

Risk Assessment of *Aponogeton distachyos*

Name of Organism:	<i>Aponogeton distachyos</i> Linnaeus filius – Cape Pond Weed
Objective:	Assess the risks associated with this species in Ireland
Version:	Final 15/09/2014
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Expert reviewer	Kevin Murphy

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

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Version Control Table

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Stage 1 - Organism Information			
<i>The aim of this section is to gather basic information about the organism.</i>			
N	QUESTION	RESPONSE	COMMENT
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>Aponogeton distachyos</i> Linnaeus filius; <i>Aponogeton distachyos</i> var. <i>lagrangei</i> Andrews (The Plant List 2012); Cape Asparagus, Cape Pond Weed, Waterblommetjie; Dog With Two Tails; Cape Water-hawthorn; Water Hawthorn, Cape Hawthorn, Cape Pond lily, Cape Pondweed, Water Hawthorn and Water-hawthorne (Hellquist and Jacobs 1998, Pemberton 2000; Randall 2001; Ecocrop 2007).
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.		<p>The following description of <i>Aponogeton distachyos</i> is provided by Hellquist and Jacobs (1998)</p> <p>"Rooted, submersed and floating, perennial aquatic. Tuber to 6 cm long. Leaves floating, blades ovate, narrowly elliptic, or narrowly lanceolate, 6–26(–32.5) cm long, 1.5–7.5(–8.6) cm wide; margins flat; base mostly obtuse or attenuate; apex obtuse, acute, or acuminate, 7–9-veined; petiole to 100 cm long. Peduncle to 80 cm long, often broadening at base of inflorescence. Spathe c. 3 cm long, caducous. Inflorescence branched with two spikes to 5.5 cm long. Flowers secund, in 2 rows. Perianth segments 1, white or pinkish, ±13-veined, 10–15(–30) mm long, 3.5–12 mm wide. Stamens 8–16, 3–4.5 mm long, anthers purplish black, filaments wider at base. Carpels 2–6. Infructescence to 7 cm long. Fruit to 22 mm long, 6 mm wide, with a curved or straight terminal beak to 5 mm long. Seeds to 18 mm long, 7 mm wide, with a single loose testa and small embryo."</p> <p>The National Biodiversity Data Centre (2010) lists key identification features as follows: <i>Aponogeton distachyos</i> "is a hairless, aquatic perennial, with elongated stems rooted in mud at its tuberous base. Its leaves float, and are oblong-elliptic, up to 25x7cm. It flowers in a forked spike at the water's surface on a long stalk, with a deciduous sheath at the base of each spike. Each spike up to 6cm, each with up to 10 flowers; sepals 10-20mm."</p>

Stage 1 - Organism Information			
<i>The aim of this section is to gather basic information about the organism.</i>			
N	QUESTION	RESPONSE	COMMENT
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	NO	No formal risk assessments were previously carried out for this species in Ireland, Britain or Europe. However, Invasive Species Ireland (2010) rates this plant as of medium risk and has placed it on its amber list as its “impact on conservation goals remains uncertain due to lack of data showing impact or lack of impact”. The National Biodiversity Data Centre (2010) lists this plant as a problematic species that needs to be monitored for range expansion and potential impact.
6	If there is an earlier risk assessment is it still entirely valid, or only partly valid?	NO	Refer to response to Question 5 above.
7	Where is the organism native?		Southern Africa (Hellquist and Jacobs 1998).
8	What is the current global distribution of the organism (excluding Ireland)?		Argentina, Australia, Belgium, Britain, Chile, France, New Zealand, Peru, South Africa and USA. (Les <i>et al.</i> 2005; Hauenstein 2006; Q-bank 2014).
9	What is the current distribution of the organism in Ireland?		<i>Aponogeton distachyos</i> is officially recorded in two isolated locations in Ireland. The first record is in a “large pond” in Derreen Gardens in the Beara peninsula, Co. Kerry. The description here given is “naturalised...plenty in one of two ponds” (National Biodiversity Data Centre 2010). The second record is in two ponds on the Citywest Business Campus in south-west Dublin in May 2014 (Dr. Joe Caffrey, IFI, personal observation). These official records are likely to be an underestimate as the plant is sold in some garden centres in the country. However, the authors are not aware of its presence in any natural waters in Ireland and it is likely to be restricted to private garden ponds or aquaria.
10	Is the organism known to be invasive anywhere in the world?	YES	It is sometimes regarded as a minor weed in Australia though it is widely planted as an ornamental in temperate areas because it is one of the few aquatic species that flowers in the cooler months (Hellquist and Jacobs 1998; Gunasekera 2003). The Weeds of Australia (2011) states the following for the plant's status in Australia: “Cape pond lily (<i>Aponogeton distachyos</i>) is regarded as an environmental weed in Victoria and as a minor environmental weed or potential environmental weed in other parts of south-eastern Australia. This species is grown as an ornamental in outdoor aquaria and water features, and is popular because it grows and flowers during the winter months. It has escaped cultivation and invaded slow-moving freshwater creeks, rivers, lakes, dams and other water bodies. Dense Cape pond lily (<i>Aponogeton distachyos</i>) infestations can alter aquatic

