Risk analysis and prioritisation

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For invasive and non-native species in Ireland and Northern Ireland

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EXECUTIVE SUMMARY

Many non-native species contribute greatly to our economies and society at large however, those species that do become invasive, and their genetic material, can have a major impact on biodiversity. Article 8h of the Convention on Biological Diversity requires signatories to 'prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species'.

Recognising which species will become invasive in a particular area is a notoriously difficult task. Additionally, managing species which are currently presenting ecological problems in a co-ordinated and joint up manner requires an informed policy response which proceeds in a transparent manner open to public scrutiny. Provision of a system(s) to meet such requirements is needed.

Risk assessment is one tool that can allow governments to make decisions in a transparent and traceable manner. Risk assessment however is not a clear cut process. Risk assessment means very different things to different people and is also context dependant. A two tiered system of risk assessment has been developed for Ireland and Northern Ireland:

The first is the prioritisation risk assessment. This assessment is key to understanding the relative risk associated with a larger array of species. This assessment is required primarily for prioritisation and informing decisions that do not have an impact on trade. The prioritisation risk assessment was carried out for 377 non-native species recorded in Ireland and 342 non-native species not known to present in Ireland. These species were assessed, scored and ranked into impact categories of high, medium and low.

The second assessment is essentially a more detailed assessment of the risks and uncertainties surrounding a particular species, group of species or pathway of concern. The purpose of this risk assessment is to gather additional information on a particular species of concern when there is an identified need to do so. This will be used, where required, for the purpose of supporting any trade restrictions. It is important to note that undertaking a detailed risk assessment will not necessarily result in trade restrictions.

Recommendations are made in relation to both risk assessments and how they might operate in the future. It is also recommended that both assessments are subject to continuous development as more data on invasive species becomes available and the regulatory framework evolves in Ireland, Northern Ireland, United Kingdom and at the European Union level.

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1.   BACKGROUND

When managing invasive species, policy decision makers are, more often than not, faced with escalating pressures in terms of which species to manage coupled with ensuring effective and responsible expenditure of public resources to protect native species and ecosystems. There are many non-native (a.k.a. alien) species already present in Ireland and Northern Ireland, some of which negatively impact on biodiversity while others do not. At present, it is beyond our capability to manage all of the species which have an impact. It is also beyond our capability to prevent all invasive species from arriving to Ireland.

Many non-native species contribute greatly to our economies and society at large however, those species that do become invasive, and their genetic material, can have a major impact on biodiversity. Invasive species can transform ecosystems (e.g. Slipper limpet), and threaten native (e.g. rats predating on nesting seabirds) and endangered species (e.g. white-clawed crayfish threatened by non-native crayfish species). The problems caused by invasive species are so serious that the introduction of these species is identified as one of the main causes of biodiversity loss worldwide[1]. This has been recognized in decisions on alien species agreed by the contracting parties to the Convention on Biological Diversity (CBD), including Ireland and the United Kingdom[2].

Article 8h of the Convention on Biological Diversity requires signatories to 'prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species'. The island of Ireland is just one example of where a co-ordinated joined up approach to achieve effective management and prevention of species invasions is needed. International co-operation is vital as there are protected sites which span the border; there is a need for early detection and a coordinated response to new invasions; plus management of existing invasive species to reduce their threat and further spread.

Europe is a major market for import and export in international trade, and this commerce has facilitated the spread of non-native and invasive species into and within the region through a variety of means[3]. The majority of species introductions to islands originate through patterns of trade flow; therefore many introductions to the island of Ireland have originated from Great Britain, due to its close proximity and frequent trade interactions[4]. The impacts of invasions may be seen locally, but the drivers of biological invasion are, to an increasing degree, global[5].

