Risk Assessment of *Allium triquetrum*

Name of Organism:	*Allium triquetrum* L. – Three-cornered Leek
Objective:	Assess the risks associated with this species in Ireland
Version:	Final 15/09/2014
Author(s)	Erin O'Rourke, Colette O'Flynn
Expert reviewer	Matthew Jebb - National Botanic Gardens

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 **N**on-native species **AP**plication based **R**isk **A**nalysis (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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Author (s):	Dr Erin O'Rourke and Ms. Colette O'Flynn				
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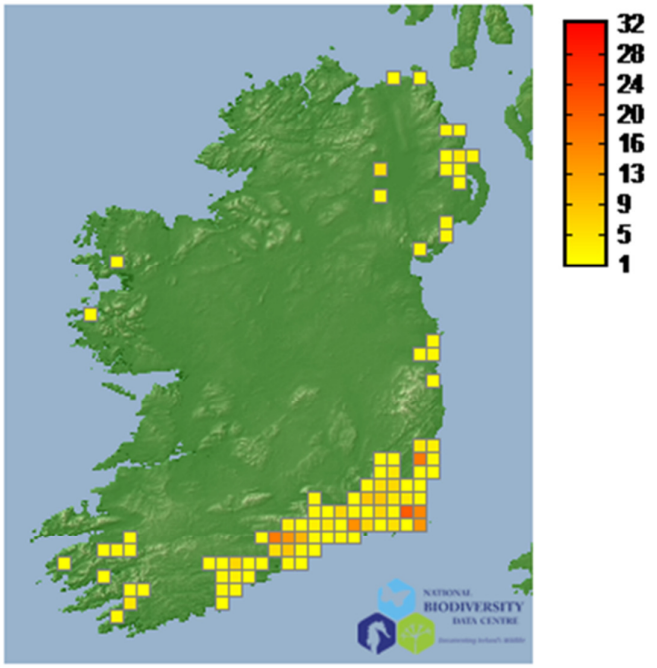
Stage 1 - Organism Information *The aim of this section is to gather basic information about the organism.*			
N	**QUESTION**	**RESPONSE**	**COMMENT**
1	What is the reason for performing the risk assessment?	-	A risk assessment is required as this species is listed as a "Non-native species subject to 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	*Allium triquetrum* L. – Three-cornered leek Taxonomy: Kingdom: Plantae Phylum: Magnoliophyta Class: Liliopsida Order: Asparagales Family: Amaryllidaceae Genus: Allium Species triquetrum (EASIN, 2014) Synonyms: *Allium medium* G.Don, *Allium opizii* Wolfner. Common names: Three cornered garlic, wild garlic, angled onion, onion weed, three-cornered garlic, triquetrous garlic, triquetrous leek, flowering onion, stinking onion, triangular stalked garlic, white-flowered onion and wild onion (DGS, 2013; UQ, 2013).
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.	-	*Allium triquetrum* is a spring-flowering, bulbous, perennial herb (Preston *et al.*, 2002). Stems to 45 cm, triangular in section with very acute angles; leaves 2-5, flat, scarcely keeled, 4-12 mm wide; inflorescence of flowers only; tepals 10-18 mm, white with strong green line; stamens shorter than tepals; filaments simple (Stace, 1997).
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment for Ireland)	YES	In Ireland, a preliminary risk assessment was previously carried out. This was a prioritisation risk assessment as part of the Risk Analysis and Prioritisation for Invasive and Non-native Species in Ireland and Northern Ireland (ISI, 2012). It designated *Allium triquetrum* as a “medium risk” invasive species.
6	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	PARTIAL	Only a preliminary risk assessment was previously conducted in Ireland (refer to Question 5)