Stage 1 - Organism Information

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

N	QUESTION	RESPONSE	COMMENT
			<p>ecosystems and shade out the native submerged flora. They also have the ability to change the physical and chemical characteristics of invaded lakes and waterways. This plant spreads by seeds and tubers and tends to invade sites in cooler temperature regions.</p> <p>It is currently mainly a problem in Victoria, where it has become naturalised in several locations. For example, there is an outbreak of Cape pond lily (<i>Aponogeton distachyos</i>) located at Jackson's Creek in Osborne near Melbourne. It is regarded as a high threat weed species in aquatic herbland vegetation in the Warrnambool Plain bioregion and in aquatic grassy wetlands in the East Gippsland Lowlands bioregion. It is also listed as a common invasive garden escape in the Gannawarra and Loddon Shires.</p> <p>Cape pond lily (<i>Aponogeton distachyos</i>) is also a minor weed of small water bodies in New South Wales and has been recorded in some conservation areas in south-eastern South Australia (i.e. Scott Creek Conservation Park and Cleland Conservation Park)".</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)?	FEW	HIGH	The principal active pathways for the importation, introduction or spread of <i>Aponogeton distachyos</i> in Ireland are through the horticultural and aquarium trades. To a far lesser extent, boating and angling may also be considered potential pathways.
1.02	List significant 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 3. Angling		<i>Aponogeton distachyos</i> is imported into Ireland via the horticultural and aquarium trade for sale to the public in garden centres. It is also available to buy on the internet. The risk of introduction by boats and anglers arises from any travel to Ireland from an infested area abroad where equipment is inadvertently contaminated with viable plant material.

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>Aponogeton distachyos</i> is deliberately imported for trade.
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?	UNLIKELY	MEDIUM	<i>Aponogeton distachyos</i> is deliberately imported for trade and subsequently sold in garden centres in Ireland as an oxygenator / ornamental plant for artificial watercourses, garden ponds and aquaria. No information is available on the amount of such trade occurring in the country but, from an internet search of the on-line listing from garden centre outlets, it is thought to be 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 via trade, survival is considered very likely.