To date, there have been no complete authoritative estimates of the number of non-native species recorded in Ireland. Some resources do exists such as the Catalogue of Alien Plants in Ireland[6] and also the work carried out by DAISIE[7]. Equally, there are no authoritative lists of non-

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[1] IUCN (The World Conservation Union). (2000) *IUCN Guidelines for the Prevention of Biodiversity Loss caused by Alien Invasive Species.* Fifth Meeting of the Conference of the Parties to the Convention on Biological Diversity. (Nairobi, Kenya 15-26 May 2000).
[2] Stokes, K., O'Neill, K. & McDonald, R.A. 2006. Invasive species in Ireland. Report to Environment & Heritage Service and National Parks & Wildlife Service by Quercus, Queens University. Environment & Heritage Service, Belfast and National Parks & Wildlife Service, Dublin.

[3] Hulme, P. 2007. Biological Invasions in Europe: Drivers, Pressures, States, Impacts and Responses. *Issues in Environmental Science and Technology.* 25, 56-80.

[4] Ermgassen, P.S.E. and Aldridge, D.C. 2009. Patterns of Invasion in Western Europe: Can We Predict Which Aquatic Invaders to Expect in Britain and Ireland? *Presentation given at the 16th International Conference on Aquatic Invasive Species, Montreal, Quebec, Canada.*

[5] *Front Ecol Environ* 2008; 6(9): 485–492, doi:10.1890/070064

[6] Reynolds, S. (2002) A catalogue of alien plants in Ireland. Occasional papers No. 14, National Botanic Gardens, Dublin.

native species in trade that could become established in the wild in Ireland or Northern Ireland, posing a threat to native biodiversity, conservation goals, economic development and social interests. The Invasive Species in Ireland report provides a review of the impacts associated with invasive species in Ireland and Northern Ireland. In Ireland, the most prominent of the negative impacts appears to be direct competition with native biota, whilst alteration to habitats and the influence of parasites and pathogens are also important. Specific habitat types currently under threat in Ireland from invasive species include freshwater river systems, ponds, mesotrophic lakes, native woodland, lowland heath, coastal floodplain, coastal salt marsh and coastal sand dunes.

Once an invasive species becomes established, it is often difficult and in some cases nearly impossible to eliminate them. Interception or removal of pathways is probably the only effective strategies for reducing future impacts. With limited funds, establishing priorities is key so that money allocated for prevention of invasions is well spent. Prioritising actions requires knowing which species are likely to be most harmful to native ecosystems, current distributions of these species, and how they are likely to be transported to new regions.

Structured and transparent evaluation techniques that both determine and justify management decisions are needed to effectively deal with introduced species in both an ecological and socio-political sense. Coupling this need with knowledge, resource and data limitations has led decision makers to use risk assessment as a means to direct their actions[8].

Risk Analysis (which includes the stages of: Risk Assessment, Risk Management and Risk Communication) is a vital component of any invasive species decision-making process. With respect to invasive species, risk analysis is a key tool to assist decision makers in making informed decisions despite the often large element of uncertainty[9].

The risk analysis process includes**:**
1. the assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information (i.e., risk assessment), and
2. to the identification of measures that can be implemented to reduce or manage these risks (i.e., risk management), taking into account socio-economic and cultural considerations. (CBD) (note: different definitions are used in other frameworks, but the intent is similar).

This report focuses on the first element of risk analysis which is risk assessment. The purpose of the risk assessment process is to identify risks and inform management decisions. It is not intended to inform a cost/benefit analysis associated with the introduction of any non-native species.

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[7] http://www.europe-aliens.org/regionFactsheet.do?regionId=IRE-IR#

[8] Campbell, ML (2009) *An overview of risk assessment in a marine biosecurity context.* In: Biological Invasions in Marine Ecosystems. Ecological Studies (Vol. 204). Springer, Heildelberg, Germany, pp. 353-373. ISBN 978-3-540-79235-2

[9] https://circabc.europa.eu/sd/d/b5b9b86b-32b8-4d5c-9295-50cd448b987c/3.Risk%20Analysis%20WG1.pdf

Risk assessment of invasive species is the evaluation of the likelihood of entry, establishment or spread of a pest or disease within the territory of an importing Member according to the sanitary or phytosanitary measures which might be applied, and of the associated potential biological and economic consequences; or the evaluation of the potential for adverse effects on human or animal health arising from the presence of additives, contaminants, toxins or disease-causing organisms in food, beverages or feedstuffs[10].