Stage 1 - Organism Information *The aim of this section is to gather basic information about the organism.*			
N	**QUESTION**	**RESPONSE**	**COMMENT**
7	Where is the organism native?	-	*Allium triquetrum* is native to the west and central Mediterranean (Preston *et al*., 2002; Stace, 1997) - Europe: Portugal, Southern Spain (including the Balearics), France (including Corsica), Italy (including Sardinia and Sicily) and Africa: Algeria, Morocco and Tunisia (Dowen, 2011).
8	What is the current global distribution of the organism (excluding Ireland)?	-	Including its native range (refer to Question 6) the species has a current global distribution spanning Australia, Argentina, Azores, Canaries, Channel Islands, England, Ireland, Madeira, New Zealand, Northern Ireland, Scotland, South Africa, Turkey, Wales (CABI, 2014; DAISIE, 2014; Dowen, 2011).
9	What is the current distribution of the organism in Ireland?	-	The species is widely distributed in the south and south east of Ireland, outside of which it has a scattered occurrence (Figure 1; Preston *et al*, 2002; Reynolds, 2002; Stace, 1997). There is a large discrepancy between the Botanical Society of Britain and Ireland (BSBI) maps and those of the National Biodiversity Data Centre (NBDC) suggesting that the true extent of the species in Ireland may be greater. It is likely, as in the case with many alien plants, to be poorly reported in that many of the sites it grows in are in large demesnes or wild gardens, many of which are privately owned and often not recorded as 'wild' places as they border the margins of cultivation. The extent of Waterford and Wexford records is largely due to intensive floristic work in these two counties.

Stage 1 - Organism Information *The aim of this section is to gather basic information about the organism.*			
N	**QUESTION**	**RESPONSE**	**COMMENT**
			 **Figure 1.** Map showing most of the known verified records for *Allium triquetrum* L. – Three-cornered leek per 10km^2 in Ireland. Colour scale bar slows density of records per 10km (National Biodiversity Data Centre, 2014).
10	Is the organism known to be invasive anywhere in the world?	YES	In the United Kingdom *Allium triquetrum* is listed on Schedule 9 of the Wildlife & Countryside Act, which makes it an offence to deliberately introduce it (Thomas, 2011). Invasive populations exist in west Cornwall, the Channel Islands and along the south coast (Dowen, 2011). It is listed as a noxious weed of Victoria, South Australia and Tasmania (Cooke, 2010; UQ, 2011). In Ireland, Reynolds (2002) describes *A. triquetrum* as a "*fairly common garden escape*". Steps to prevent the species escaping from garden habitat into the wild are promoted under a 'Be Plant Wise' campaign by Invasive Species Ireland, supported by the National Botanic Gardens (NBG, 2012).

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	There are few active/future pathways relevant to the entry of *A. triquetrum*.
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 trade 2. Contaminate horticulture	HIGH	Potential for the species (as seed, bulb and/or plant) to be sourced through the horticultural trade for use as a garden plant. From gardens to which it is introduced it may escape and become naturalised/invasive. Potential for the species (as seed and/or bulb) to enter Ireland as a contaminate of imported horticultural plants and/or associated soil mediums.

Pathway 1 – Horticultural 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	HIGH	The species may be imported for the horticultural trade and planted by gardeners, mainly for its early season flowers and also as all the plant is edible.
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?	MODERATELY LIKELY	MEDIUM	There is no reliable data that exists to allow a reasonable assessment of the number of *A. triquetrum* travelling along this pathway. However, movement would be dependent on the level of supply and demand, with demand not expected to be high. Intentional planting in gardens would only be expected to account for a small volume of entry. With a developing appreciation for the invasiveness of the species, as reflected in online gardening blogs (see, for example, http://www.pfaf.org/user/plant.aspx?LatinName=Allium+triquetrum), the plant may not often be deliberately cultivated these days. However, for a viable population to develop only a small number of plants are needed and suitable habitat (see Question 1.08) is plentiful and in close proximity to human habitation.

