long fine stem. In Europe dispersal is vegetative. Plant fragments develop adventitious roots, which have aided its rapid establishment. <i>Elodea canadensis</i> is a shallow rooted plant found in mesotrophic and eutrophic still and slow flowing waters. It can occupy a wide range of water depths from shallow margins to waters over 3 m deep where it develops large dominant stands. It prefers high levels of silt but can tolerate a range of mineral conditions and can persist in anaerobic substrates (Preston and Croft, 1997, McGavigan, 2011). The plant is also an early coloniser of new habitats, such as artificial lakes and water-bodies recovering from pollution. (Simpson 1990). It can also occur in fast flowing waters but only at low abundance (GB Non-native Species Secretariat 2014).
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	YES	Two preliminary risk assessments were previously carried out for Ireland as follows. A stage one and two risk assessment as part of <i>Ireland's National Plant Conservation Strategy - Target 10 - Managing Invasive Alien Species</i> (Botanic Gardens 2007); and a prioritisation risk assessment as part of the <i>Risk Analysis</i>

<b>Stage 1 - Organism Information</b>			
<i>The aim of this section is to gather basic information about the organism.</i>			
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>COMMENT</b>
			<i>and Prioritisation for Invasive and Non-native Species in Ireland and Northern Ireland (Kelly et al. 2013a). The former assessment designated <i>Elodea canadensis</i> as a “most significant invasive plant” and the latter assessment designed the plant as a ‘high risk’ invasive species for Ireland.</i>
6	If there is an earlier risk assessment is it still entirely valid, or only partly valid?	PARTIAL	Only preliminary risk assessments were previously conducted in Ireland (refer to Question 5).
7	Where is the organism native?		<i>Elodea canadensis</i> is native to North America, being particularly common in southern Canada, the northern and eastern United States (Simpson 1986) concentrated around the St Lawrence Valley and the Great Lakes regions, and the Pacific West Coast (Bowmer et al. 1995).
8	What is the current global distribution of the organism (excluding Ireland)?		<b>Asia</b> (China, India, Malaysia, Saudi Arabia, Singapore and Thailand); <b>Africa</b> (Egypt, Mauritius and South Africa); <b>Central America and Caribbean</b> (Belize, Cuba and Puerto Rico); <b>Europe</b> (Austria, Belgium, Britain, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, The Netherlands, Northern Ireland, Norway, Poland, Portugal, Romania, Russia, Slovakia Spain, Sweden, Switzerland, Ukraine and Yugoslavia (former)); <b>Oceania</b> (Australia and New Zealand); <b>North America</b> (Canada, Mexico and USA); and <b>South America</b> (Argentina, Chile and Ecuador); (CABI 2014) .
9	What is the current distribution of the organism in Ireland?		Since the 19 <sup>th</sup> century populations of <i>E. canadensis</i> in Europe have gone through a pattern of: invasion, then rapid growth followed by steady decline and stabilisation or complete disappearance from the habitat (Rodwell, 1995) Populations in Ireland have followed a similar patter. <i>Elodea canadensis</i> was first recorded in Ireland in 1836 in Co. Down (Moore and More 1866). Thirty years after its introduction, it was considered to be rather local in occurrence “but not unfrequent in canals, streams and ponds in many parts of Ireland” (Moore and More 1866). By the start of the twentieth century it was considered to be abundant and occurring in all suitable waters (Walker 1912 as cited in Simpson 1984). Since that time, <i>Elodea canadensis</i> populations appear to have stabilised in Ireland (Simpson 1984; Simpson and Duenas 2011). In Ireland populations recorded in several lakes (>16) in the Northern Ireland Lake Survey (Gibson et al. 1992) have declined and in some cases disappeared (McGavigan Pers. comm.). <i>Elodea canadensis</i> is frequently displaced by similar invasive species, notably <i>Elodea nuttallii</i> (Barrat-Segretain et al. 2004 ) and <i>Lagarosiphon major</i> (James et al. 1999).; Nevertheless, <i>Elodea canadensis</i> remains widely distributed on the island of

**Stage 1 - Organism Information**

The aim of this section is to gather basic information about the organism.