1.1   Origin of this report

The risk assessment detailed in this report was developed and carried out by Invasive Species Ireland which is a cross border initiative funded by both governments through the Northern Ireland Environment Agency and National Parks and Wildlife Service. This report contributes, either fully or partially, to the following requirements in the Invasive Species Ireland programme of work:

Requirement 8.1	Review and refine the existing risk assessment methodology if necessary.
Requirement 8.2	Re-run the risk assessment procedure for all known established and potential non-native invasive species where new information is available.
Requirement 8.3	Carrying out a more detailed risk assessment, for the purposes of banning for sale of those species requested by the Project Steering Group. This element will require direct liaison with relevant organisations in GB.
Requirement 9.1	Carry out pathway vectors risk assessment analysis.
Requirement 9.2	Produce management strategies for high risk pathways.

1.2   Key achievement

The risk assessment was carried out for 377 non-native species recorded in Ireland and 342 non-native species not known to present in Ireland. These species were assessed, scored and ranked into impact categories of high, medium and low risk.

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[10] http://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm

2.   RISK ANALYSIS METODOLOGY FOR IRELAND AND NORTHERN IRELAND

Recognising which species will become invasive in a particular area is a notoriously difficult task. Additionally, managing species which are currently presenting ecological problems in a co-ordinated and joint up manner requires an informed policy response which proceeds in a transparent manner open to public scrutiny. Provision of a system(s) to meet such requirements is needed.

2.1   Overview of proposed risk assessment process

To date, the risk assessment process for Ireland and Northern Ireland has been an evolving framework. The strength of the framework is that it allowed the cost effective prioritisation of invasive species and development of lists of species which are of concern allowing state agencies to better direct their efforts. However, weaknesses in this framework is that the previous assessment was never formally reported on and that while it could inform actions to take, it was never intended to underpin legislation measures directly or any trade restrictions.

The lack of an accompanying report has been corrected in the current risk assessment with this report. However; since the development of the previous assessment, the need for more detailed risk assessment suitable to underpin legislation developments with any potential implications for trade has become more prominent. This reflects the new regulations in both Ireland and Northern Ireland (see Wildlife (Northern Ireland) Order 1985 (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011). There is now a need for a two tiered system of risk assessment for Ireland and Northern Ireland:

- The first is the prioritisation risk assessment as outlined in Section 3 of this report. This assessment is key to understanding the relative risk associated with a larger array of species. This assessment is required primarily for prioritisation and informing decisions that do not have an impact on trade.
- The second assessment is essentially a more detailed assessment of the risks and uncertainties surrounding a particular species, group of species or pathway of concern. The purpose of this risk assessment is to gather additional information on a particular species of concern when there is an identified need to do so. This will be used, where required, for the purpose of supporting any trade restrictions. It is important to note that undertaking a detailed risk assessment will not necessarily result in trade restrictions.

The approach detailed in this document is disaggregated into two separate assessment processes:
1. Prioritisation risk assessment process (discussed in Section 3);
2. Detailed risk assessment (discussed in Section 4).