Pathway 1 – Horticultural trade				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	LIKELY	MEDIUM	It is likely that the species could enter Ireland undetected and without the knowledge of the relevant authority, particularly as seeds and/or bulbs via internet horticultural trade. It may be less likely for the species to go undetected as a plant, especially if it is labeled and checked at an entry point into the country. Car ferry transportation is the most likely route, but such traffic is routinely ignored. Once planted it is only likely to be detected when it flowers in spring (April to May).
1.06	How likely is the organism to survive during passage along the pathway?	LIKELY	HIGH	Likely for any housing and nutritional requirements to be catered for by the horticultural trader and subsequently by the gardener. The species is known to have previously establishment via this pathway (refer to Question 1.03), substantiating that survival during passage in likely. The bulbous nature of the species means that survival is more or less guarantied.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	MEDIUM	Horticultural traders and gardeners are likely to stock and buy *A. triquetrum* at the time of year most appropriate to planting, with seeds sown best in spring and bulbs sown best in late summer (DGS, 2013).
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	The species is intentionally planted domestically in horticultural habitat i.e. gardens. From gardens the species can spread via natural and human assisted dispersal (refer to Questions 3.02 and 3.03). Typical habitats where it is known to invade or naturalise include hedgerows, parks, footpaths, roadsides, waste areas, disturbed/cultivated sites, orchards, open woodlands, forests, moist pastures and riparian areas (Reynolds, 2002; Stace, 1997). The species is likely to encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000).
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	MODERATELY LIKELY	MEDIUM	The horticultural trade is the primary factor in the entry of this species to new areas. Intentional planting in gardens would only be expected to account for a small volume of entry. Well informed gardeners are likely to appreciate the invasive traits of *A. triquetrum* and not plant it.
1.10	Do other pathways need to be considered?	YES	HIGH	

Pathway 2 – Contaminate horticulture				
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	*Allium triquetrum* may travel as a hitchhiker through contamination of other plants imported, sold or donated in pots from contaminated gardens.
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	There are no reliable data that exists to allow a reasonable assessment of the number of *A. triquetrum* that may, or may not, be brought inadvertently into Ireland through contaminated horticultural plants/material. There is a large horticultural trade of potted and bare-rooted shrubs into Ireland, which are largely nursery grown in sterile composts. But there is a smaller trade from specialist nurseries that can introduce contaminated soil. The numbers of *A. triquetrum* likely to travel along this pathway (i.e. as a contaminate of plants and/or soil) would be considered dependent on the smaller trade from specialist nurseries.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	VERY LIKELY	HIGH	As a contaminate of horticultural material it is very likely that the species could enter Ireland undetected and without the knowledge of the relevant authority.
1.06	How likely is the organism to survive during passage along the pathway?	LIKELY	HIGH	The bulbous nature of the species means that survival is more or less guarantied.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	MEDIUM	Establishment would be initially dependent on successful germination.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	*A. triquetrum* can inhabit a wide range of habitats, including hedgerows, parks, footpaths, roadsides, waste areas, disturbed/cultivated sites, orchards, open woodlands, forests, moist pastures and riparian areas (Reynolds, 2002; Stace, 1997) and can spread to and from these habitats via natural and human assisted dispersal (refer to Questions 3.02 and 3.03). The species is likely to encounter such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000).

Pathway 2 – Contaminate horticulture				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	UNLIKELY	MEDIUM	Entry of the species via the contaminate horticulture pathway would be considered dependent on existing supply and demand for plants imported, sold or donated in pots from countries where *A. triquetrum* is native and/or introduced (refer to Question 8) and with such plants and associated soil mediums acting as likely hosts for seeds and/or bulbs of the species to hitchhike with. There is, however, no reliable data that exists to allow a reasonable assessment of the likelihood or even past knowledge of *A. triquetrum* entry via contaminate horticulture; which in and of itself may make it reasonable to infer that the numbers and likelihood of *A. triquetrum* travelling along this pathway are low. There is a greater likelihood for *A. triquetrum* to enter the Ireland intentionally via the horticultural trade (refer to Pathway 1: Question 1.09).
1.10	Do other pathways need to be considered?	NO	HIGH	