Pathway 1 - Horticultural and aquarium trade				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	MEDIUM	Trade imports and purchases may occur throughout the year, but it seems common sense that most outdoor garden or trade introductions would be made outwith the winter season, for planting in spring/ summer. There is a paucity of specific information to comment on what time of year or under what climatic conditions the plant could establish. In Australia, it is widely planted as an ornamental in temperate areas because it is one of the few aquatic species that flowers and grows best in the cooler months of the year, being most productive in spring and autumn (Hellquist and Jacobs 1998).
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	<i>Aponogeton distachyos</i> grows in slow flowing freshwater streams and rivers, and in lakes and garden ponds (Gunasekera 2003). There is a high density and abundance of natural freshwaters in Ireland, of which a good proportion may, in theory, be suitable for the establishment of <i>Aponogeton distachyos</i> . The practice of planting <i>Aponogeton distachyos</i> in artificial watercourses or ponds, which are often proximal to these natural systems, and its use in aquaria, increases the likelihood of it transferring from this pathway to a suitable habitat either by natural spread or from the disposal of plant material into the wild. This pathway may also facilitate the deliberate introduction or planting of waterbodies into waterbodies as an oxygenator or as an ornamental plant.
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	VERY LIKELY	VERY HIGH	It is already deliberately imported for trade.
1.10	Do other pathways need to be considered?	YES		

Pathway 2 – Boating				
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)?	ACCIDENTAL	HIGH	The overland or cross-channel movement of boats, boat trailers and boat engines from an infested to uninfested area has a low potential to inadvertently spread this organism if viable plant material (i.e. seed or tubers) is attached. This includes the import of used boats from abroad.
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?	VERY UNLIKELY	HIGH	There is a very low potential for the inadvertent transfer of <i>Aponogeton distachyos</i> overland or cross-channel on boating equipment from infested to uninfested waters. In Britain, where presumably the majority of such boat traffic would arise, this plant is not common in the wild, only being recorded in 39 x 10 km squares there (Palmer 2008). It is unknown how many of these waters are used for boating purposes.
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?	UNLIKELY	LOW	As <i>Aponogeton distachyos</i> is not drought tolerant (Ecocrop 2007), it is considered that viable plant material cannot easily survive during passage along this pathway.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	LOW	Refer to Pathway 1, Question 1.07. Boat movements may occur throughout the year.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	UNLIKELY	HIGH	Boat movements act as a direct pathway to transfer this organism from an infested water to a suitable habitat elsewhere. As noted in Pathway 1, Question 1.08, there is a high density and abundance of natural freshwaters in Ireland, of which a good proportion may, in theory, be suitable for the establishment of <i>Aponogeton distachyos</i> . Survival during boat 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?	VERY UNLIKELY	MEDIUM	This pathway depends on the transfer of viable plant material surviving an overland or cross-channel journey in association with boats from an infested water abroad to an uninfested water in Ireland. There is a very low potential that the organism can enter <i>via</i> this pathway because of its low prevalence in Britain (Palmer 2008), where the majority of boats would originate.

Pathway 2 – Boating				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.10	Do other pathways need to be considered?	YES		

Pathway 3 – Angling				
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)?	ACCIDENTAL	HIGH	The overland or cross-channel movement of angling equipment from an infested to uninfested area has the potential to inadvertently spread this organism if viable plant material (i.e. seeds or tubers) is attached. It is unknown if such plant material could survive in a damp environment on angling equipment (e.g. landing or keep net, stink bag, angling box and stand, boots and waders) but, if so, this has the potential to spread this organism.
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?	VERY UNLIKELY	HIGH	This pathway depends on the transfer of viable plant material surviving an overland / cross-channel journey in association with angling equipment from an infested water outside Ireland (most likely from Britain) to an uninfested water in the country. In Britain's freshwaters, it is not commonly recorded, being present in only 39 x 10 km squares there (Palmer 2008). As there is a paucity of specific information available on the movement of anglers from these areas to Ireland (or even if such waters are fished), it is considered very unlikely that the organism can enter <i>via</i> this pathway.
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?	UNLIKELY	LOW	Refer to response to Pathway 2, Question 1.06.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	LOW	Refer to Pathway 1, Question 1.07. Movement in association with anglers may occur throughout the year.