N	QUESTION	RESPONSE	COMMENT
			<p>Ireland, being recorded in a total of 361 x 10km squares (National Biodiversity Data Centre 2009).</p> <p>It is likely that the <i>Elodea canadensis</i> presently occupies the vast majority of habitats suitable for colonisation in Ireland.</p>
10	Is the organism known to be invasive anywhere in the world?	YES	<p><i>Elodea canadensis</i> is "Known to be invasive in all areas where present outside its native range, including parts of Europe, South America, Central America, Asia, Australasia, and Africa. Invasion and spread were most rapid during the 19th century and many populations, particularly in the UK, have stabilized (CABI 2014) Dramatic increases have been rare since the start of the 20th century and have usually occurred when the plant has become established in made-made water bodies such as drainage channels and gravel pits. Decline may be due to reduction in certain nutrients, pathogenic effects, or displacement by similar invasive species, notably <i>Elodea nuttallii</i> and <i>Lagarosiphon major</i>."</p>

**Stage 2 - Detailed assessment: Section A - Entry**

This section evaluates the probability of entry of an organism into Ireland. For organisms which are already present, only complete the entry section for currently active pathways of entry and potential future pathways. The entry section need not be completed for pathways which have allowed an organism to enter in the past but are no longer active.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.01	How many active/future pathways are relevant to the potential entry of this organism (n/a, very few, few, moderate number, many or very many)?	MODERATE	VERY HIGH	Horticultural and aquarium trade, boating, angling and other water activities, natural spread from habitats where already present especially when seasonal flooding occurs (Barrat-Segretain <i>et al.</i> 2004). Fragments have high survival rates which allow them to be dispersed over long distances, therefore increasing their invasion capabilities.
1.02	List <u>significant</u> pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways.	1. Horticultural and aquarium trade  2. Boating, angling and other water activities		<i>Elodea canadensis</i> is for sale in Ireland from horticultural / aquarium retailers for use as an ornamental or 'oxygenating' plant. The overland or cross-channel movement of boats, boat trailers, boat engines, angling gear and other items used in water activities from an infested to uninfested area has the potential to inadvertently spread this organism if viable plant material is attached.  During seasonal flood events the plant may be spread from its existing habitat to uninhabited waterways or to uninhabited stretches of the existing waterway (Barrat-Segretain <i>et al.</i> 2004).

Pathway 1 - Horticultural and aquarium trade				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.03	Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (e.g. the organism is a contaminant of imported goods)?	INTENTIONAL	VERY HIGH	<i>Elodea canadensis</i> is for sale in Ireland from horticultural / aquarium retailers for use as an ornamental or 'oxygenating' plant.
1.04	How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year?	LIKELY	HIGH	No specific data is available, but this is one of the more common aquatic plants listed for sale in the horticultural / aquarium trade in Ireland and on foreign internet sites that deliver to Ireland. The plant is also easily acquired directly from the wild in Ireland and therefore, imports from abroad are probably low.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	VERY LIKELY	HIGH	Awareness by the relevant competent authorities at points of entry to recognise and identify this species is limited or non-existent at present.
1.06	How likely is the organism to survive during passage along the pathway?	VERY LIKELY	VERY HIGH	As the organism is distributed deliberately <i>via</i> trade, survival is considered very likely. Vegetative fragments of this organism have a high survival rate and so are very likely to survive transport.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	VERY LIKELY	VERY HIGH	The main growing season is between mid-April to October. Plants die back in Autumn to reemerge the following spring. Turions may dislodge from the plant, reside in the substrate over winter and germinate as new plants the following spring.  It is likely that most sales will occur during the growing season.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	VERY LIKELY	HIGH	It is very likely that the organism will be able to transfer from the pathway to a suitable habitat or host.  In general, Ireland has a high density and abundance of natural freshwaters suitable for colonisation, many are already colonised by <i>Elodea canadensis</i> (Simpson 1986). However the plant is also an early coloniser of new habitats, such as artificial lakes and water-bodies recovering from pollution. (Simpson 1990). It can also occur in fast flowing waters but only at low abundance (GB Non-native Species Secretariat 2014).