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).	MODERATELY LIKELY	MEDIUM	The horticultural trade is the primary factor in the entry of this species to new areas. Intentional planting in gardens would only be expected to account for a small volume of entry, with well informed gardener providers and gardeners likely to appreciate the invasive traits of *A. triquetrum* and not sell or plant it. Entry of the species via the contaminate horticulture pathway would be considered dependent on existing supply and demand for plants imported, sold or donated in pots from countries where *A. triquetrum* is native and/or introduced (refer to Question 8) and with such plants and associated soil mediums acting as likely hosts for seeds of the species to hitchhike with. There is, however, no reliable data that exists to allow a reasonable assessment of the likelihood or even past knowledge of *A. triquetrum* entry via contaminate horticulture; which in and of itself may make it reasonable to infer that the numbers and likelihood of *A. triquetrum* travelling along this pathway are 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
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	YES&NO	MEDIUM	The species is established in the south and south east of Ireland, outside of which it has a scattered occurrence (Figure 1; Preston *et al*, 2002). As it is not as well established outside of this region, the rest of this section is completed.
2.02	How likely is it that the organism will be able to establish in Ireland based on the similarity between local climatic conditions and the organism's current global distribution?	LIKELY	HIGH	*Allium triquetrum* has become best established in the mildest regions of Ireland, where the climate is most comparable to the western and central Mediterranean origin of the species. It is established in the south and south east (Figure 1) where mean daily minimum temperatures are 5-7°C and mean daily maximum temperatures are 5.5-7.5°C (Cummins and Collins, 1996). This climatic region may be reflective of the species current edge of range in Ireland. However, as global warming takes effect its range would be expected to expand northwardly.
2.03	How likely is it that the organism will be able to establish in Ireland based on the similarity between other local abiotic conditions and the organism's current global distribution?	LIKELY	HIGH	It prefers a rich, moist, well-drained soil and thrives in both light (sandy) and medium (loamy) soils (BSBI, 2011).
2.04	How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland?	VERY LIKELY	HIGH	As a garden plant the species is often established in long grass that transitions into suitable wild habitat, particularly roadsides, base of hedgerows and disturbed ground. The species is very likely to encounter and/or be introduced to such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000). Accidental distribution probably occurs when the plant travels as a hitchhiker through contamination of other plants sold or donated in pots from contaminated gardens.
2.05	How likely is it that establishment will occur despite competition from existing species in Ireland?	LIKELY	MEDIUM	*Allium triquetrum* may be competitively advantaged; coming into growth and flowering early in the spring allows for the species to dominant before competition from other species becomes an issue (Dowen, 2011; BSBI, 2011)
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?	LIKELY	MEDIUM	Adult stage may be vulnerable to slug damage and mildew, while seeds are largely resistant to herbivory (NNSS, 2011). *Allium triquetrum* is thought to have repellent properties against insects (Riotte, 1978).

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
2.07	How likely is it that establishment will occur despite existing management practices?	LIKELY	MEDIUM	At present we are not aware of any existing targeted management strategies that will limit or prevent the establishment of this species in Ireland i.e. the species is not under targeted control.
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?	LIKELY	MEDIUM	The trimming of hedgerows and roadside verges at the time the species is in leaf and/or flowering, long-distance transport of seed in fodder or earth-moving machinery may facilitate the spread and establishment of the species (Cooke, 2010).
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?	LIKELY	MEDIUM	There are no known eradication campaigns currently in place in Ireland. With reference to Question 2.10, eradication of the plant would be difficult. Control in other countries has been show to require a combination of manual cultivation, removal and herbicide spraying of the exposed bulbs (HerbiGuide, 2014). While manual removal of bulbs is feasible for isolated occurences, widespread eradication in well-established areas (i.e. the south and south east of Ireland) may not be considered economically viable and may also impact on non-target species.
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?	LIKELY	MEDIUM	This plant reproduces by seed and also vegetatively by its long-lived bulbs (UQ, 2011).
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?	LIKELY	MEDIUM	*Allium triquetrum* spreads vegetatively in clumps, while seeds are spread by ants or carried along roads by vehicles (BSBI, 2011; Preston *et al.*, 2002).
2.12	How likely is it that the organism's adaptability will facilitate its establishment?	LIKELY	MEDIUM	Prefers shady-areas but is fairly tolerant of most conditions (Dowen, 2011; Downs Garden Services, 2013)
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?	LIKELY	MEDIUM	Low genetic diversity in the founder population is unlikely to prevent establishments (Dowen, 2011).
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	HIGH	*Allium triquetrum* is thought to have been introduced to Ireland some three-hundred years ago (Devlin, 2014) and is established in the south and south east of Ireland, outside of which it has a scattered occurrence (Figure 1; Preston *et al*, 2002; Reynolds, 2002; Stace, 1997).