Pathway 3 – Angling				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	UNLIKELY	LOW	The movement of anglers acts as a direct pathway to transfer this organism from an infested water to a suitable habitat elsewhere. As noted in Pathway 1, Question 1.08, there is a high density and abundance of natural freshwaters in Ireland, of which a good proportion may, in theory, be suitable for the establishment of <i>Aponogeton distachyos</i> . Survival during such 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?	VERY UNLIKELY	MEDIUM	This pathway depends on the transfer of viable plant material surviving an overland / cross-channel journey in association with angling equipment from an infested water outside Ireland to an uninfested water in the country. There is a very low potential that the organism can enter <i>via</i> this pathway because of its low prevalence in Britain (Palmer 2008), where the majority of anglers would originate.
1.10	Do other pathways need to be considered?	NO		

Overall likelihood				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
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	The primary confirmed pathway of entry into Ireland is through deliberate trade <i>via</i> the horticultural and aquarium sectors. The movement of boats and anglers from infested areas outside of Ireland into the country may also facilitate entry but the low prevalence of <i>Aponogeton distachyos</i> in Britain, where these pathways largely would originate, makes it very unlikely that transfer would occur in this manner.

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.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	NO	-	<i>Aponogeton distachyos</i> is officially recorded in two isolated locations in Ireland. The first record is in a “large pond” in Derreen Gardens in the Beara peninsula, Co. Kerry. The description here given is “naturalised...plenty in one of two ponds” (National Biodiversity Data Centre 2010). The second record is in two ponds on the Citywest Business Campus in south-west Dublin in May 2014 (Dr. Joe Caffrey, IFI, personal observation). These official records are likely to be an underestimate as the plant is sold in some garden centres in the country. However, the authors are not aware of its presence in any natural waters in Ireland and it is likely to be restricted to private garden ponds or aquaria.
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?	VERY LIKELY	HIGH	It has demonstrated its ability to establish under Irish climatic conditions in at least two locations in Ireland and is sold in Irish garden centres. Its presence in the wild in Britain, France and New Zealand (Les <i>et al.</i> 2005) also supports this. Nevertheless, it is uncertain how vigorous or widespread establishment could be in Ireland. Given that the native habitat of the species, in the Western Cape of South Africa, experiences a Mediterranean climate, it is likely that Ireland is at the extreme limit of its likely invasive distribution in Europe. Ireland's relatively mild winters may tend to assist establishment, but populations of the plant which succeed in establishing are likely to be vulnerable to high mortality in very cold winters (although it has a degree of frost-hardiness: Plant Database 2014). It is notable that much of its successful spread to date away from the Western Cape of South Africa has been to other regions with a Mediterranean climate (e.g. central Chile, Victoria in Australia, California), but the mild northerly climate of the Gulf Stream - influenced Atlantic seaboard countries of northern Europe, including Ireland, may also provide suitable habitat for it.
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?	VERY LIKELY	HIGH	There is a paucity of specific information on abiotic conditions in its current global range. The species is intolerant of drought conditions and has a pH range of between 4.5 and 8 (Ecocrop 2007; Plant Database 2014). In areas of southern England during the 19 th century, <i>Aponogeton distachyos</i> “completely established itself as if it were native” (Paxton and Lindley 1883 as cited in Pemberton 2000), and is now present in 39 x 10 km squares in Britain (Palmer 2008). In Australia, it is widely planted as an ornamental in temperate areas because it is one of the few aquatic