<b>Pathway 1 - Horticultural and aquarium trade</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	VERY LIKELY	VERY HIGH	<i>Elodea canadensis</i> is for sale in Ireland from horticultural / aquarium retailers for use as an ornamental or 'oxygenating' plant.
1.10	Do other pathways need to be considered?	YES		

<b>Pathway 2 – Boating, angling and other water activities</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.03	Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (e.g. the organism is a contaminant of imported goods)?	ACCIDENTAL	VERY HIGH	The overland or cross-channel movement of boats, boat trailers, boat engines, angling gear and other items used in water activities from an infested to uninfested area has the potential to inadvertently spread this organism if viable plant material is attached.
1.04	How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year?	LIKELY	HIGH	It is reasonable to assume, due to their widespread presence in Irish freshwaters, that vegetative fragments of <i>Elodea canadensis</i> are regularly moved between waters on equipment used in association water-based activities. Indeed, the authors have observed this occurring on numerous occasions (Millane and Caffrey personal observations).
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	VERY LIKELY	VERY HIGH	Awareness by the relevant competent authorities at points of entry to recognise and identify this species is limited or non-existent at present.
1.06	How likely is the organism to survive during passage along the pathway?	VERY LIKELY	HIGH	Survival along this pathway is ultimately dependent on environmental conditions and duration of transport. It is considered that viable plant material can survive in a damp, cool environment on equipment for at least several days (Barnes <i>et al.</i> 2013).
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	HIGH	Viable plant material could be inadvertently transferred from colonised to uncolonised areas <i>via</i> this pathway at any time of year

<b>Pathway 2 – Boating, angling and other water activities</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	Ireland has a high density and abundance of natural freshwaters, many of which are suitable for the establishment of <i>Elodea canadensis</i> . The movement of boats, boat trailers, boat engines, angling gear and other items used in water activities can act as a direct pathway to transfer this organism from an infested water to a suitable habitat elsewhere. As <i>Elodea canadensis</i> has a medium resilience to desiccation (Barnes <i>et al.</i> 2013), successful transfer would be dependent on the environmental conditions and duration of transport.
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	MODERATELY LIKELY	HIGH	This pathway depends on the transfer of viable plant material surviving an overland or cross-channel journey in association with the movement of boats, boat trailers, boat engines, angling gear and other items used in water activities from an infested water abroad to an uninfested water in Ireland. There is no specific data available on the movement of boats, boat trailers, boat engines, angling gear and other items used in water activities from infested areas abroad to Ireland. However, it is considered moderately likely that the organism can enter <i>via</i> this pathway from such areas.
1.10	Do other pathways need to be considered?	NO		

<b>Overall likelihood</b>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
1.11	Estimate the overall likelihood of entry into Ireland based on all pathways (comment on the key issues that lead to this conclusion).	VERY LIKELY	VERY HIGH	This organism sold widely by horticultural and aquarium traders where it is sold as an ornamental plant or an oxygenator. Also, the organism can easily be spread by the transport of boats and equipment between waterbodies. Seasonal flooding can also result in the spread of the organism into and within Ireland (Barrat-Segretain <i>et al.</i> 2004).

**Stage 2 - Detailed assessment: Section B – Establishment**

*This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	YES	VERY HIGH	<i>Elodea canadensis</i> is well-established and widespread on the island of Ireland. There are 2077 records of the species in a total of 361 x 10 km squares (National Invasive Species Database 2010). <i>For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.</i>
2.02	How likely is it that the organism will be able to establish in Ireland based on the similarity between local <u>climatic conditions</u> and the organism's current global distribution?			
2.03	How likely is it that the organism will be able to establish in Ireland based on the similarity between other local <u>abiotic conditions</u> and the organism's current global distribution?			
2.04	How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland?			
2.05	How likely is it that establishment will occur despite competition from existing species in Ireland?			
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?			
2.07	How likely is it that establishment will occur despite existing management practices?			
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?			
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?			

**Stage 2 - Detailed assessment: Section B – Establishment**

*This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?			
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?			
2.12	How likely is it that the organism's adaptability will facilitate its establishment?			
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?			
2.14	Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in Ireland? If possible, specify the instances of invasion elsewhere in the justification box			
2.15	If the organism does not establish, then how likely is it that transient populations will continue to occur?			
2.16	Estimate the overall likelihood of establishment. Mention any key issues in the comments box			