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
2.15	If the organism does not establish, then how likely is it that transient populations will continue to occur?	LIKELY	MEDIUM	In Ireland, where the climatic conditions are not ideal for establishment and spread, there are scattered populations of the species, which are sometimes short lived (Preston *et al*., 2002).
2.16	Estimate the overall likelihood of establishment. Mention any key issues in the comments box	VERY LIKELY	HIGH	Garden escapes, either via natural dispersal or human assistance, allow for the establishment of *A. triquetrum* in the wild. Suitable wild habitat is plentiful close to the species garden habitation. The species is widely distributed in the south and south east of Ireland, outside of which it has a scattered occurrence (Figure 1; Preston *et al*, 2002; Reynolds, 2002; Stace, 1997). This climatic region may be reflective of the species current edge of range in Ireland. However, as global warming takes effect its range would be expected to expand northwardly.

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%	MEDIUM	Typical habitats where it is known to invade or naturalise include hedgerows, parks, footpaths, roadsides, waste areas, disturbed/cultivated sites, orchards, open woodlands, forests, moist pastures and riparian areas (Reynolds, 2002; Stace, 1997). The species is likely to encounter and/or be introduced to such suitable habitat within the Irish landscape (CORINE, 2006; Fossitt, 2000). With reference to the CORINE (2006) land cover classification *Allium triquetrum* has the potential to establish in or along the edges of road and rail networks (0.06%), dumps (0.01%), construction sites (0.03%), green urban areas (0.04%), pasture (50.53%), land principally occupied by agriculture with areas of natural vegetation (6.27%), broad leaved forests (0.42%), coniferous forest (3.23%), mixed forest (0.42%), natural grassland (1.26%), transitional woodland (5.89%) and stream courses (0.11%). *Allium triquetrum* preference for rich, moist, well draining soil under mild climatic conditions makes its potential to spread over such a large land surface area unlikely. However, under a changing milder and moister climate, as is predicted for Ireland (Sweeney *et al*., 2003), its range would be expected to expand to some extent. Invasion of pasture (50.53% of land cover), which is under continual management for the production of grass fodder and livestock, is highly unlikely, and is therefore not taken into account.
3.02	How important is the expected spread of this organism in Ireland by natural means (minimal, minor, moderate, major or massive)?	MODERATE	MEDIUM	*Allium triquetrum* spreads vegetatively in clumps, while seeds are spread by ants (BSBI, 2011; Preston *et al*., 2002). Localised spread of the species is likely underpinned by natural dispersal.
3.03	How important is the expected spread of this organism in Ireland by human assistance (minimal, minor, moderate, major or massive)?	MAJOR	MEDIUM	Humans aid the spread for *A. triquetrum* through garden discards and the seed is also transported in the air turbulence created by vehicles along road corridors (BSBI, 2011). Human assisted dispersal plays a greater role in the long distance spread of the species relative to natural dispersal. Transportation of bulbils and/or seeds on grass-cutting equipment is likely to spread the plant rapidly following introduction into semi-natural garden areas.