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.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				species that flowers and grows best in the cooler months of the year, being most productive in spring and autumn (Hellquist and Jacobs 1998). <i>Aponogeton distachyos</i> has demonstrated its ability to establish, at least two isolated locations in Ireland. As mentioned previously, it is uncertain how vigorous or widespread establishment could be in Ireland.
2.04	How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland?	VERY LIKELY	VERY HIGH	<i>Aponogeton distachyos</i> grows in slow flowing freshwater streams and rivers, lakes and garden ponds (Gunasekera 2003). There is a high density and abundance of natural freshwaters in Ireland, of which a good proportion, may, in theory, be suitable for the establishment of this species.
2.05	How likely is it that establishment will occur despite competition from existing species in Ireland?	UNKNOWN	LOW	There is insufficient information to comment on this.
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?	UNKNOWN	LOW	There is insufficient information to comment on this.
2.07	How likely is it that establishment will occur despite existing management practices?	UNLIKELY	HIGH	In general, the State management of waterways is undertaken cognisant of ensuring biosecurity measures are in place to mitigate for the spread of aquatic invasive species. An increase in awareness of the threat from aquatic invasive species by some private entities has also reduced this risk.
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?	UNLIKELY	HIGH	Refer to Question 2.07.
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?	MODERATELY LIKELY	MEDIUM	<i>Aponogeton distachyos</i> is capable of both sexual and asexual reproduction (Pemberton 2000; Gunasekera 2003). Based on experiences controlling other non-native plants in Ireland (CAISIE 2013), this should increase its ability to survive an eradication program which uses mechanical or manual removal, particularly as it would be difficult to remove all tubers from a colonised sediment. However, it is sensitive to herbicide (neither active ingredient nor product specified, Pemberton 2000). In general, the success of an eradication campaign would be dependent on the abundance and extent of any infestation and the type of water colonised i.e. small infestations in confined waters would be easier to eradicate.

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.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?	VERY LIKELY	VERY HIGH	The ability of <i>Aponogeton distachyos</i> to reproduce both sexually and asexually (Pemberton 2000; Gunasekera 2003) may facilitate its establishment. However, its reported low drought tolerance may hamper its survival in waters that are subject to fluctuating water levels.
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?	LIKELY	MEDIUM	<p>Within systems, internal spread by natural means is likely, primarily <i>via</i> sexual reproduction where ripe fruits become detached and float for a short time before releasing seeds, which then settle. The seeds germinate freely on the water surface (Gunasekera 2003). This confers a high capacity for dispersal.</p> <p>Between watersheds, there is a very low potential for natural spread, although it could be transferred <i>via</i> plant fragments attached to animals. Anthropogenic-mediated transfer would be the principal pathway to facilitate the establishment of the plant from colonised to uncolonised waters.</p> <p>There is no information available to assess the reproductive capacity of this plant in Ireland.</p>
2.12	How likely is it that the organism's adaptability will facilitate its establishment?	UNKNOWN	LOW	There is a paucity of information available to assess this.
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?	UNKNOWN	LOW	There is a paucity of information available to assess this.
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	VERY LIKELY	VERY HIGH	<i>Aponogeton distachyos</i> has already demonstrated this capacity in Ireland in at least two isolated locations (refer to response to Question 9). In Britain, it is recorded in 39 x 10 km squares. In southern England, the plant "completely established itself as if it were native" during the 19 th century (Paxton and Lindley 1883 as cited in Pemberton (2000). These instances indicate that <i>Aponogeton distachyos</i> can establish more widely in Ireland but do not confirm whether the plant would be invasive or not.
2.15	If the organism does not establish, then how likely is it that transient populations will continue to occur?	UNKNOWN	LOW	

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.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.16	Estimate the overall likelihood of establishment. Mention any key issues in the comments box	VERY LIKELY	HIGH	<i>Aponogeton distachyos</i> has already demonstrated its capacity to establish in at least two isolated locations in Ireland and is present for over a century in Britain, both of which indicate its capacity for further establishment in this country. There is insufficient information in the literature to comment authoritatively on how successful any further establishment or range expansion would be.