**Stage 2 - Detailed assessment: Section C - Spread**

*This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.01	What area (given in % or 10km squares) in Ireland could the organism establish (0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%)?	34% - 67%, (of 10 km squares)	VERY HIGH	<i>Elodea canadensis</i> is well-established and widespread on the island of Ireland. There are 2077 records of the species in a total of 361 x 10 km squares (National Invasive Species Database 2010).
3.02	How important is the expected spread of this organism in Ireland by <u>natural</u> means (minimal, minor, moderate, major or massive)?	MODERATE	VERY HIGH	<i>Elodea canadensis</i> has colonised many of the available habitats in Ireland.
3.03	How important is the expected spread of this organism in Ireland by <u>human assistance</u> (minimal, minor, moderate, major or massive)?	MODERATE	VERY HIGH	<i>Elodea canadensis</i> has colonised many of the available habitats in Ireland.
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MASSIVE	VERY HIGH	There is no potential for containment as the species is already widespread in Ireland.
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	68% - 90%	MEDIUM	This is hard to quantify with accuracy, suffice to say <i>Elodea canadensis</i> has colonised many of the available habitats in Ireland.
3.06	What proportion of the area in Ireland suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	68% - 90%	MEDIUM	This is hard to quantify with accuracy, suffice to say <i>Elodea canadensis</i> has colonised many of the available habitats in Ireland.
3.07	What other timeframe would be appropriate to estimate any significant further spread of the organism (10, 20, 40, 80 or 160 years)? Please comment on why this timeframe is chosen.	20 -40 years	LOW	There may be some local declines in the abundance of <i>Elodea canadensis</i> in future. This was documented in Ireland and Britain following the initial rapid dispersal and population expansion of the species in the years after it was introduced (Simpson 1984). However, despite potential local declines in abundance, the overall distribution of <i>Elodea canadensis</i> should remain unchanged.  However, there is uncertainty what the impact of climate change will have on this organism's invasive traits therefore a review in 20 – 40 years would be appropriate.
3.08	In this timeframe, what proportion of the endangered area (including any currently occupied areas) is likely to have been invaded by this organism?	91% - 100%	LOW	Refer to Question 3.07.

**Stage 2 - Detailed assessment: Section C - Spread**

*This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
3.09	Based on the answers to questions on the potential for establishment and spread in Ireland, define the area endangered by the organism. Be as specific as possible. If available, provide a map showing the area most likely to be endangered.	-	VERY HIGH	<i>Elodea canadensis</i> has colonised many of the suitable habitats in Ireland, however the remaining uninvaded habitats and any newly developed habitats such as manmade ditches, ponds, reservoirs or waterways are in danger of colonisation..
3.10	Estimate the overall potential for future spread for this organism in Ireland (very slowly, slowly, moderately, rapidly or very rapidly). Use the justification box to indicate any key issues .	VERY SLOWLY	HIGH	<i>Elodea canadensis</i> has already colonised many of available habitats in Ireland. Therefore it is likely that the overall distribution should remain unchanged.

<b>Stage 2 - Detailed assessment: Section D - Impact</b>				
<i>This section evaluates the probability of impact of an organism within Ireland.</i>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
4.01	How great is the economic loss caused by the organism within its global distribution (excluding Ireland), including the cost of any current management?	MODERATE	HIGH	Refer to Question 4.06.
4.02	How great has the economic cost of the organism been in Ireland from the <u>time of introduction to the present</u> ? Exclude any costs associated with managing the organism from your answer.	MODERATE	MEDIUM	There is a paucity of specific information available on the economic loss caused by <i>Elodea canadensis</i> to date in Ireland. Problematic populations of the plant which may have incurred economic costs appear to have been more historical rather than recent (Simpson 1984; Simpson and Duenas 2011) and were likely not quantified in any detail at the time. The plant is likely to have impeded boat movements and angling on navigable waters such as the Grand Canal system, Barrow Navigation and Royal Canal and required regular weed maintenance to keep such waters open to transport goods. In modern times, such waterways are primarily used for recreational boating and angling. These require routine annual weed cutting and harvesting operations (which remove the cut weed from the watercourse) to keep them open for boat traffic. In general, these operations do not target specific aquatic plant species.
4.03	How great is the economic cost of the organism likely to be in the <u>future</u> in Ireland? Exclude any costs associated with managing the organism from your answer.	MINOR	MEDIUM	
4.04	How great have the economic costs of managing this organism been in Ireland from the <u>time of introduction to the present</u> ?	MODERATE	MEDIUM	Refer to response to Question 4.02.
4.05	How great is the economic cost of managing this organism likely to be in the <u>future</u> in Ireland?	MINOR	MEDIUM	The economic cost of managing <i>Elodea canadensis</i> in the future in Ireland is likely to be minor and part of routine weed control operations to keep navigable waters open for recreational boating. Such operations are not specifically conducted to target this plant, but are more generalist in approach.  <i>Elodea canadensis</i> is not officially considered a threat to the ecological or conservation status of waters where it is present (e.g. for the Water Framework Directive) and therefore, is unlikely to be the attention of control or conservation management measure that would incur costs in future.