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
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MAJOR	HIGH	*Allium triquetrum* is increasingly abundant and widespread in milder areas with scattered, sometimes short-lived, populations elsewhere (Preston *et al*., 2002). The current climatic conditions play the greatest role in containment of the species at a regional level (refer to Question 2.02 and Figure 1).
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	0-10%	MEDIUM	*Allium triquetrum* is present in 113 of the ~1018 10 km squares that constitute Ireland (Preston *et al*., 2002). It does not currently occur in more than 0-10% of land cover.
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%	MEDIUM	Unlike climatic conditions, the availability of suitable habitat would not be expected as a limiting factor in the spread of the species (refer to Question 3.01). Habitat in which the species is found to occur is likely equally as common in parts of Ireland that have not yet been colonised by *A. triquetrum*. The effects of a warming climate over the next five years may increase the area currently occupied by this species where it already occurs. Establishment of new sites is probably less likely than in the past, due to a better public understanding of the species as an invasive plant.
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.	10-160	MEDIUM	Any timeframe during which the Irish climate experiences warming effects as a result of climate change may be significant to the further spread of the species.
3.08	In this timeframe, what proportion of the area (including any currently occupied areas) is likely to have been invaded by this organism?	0-10%	MEDIUM	Given the large area of suitable grassland under management in the country (refer to Question 3.01) the proportion invaded by the species will always be well below 10%.
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.	-	MEDIUM	Under suitable climatic conditions the area north of the species' stronghold along the south and south eastern seaboard may be most endangered to invasion. Roadside verges are most like to be at risk of invasion in the future (Dowen, 2011, BSBI, 2011).

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
3.10	Estimate the overall potential for future spread for this organism in (very slowly, slowly, moderately, rapidly or very rapidly). Use the justification box to indicate any key issues.	MODERATELY	HIGH	Further spread of the species is dependent on suitable climatic conditions, which are likely to manifest over the coming years as a result of global warming. Habitat availability is not expected to be a limiting factor to future spread. Movement of seed in the air turbulence of vehicles along road corridors is likely to be the most significant means of future long distance spread of the species, with roadside verges the most at risk habitat to future spread.

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?	N/A	MEDIUM	In Australia it is considered likely to taint milk (Cooke, 2010; BSBI, 2011). However, there is no knowledge of any global economic costs incurred to-date.
4.02	How great has the economic cost of the organism been in Ireland from the time of introduction to the present? Exclude any costs associated with managing the organism from your answer.	N/A	HIGH	There is no knowledge of any economic costs incurred to-date in Ireland.
4.03	How great is the economic cost of the organism likely to be in the future in Ireland? Exclude any costs associated with managing the organism from your answer.	N/A	HIGH	If any economic costs where to be incurred they are likely to only be associated with management of the species.
4.04	How great have the economic costs of managing this organism been in Ireland from the time of introduction to the present?	N/A	HIGH	There is no knowledge of any economic costs incurred to-date in Ireland.
4.05	How great is the economic cost of managing this organism likely to be in the future in Ireland?	MODERATE	MEDIUM	Economic cost would only arise if the species was to become subject to targeted control measures in agricultural, transport or forestry sectors. It is not noted as a weed of agricultural crop production in Ireland and control of the species if or when it occurs on the borders of arable fields would not be additional to the existing herbicidal practices.
4.06	How important is environmental harm caused by the organism within its global distribution?	MAJOR	MEDIUM	In Australia *A.triquetrum* has been shown to reduce understory biodiversity significantly and to affect regeneration of native flora. It forms monocultures and its allelopathic traits endanger species such as orchids, native lilies and grasses (Tehranchian, 2011).
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	MINOR	MEDIUM	There is no published literature on the impact of *A. triquetrum* on biodiversity in Ireland to-date. *Allium triquetrum* can become dominant in grass swards where it has been present for over 10 years, total cover can be as high as 10-33%. There is no data on the effects of such cover on native species especially as many other cultivated species (Narcissus, Crocus, Hyacinthoides etc.) are often present.

Stage 2 - Detailed assessment: Section D - Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
4.08	How important is the impact of the organism on biodiversity likely to be in the future in Ireland?	MODERATE	MEDIUM	Spread of the species to semi-natural grassland and the potential for the species to form dense monocultural masses, may pose a threat to indigenous biodiversity (Dowen, 2011; BSBI, 2011). The life cycle of *A. triquetrum* means it only has the potential to effect low growing spring flowers, with native bluebells considered to be at risk (Dowen, 2011).
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	N/A	MEDIUM	There is no knowledge of any alteration of ecosystem function to-date.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the future?	MINIMAL	MEDIUM	The types of grassland where *A.triquetrum* becomes invasive suggests that the impact on ecosystem function will be slight.
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.	N/A	MEDIUM	There is no knowledge of any decline in conservation status to-date.
4.12	How important is decline in conservation status caused by the organism likely to be in the future in Ireland?	MODERATE	MEDIUM	If the species, over time, is allowed to establish dense stands in protected or vulnerable habitats, the environmental impacts are likely to be in line with those discussed in Question 4.08.
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?	N/A	MEDIUM	There is no knowledge of any social or human health harm caused by *A.triquetrum* within its global distribution to-date.
4.14	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within Ireland?	N/A	MEDIUM	There is no knowledge of any social or human health harm caused by *A.triquetrum* within Ireland to-date.
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	N/A	MEDIUM	No hybrids are known with other species of *Allium* species.