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%)?	11% - 33% (of 10 km squares)	LOW	This species could establish in a range of freshwaters with soft sediment habitat in Ireland such as slow flowing freshwater streams and rivers, and in lakes and garden ponds (Gunasekera 2003), which are abundant in the country.
3.02	How important is the expected spread of this organism in Ireland by <u>natural</u> means (minimal, minor, moderate, major or massive)?	MINIMAL	HIGH	<i>Aponogeton distachyos</i> has only been confirmed at two isolated locations (Derreen Gardens and Citywest) in Ireland to date (National Biodiversity Data Centre 2010; Joe Caffrey personal observation). Otherwise, undocumented instances are likely to be confined to private garden ponds or aquaria after being purchased in a garden centre and planted out. Therefore, the expected spread of this plant by natural means is considered to be minimal.
3.03	How important is the expected spread of this organism in Ireland by <u>human assistance</u> (minimal, minor, moderate, major or massive)?	MINOR TO MODERATE	MEDIUM	Anthropogenic-mediated transfer is the principal pathway which could spread <i>Aponogeton distachyos</i> in Ireland. Although for sale in some garden centres, it appears that this plant is not commonly sold in Ireland to date. Therefore, this is rated a minor to moderate.
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MINIMAL	HIGH	As there is only two confirmed records of <i>Aponogeton distachyos</i> in Ireland to date and as undocumented instances are likely to be confined to private garden ponds or aquaria, it is contended that, at present, it would not be difficult to contain this plant to its current range. It may be worthwhile to contact the owners of Derreen Gardens to inform them of the potential invasiveness of this plant in order to minimise any risk of external spread e.g. by visitors taking cuttings and re-planting it elsewhere.
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	0% - 10%	HIGH	Refer to Question 3.04.
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)?	0% - 10%	HIGH	In the absence of restrictions on sale and import, further anthropogenic-mediated spread is considered likely, although the rate of spread and capacity for establishment is highly uncertain.

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
3.07	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.	10 - 20 years	MEDIUM	Refer to response to Questions 3.06 above.
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?	0% - 10%	HIGH	Refer to response to Questions 3.06 above.
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.	-	HIGH	This species could establish in a range of freshwaters with soft sediment habitat in Ireland such as slow flowing freshwater streams and rivers, in lakes and garden ponds (Gunasekera 2003), which are abundant in the country.
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 .	SLOWLY	MEDIUM	In the absence of restrictions on sale and import, further anthropogenic-mediated spread is considered likely, although the rate of spread and capacity for establishment is uncertainly.

Stage 2 - Detailed assessment: Section D - Impact

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

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.01	How great is the economic loss caused by the organism within its global distribution (excluding Ireland), including the cost of any current management?	MINOR	HIGH	There is a paucity of specific information available on the economic loss caused by <i>Aponogeton distachyos</i> within its global distribution. Gunasekera (2003) report that it “can block waterways, irrigation pumps and water metering equipment. Thick infestations interfere with the use of lakes and rivers for recreation, and provide an ideal breeding ground for mosquitoes.” The species is of economic benefit in South Africa where it is used and traded as food (Pemberton 2000).
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.	MINIMAL	VERY HIGH	No such economic costs have been reported.
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 TO MODERATE	MEDIUM	This is uncertain as its potential for invasiveness in Ireland is unknown and there is no specific information available from other countries to deduce this.
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> ?	MINIMAL	VERY HIGH	There have been no known costs incurred to date – there is only two records confirmed of this species <i>in the wild</i> in Ireland, where it is restricted to a large pond in a country estate and two ponds in a business campus.
4.05	How great is the economic cost of managing this organism likely to be in the <u>future</u> in Ireland?	MINOR to MODERATE	LOW	This is difficult to quantify and depends on a range expansion of the plant and the levels of infestation achieved in colonised waters.
4.06	How important is environmental harm caused by the organism within its global distribution?	MINOR	LOW	According to Gunasekera (2003) <i>Aponogeton distachyos</i> “has the ability to change the physical and chemical characteristics of lakes and streams. Infestations can alter aquatic ecosystems by shading out the native flora. In addition, <i>Aponogeton distachyos</i> can block waterways, irrigation pumps and water metering equipment. Thick infestations interfere with the use of lakes and rivers for recreation, and provide an ideal breeding ground for mosquitoes.” No further details or specific instances of environmental harm caused by this plant can be found in the literature.