**Stage 2 - Detailed assessment: Section D - Impact**

*This section evaluates the probability of impact of an organism within Ireland.*

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.06	How important is environmental harm caused by the organism within its global distribution?	MODERATE	HIGH	<p><i>E. canadensis</i> is considered a serious weed in Australia, and as a principal weed in Denmark, England, Germany, Italy, New Zealand, The Netherlands, Norway, Poland, Sweden and the USA (Holm <i>et al.</i> 1997). <i>Elodea canadensis</i> can negatively impact the functioning of aquatic ecosystems. It often forms dense monospecific stands and displaces other aquatic plants from many localities (Simpson 1984; Barrat-Segretain 2005). <i>E. canadensis</i> have shading effects during phases of rapid growth and mass occurrence. Dense stands reduce water movement, cut off light, produce anoxic conditions and trap sediments in the system. Autumnal plant can induce a secondary eutrophication. Extracts from this species reduce the growth of several aquatic primary producers, among them epiphytic algae and cyanobacteria isolated from different submersed macrophytes (Erhard and Gross 2006).</p> <p>Although evidence shows that <i>E. canadensis</i> abundance has reduced in some Irish waters (McGavigan pers comm., Caffrey pers. comm.), high abundances of this species continue to persist in Welsh standing water SSSIs, therefore close monitoring will be required, especially if climatic conditions change through global warming, to limit further spread in existing sites and to prevent its spread into previously un-invaded sites.</p>
4.07	How important has the impact of the organism on biodiversity* been in Ireland from the time of introduction to the present? *e.g. decline in native species, changes in community structure, hybridisation	MODERATE	MEDIUM	<p>There is a paucity of specific information available on the impact to native biodiversity caused by <i>Elodea canadensis</i> to date in Ireland. Problematic populations of the plant which may have had negative impact to native species appear to have been more historical rather than recent (Simpson 1984; Simpson and Duenas 2011) and were not quantified in any detail at the time. Any present impacts (e.g. displacing native plant species and associated invertebrate fauna) are likely to be very localised and not systemic within waters.</p>
4.08	How important is the impact of the organism on biodiversity likely to be in the <u>future</u> in Ireland?	MINOR	MEDIUM	<p>It is likely that the <i>Elodea canadensis</i> presently occupies many habitats suitable for colonisation in Ireland. However, see comments in 3.07.</p>

<b>Stage 2 - Detailed assessment: Section D - Impact</b>				
<i>This section evaluates the probability of impact of an organism within Ireland.</i>				
<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
4.09	How important has alteration of ecosystem function* caused by the organism been in Ireland from the time of introduction to the present? *e.g. habitat change, nutrient cycling, trophic interactions	MODERATE	MEDIUM	Refer to response to Question 4.07.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the <u>future</u> ?	MINOR	MEDIUM	Refer to response to Question 4.08.
4.11	How important has decline in conservation status* caused by the organism been in Ireland from the time of introduction to the present? *e.g. sites of nature conservation value, WFD classification, etc.	MINIMAL	VERY HIGH	There has been no official decline in conservation status caused by <i>Elodea canadensis</i> to date. <i>Conservation status</i> was not a considered concept when the plant first colonised waterways in Ireland.
4.12	How important is decline in conservation status caused by the organism likely to be in the <u>future</u> in Ireland?	MINIMAL	HIGH	It is likely that the <i>Elodea canadensis</i> presently occupies many of the habitats suitable for colonisation in Ireland. The species is now rarely problematic. Therefore, it is likely that no future decline in conservations status is anticipated.
4.13	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within its global distribution?	MINIMAL	HIGH	None reported.
4.14	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within Ireland?	MINIMAL	VERY HIGH	None reported.
4.15	How important is it that genetic traits of the organism could be carried to other organisms / species, modifying their genetic nature and making their economic, environmental or social effects more serious?	MINIMAL	VERY HIGH	<i>Elodea canadensis</i> only reproduces vegetatively in Ireland so there is minimal risk of genetic traits being carried to other species (Simpson and Duenas 2011).
4.16	How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	MINIMAL	VERY HIGH	<i>Elodea canadensis</i> is a commonly used colonisation substrate for zebra mussels (Millane <i>et al.</i> 2008).