Stage 2 - Detailed assessment: Section D - Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
	effects more serious?			
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)?	N/A	MEDIUM	The species is not known as a host or habitat for pests or diseases.
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.	N/A	MEDIUM	We are not aware of any other impacts the introduction of this species would have.
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	MEDIUM	Likely for the expected impacts of *A. triquetrum* to be unaltered by any potential natural enemies (refer to Question 2.06).
4.19	Indicate any parts of 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.	-	MEDIUM	Currently any potential economic, environmental and social impacts would be most likely to occur in the species strong hold, along the south eastern seaboard. Within this range it may have the potential to become an economic and environmental problem in areas of agricultural production or conservation interest. Social impacts are considered negligible.
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MODERATE	MEDIUM	No known social or economic impacts to-date. If any economic costs where to be incurred they are likely to only be associated with management of the species within the agricultural sector. May pose a threat to biodiversity where the plant forms early season dense monocultural masses, particularly at protected sites.

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	MODERATE	MEDIUM	The horticultural trade is the primary factor in the entry of this species to new areas. Intentional or accidental planting in gardens would only be expected to account for a small volume of entry. Well-informed gardeners are likely to appreciate the invasive traits of *A. triquetrum* and not plant it. The species is widely distributed in the south and south east of Ireland, outside of which it has a scattered occurrence (Figure 1; Preston *et al*, 2002; Reynolds, 2002; Stace, 1997). This climatic region may be reflective of the species current edge of range in Ireland. Garden escapes, either via natural dispersal or human assistance, allow for the establishment of *A. triquetrum* in the wild. Suitable wild habitat is plentiful close to the species garden habitation. Further spread of the species is dependent on suitable climatic conditions, which are likely to manifest over the coming years as a result of global warming. Habitat availability is not expected to be a limiting factor to future spread. Movement of seed in the air turbulence of vehicles along road corridors is likely to be the most significant means of future long distance spread of the species, with roadside verges the most at risk habitat to future spread. Transfer of the species as a hitch-hiker in potted plants is likely to act as an occasional opportunity for dispersal between gardens. No know social or economic impacts to-date. If any economic costs where to be incurred they are likely to only be associated with management of the species. May pose a threat to biodiversity where the plant forms early season dense monocultural masses, particularly at protected sites.

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?	LIKELY	HIGH	*Allium triquetrum* has a great potential to spread under the influence of a warming climate, with Dowen (2011) describing it as one of the species most likely to further increase its range in Britain as global warming takes effect.
6.02	What is the likely timeframe for such changes (5, 10, 15, 20, 50 or 100 years)?	5-100	MEDIUM	Any timeframe during which the Irish climate experiences as warming effect as a result of climate change may be significant to the further spread of the species.
6.03	What aspects of the risk assessment are most likely to change as a result of climate change		MEDIUM	The increasingly favourable climatic conditions as a result of climate change would require for the risk assessment on the invasiveness of *A. triquetrum* to reconsider establishment and spread and their associated potential impacts to the Irish economy, environment and society.
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.	-	MEDIUM	An unpublished thesis conducted on possible biological control of A. triquetrum in Australia (Tehranchian, 2011) provides limited additional information to that presented here. The most common habitat for the species is mechanically cut long-grass areas in 'wild' gardens or on road margins. There is a need for research into understanding if the species can survive in hay meadow habitats or under various grazing regimes to determine the possible risk of the species invading these habitats in the future (see questions 2.04, 2.08 and 3.01).

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