Stage 2 - Detailed assessment: Section D - Impact				
<i>This section evaluates the probability of impact of an organism within Ireland.</i>				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
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	MINIMAL	VERY HIGH	There have been no such impacts reported to date, presumably because of its confined distribution in Ireland.
4.08	How important is the impact of the organism on biodiversity likely to be in the <u>future</u> in Ireland?	MINOR to MODERATE	LOW	This is difficult to quantify and depends on a range expansion of the plant and the levels of infestation achieved in colonised waters.
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	MINIMAL	HIGH	There have been no such impacts reported to date, presumably because of its confined distribution in Ireland.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the <u>future</u> ?	MINOR to MODERATE	MEDIUM	This is difficult to quantify and depends on a range expansion of the plant and the levels of infestation achieved in colonised waters.
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>Aponogeton distachyos</i> to date.
4.12	How important is decline in conservation status caused by the organism likely to be in the <u>future</u> in Ireland?	MAJOR	VERY HIGH	This is difficult to quantify and depends on a range expansion of the plant and the levels of infestation which might be achieved in colonised waters. If it was to expand its range and prove to be invasive, this may result in the downgrading of ecological status under the Water Framework Directive and have implications for Natura 2000 designated sites.
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	LOW	According to Gunasekera (2003), thick infestations of <i>Aponogeton distachyos</i> can interfere with the use of lakes and rivers for recreation, and provide an ideal breeding ground for mosquitoes." No further details or specific instances of social or human health harm can be found in the literature.

Stage 2 - Detailed assessment: Section D - Impact				
<i>This section evaluates the probability of impact of an organism within Ireland.</i>				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
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	HIGH	Highly unlikely - there is no evidence for this from the literature reviewed.
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)?	MINOR to MODERATE	MEDIUM	<i>Aponogeton distachyos</i> has increasingly been cultivated for food in parts of South Africa in the last 30 years or so (Pemberton 2000). Thick infestations can provide breeding grounds for mosquitos (Gunasekera 2003).
4.17	How important might other impacts not already covered by previous questions be resulting from introduction of the organism? Specify in justification box.	UNKNOWN	LOW	There is a paucity of literature available to assess this.
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?	UNKNOWN	LOW	There is a paucity of literature available to assess this. Where it is present in Derreen Gardens, it appears to have firmly established in a large pond (National Biodiversity Data Centre 2010). In Citywest, it is present in low abundance (i.e. only isolated stands in each pond). There is no information available on control of this plant by potential predators, parasites or pathogens that are present in Ireland, or indeed elsewhere.
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.	-	LOW	This is difficult to assess and depends on a range expansion of the plant and the levels of infestation achieved in colonised waters. If it were to expand its range and prove to be invasive, impacts could occur in waters such as slow flowing freshwater streams and rivers, and in lakes and ponds.
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MINOR to MODERATE	LOW	There is a paucity of information available to assess this in detail. The species has shown that it can establish in abundance in a large pond in Derreen Gardens, Co. Kerry suggesting that there is potential to become invasive and cause environmental and socio-economic impacts. The lack of impact in this country to date may be as a result of its confined distribution.

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 to MODERATE	LOW	There is a paucity of information available to assess this in detail. The species has shown that it can establish in abundance in a large pond in Derreen Gardens, Co. Kerry. Lack of impact thus far in this country may be a function of its confined distribution.

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). Increasing drought conditions may not favour this species in aquatic habitats subject to intermittent periods of drying out (Ecocrop 2007).
6.02	What is the likely timeframe for such changes (5, 10, 15, 20, 50 or 100 years)?	UNKNOWN	LOW	
6.03	What aspects of the risk assessment are most likely to change as a result of climate change		MEDIUM	Refer to response to Question 6.01.
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.	YES		In general, there is a paucity of information available in the formal scientific, grey or general literature on <i>Aponogeton distachyos</i> to assess its invasive potential in Ireland. Such information would significantly strengthen this risk assessment. Information from Irish gardeners or stockists who have first-hand knowledge of its growth, reproduction and general suitability to the Irish climate may also be useful in this regard.

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