**Stage 2 - Detailed assessment: Section D - Impact**

*This section evaluates the probability of impact of an organism within Ireland.*

<b>N</b>	<b>QUESTION</b>	<b>RESPONSE</b>	<b>CONFIDENCE</b>	<b>JUSTIFICATION</b>
4.17	How important might other impacts not already covered by previous questions be resulting from introduction of the organism? Specify in the justification box.	MINIMAL	HIGH	
4.18	How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Ireland?	MINIMAL	HIGH	<i>Elodea canadensis</i> is not naturally controlled by any predator, parasite or pathogen in Ireland or Northern Ireland.
4.19	Indicate any parts of Ireland where economic, environmental and social impacts are particularly likely to occur. Provide as much detail as possible, where possible include a map showing vulnerable areas.		HIGH	As <i>Elodea canadensis</i> is now rarely a problematic organism within the water bodies in Ireland, it is unlikely to cause any further negative impacts except under certain circumstances (e.g. in localised parts of disturbed, artificial or newly introduced habitats).
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MINOR	HIGH	As <i>Elodea canadensis</i> is now now rarely a problematic organism within the water bodies in Ireland, it is unlikely to cause any further negative impacts except under certain circumstances (e.g. in localised parts of disturbed, artificial or newly introduced habitats).

**Stage 2 - Detailed assessment: Section E – Conclusion**

This section requires the assessor to provide a score for the overall risk posed by an organism, taking into account previous answers to entry, establishment, spread and impact questions.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
5.01	Estimate the overall risk of this organism in Ireland (noting answers given in 1.11, 2.16, 3.10 & 4.20).	MINOR	HIGH	As <i>Elodea canadensis</i> is now rarely a problematic organism within the water bodies in Ireland, it is unlikely to cause any further negative impacts except under certain circumstances (e.g. in localised parts of disturbed, artificial or newly introduced habitats).

**Stage 2 - Detailed assessment: Section F – Additional questions**

This section is used to gather information about the potential effects of climate change on the risk posed by an organism. It is also an opportunity for the risk assessor to highlight high priority research that could help improve the risk assessment.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
6.01	What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?		LOW	Climate change is expected to increase water temperatures over time in Ireland, with increased periods of drought in summer and higher rainfall in winter leading to more flooding events (Desmond <i>et al.</i> 2008). Increased flooding events will provide further opportunities for natural spread of <i>Elodea canadensis</i> .  Global climate niche and environmental niche modelling project that the suitable range of <i>Elodea canadensis</i> in the island of Ireland will decrease by 9% and 31%, respectively, by 2080 (based on the International Panel on Climate Change high emissions climate change scenario) (Kelly <i>et al.</i> 2014).
6.02	What is the likely timeframe for such changes (5, 10, 15, 20, 50 or 100 years)?	50 YEARS	LOW	This is based on the global climate niche modelling projection.
6.03	What aspects of the risk assessment are most likely to change as a result of climate change		MEDIUM	The number of opportunities for the plant to spread to uninvaded sites may increase as the number of flood events increases.
6.04	If there is any research that would significantly strengthen confidence in the risk assessment, please note this here. If more than one research area is provided, please list in order of priority.	NO		The invasion history and population status of <i>Elodea canadensis</i> are well known in Ireland and abroad.

## References

- Barnes, M.A., Jerde, C.L., Keller, D., Chadderton, W.L., Howeth, J.G. and Lodge, D.M. (2013). Viability of Aquatic Plant Fragments following Desiccation. *Invasive Plant Science and Management* 6(2):320-325.
- Barrat-Segretain, M.-H. and Bornette, G. (2000). Regeneration and colonization abilities of aquatic plant fragments: Effect of disturbance seasonality. *Hydrobiologia* 421(1-3):31-39.
- Barrat-Segretain, M.H., Elger, A., Sagnes, P. and Puijalon, S. (2002). Comparison of three life-history traits of invasive *Elodea canadensis* Michx. and *Elodea nuttallii* (Planch.) H. St. John. *Aquatic Botany* 74:299–313.
- Barrat-Segretain, M.-H. and Cellot, B. (2007). Response of invasive macrophyte species to drawdown: The case of *Elodea* sp. *Aquatic Botany* 87(4):255-261.
- Bill, S. (1969). Water weed problems of Australia. *Hyacinth Control Journal* 8:1-6.
- Botanic Gardens (2007). Ireland's National Plant Conservation Strategy - Target 10 - Managing Invasive Alien Species. Botanic Gardens, Glasnevin, Dublin. (accessed 17/06/2014).
- Bowmer, K.H., Jacobs, S.W.L. and Sainty, G.R. (1995). Identification, Biology and Management of *Elodea canadensis*, Hydrocharitaceae. *Journal of Aquatic Plant Management* 33:13-19.
- CABI (2008). *Elodea canadensis*. In: Invasive Species Compendium. Wallingford, UK: CAB International. <http://www.cabi.org/isc/datasheet/20759> (accessed 17/06/2014).
- Cook and Urmi-König (1985). Range extension of aquatic vascular plant species. *Journal of Aquatic Plant Management* 23:1-6.
- Dutta, T.R., and Gupta, J.N. (1976). Some experiments on aquatic weed control in fisheries lakes and streams in Upper Pradesh. In: Aquatic weeds in S. E. Asia, Proceedings of a Regional Seminar on Noxious Aquatic Vegetation, New Delhi, India, 12-17 December, 1973: 249-253.
- GB Non-native Species Secretariat (2014). Canadian Pondweed, *Elodea canadensis*. Factsheet <http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=1303> (accessed 17/06/2014).
- Holm, L., Doll, J., Holm, E., Pancho, J. and Herberger, J. (1997). World Weeds. Natural Histories and Distribution. New York, USA: John Wiley and Sons, Inc.
- Kelly, J., O'Flynn, C. and Maguire, C. (2013a). Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. A report prepared for the Northern Ireland Environment Agency and National Parks and Wildlife Service as part of Invasive Species Ireland. 59 pp.
- McGavigan, C. (2011). The quantitative contribution of discrete littoral habitats and the pelagic habitat to whole lake zooplankton abundance, biomass and diversity. Thesis (Ph.D.) University of Ulster, unpublished.
- McGavigan, C. (2012). A quantitative method for sampling littoral zooplankton in lakes: The active tube, *Limnology and Oceanography Methods* 10:289-295
- Mehta, I., Krishna, R. and Taunk, A.P. (1973). The aquatic weed problem in the Chambal Irrigated Area and its control using grass carp fish. Abstracts, Regional Seminar on Noxious Aquatic Vegetation in Tropics and Sub-tropics, New Delhi, 1973., 48-49.
- Millane, M., Kelly-Quinn, M. and Champ, T. (2008). Impact of zebra mussel invasion on the ecological integrity of Lough Sheelin, Ireland: distribution, population characteristics and water quality changes in the lake. *Aquatic Invasions* 3(3):271-281.

- Moore, D. and More, A.G. (1866). Contributions towards a Cybele Hibernica. Dublin. 399 pp.
- National Biodiversity Data Centre (2009). Canadian Pondweed.  
<http://maps.biodiversityireland.ie/#/Species/41362> (accessed 17/06/2014).
- Preston, C.D. and Croft, J.M. (1997). Aquatic plants in Britain and Ireland (1<sup>st</sup> ed.), Harley Books, England. Pp. 365
- Simpson, D.A. (1983). Experimental taxonomic studies of *Elodea* Michx in the British Isles. Ph.D. thesis, University of Lancaster.
- Simpson, D.A. (1984). A short history of the introduction and spread of *Elodea* Michx in the British Isles. *Watsonia* 15:1-9.
- Simpson, D.A. (1986). Taxonomy of *Elodea* Michx in the British Isles. *Watsonia* 16:1-14.
- Simpson, D.A. (1990). Displacement of *Elodea canadensis* Michx. by *Elodea nuttallii* (Planch.) St John in the British Isles. *Watsonia* 18:173-177.
- Simpson, D.A. and Duenas, M.A. (2011). GB Non-native Organism Risk Assessment for *Elodea canadensis*. Food and Environment Research Agency, UK.  
<https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=618> (accessed 17/06/2014).
- Walker, A.O. (1912). The distribution of *Elodea canadensis* Michaux in The British Isles in 1909. *Proceedings of the Linnean Society of London* 124:71-79.