This report details the results and our analysis of the prioritisation risk assessment. It also introduces the detailed risk assessment process, its structure and recommended uses. A generalised overview is provided for in Figure 1.
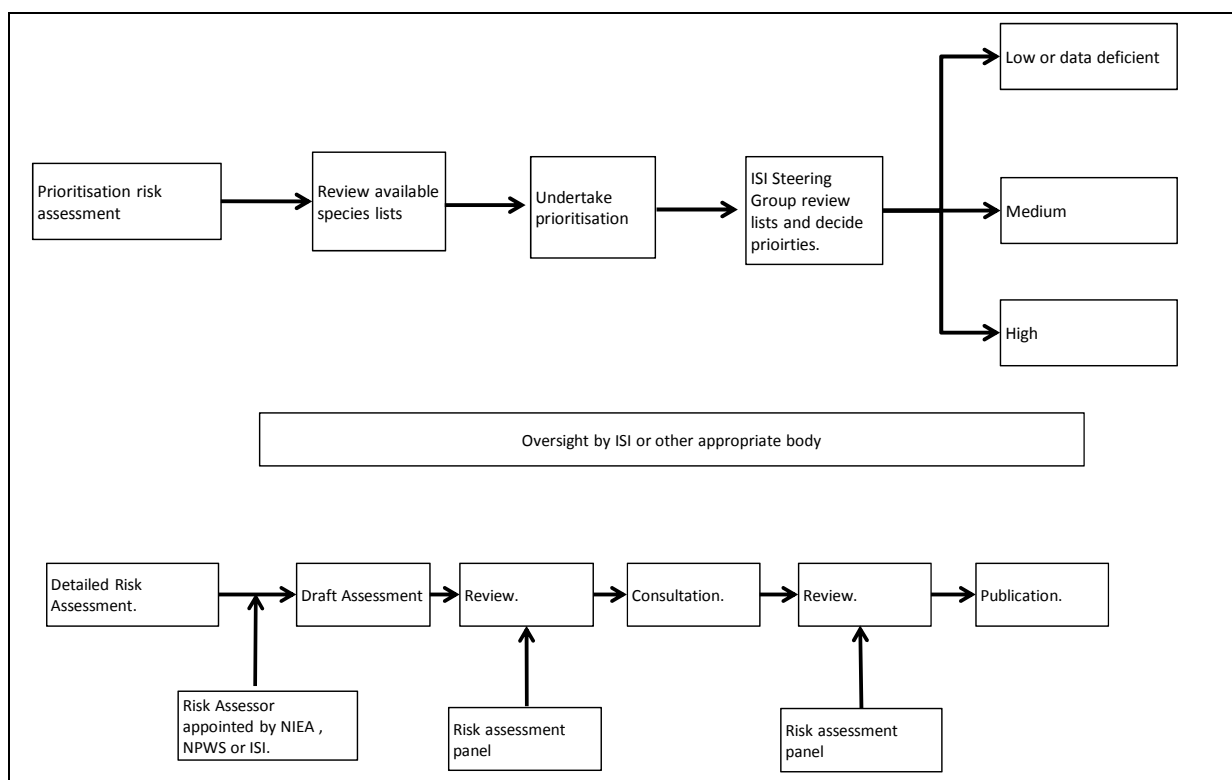
Figure 1: Flow chart showing a generalised overview of the two risk assessment methodologies for Ireland and Northern Ireland.

Note that the prioritisation assessment is to inform government decisions and actions while the more detailed risk assessment is intended to support trade restrictions, legislative developments and greater understanding of risks and options open to government to take. Undertaking a detailed risk assessment may not result in trade restrictions been brought forward. Usually, detailed risk assessments will be subject to consultation while the prioritisation risk assessment will be open for public input to allow improvements on www.invasivespeciesireland.com but not as a formal consultation process.

3.   PRIORITISATION RISK ASSESSMENT PROCESS

It is simply not viable to undertake a detailed risk assessment of all non-native species in Ireland and Northern Ireland. To undertake such a task would require substantial resources both in terms of continuous capital investment and person hours. Additionally, risk assessment is a tool to inform management and policy decisions; it is not the end point in the process.

A risk assessment methodology was developed by Invasive Species Ireland in 2007. The development of the risk assessment methodology was a pro-active measure as there was a need for a system that enabled both governments to prioritise management actions for invasive species that were already established in Ireland and ones that were likely to invade and impact on native biodiversity in the future. The aim of this exercise was to prioritise non-native species already present on the island of Ireland and to also conduct a horizon scanning exercise for species not yet recorded here. The purpose of which is to inform prevention strategies and an early warning system. This was the first attempt to risk assess and prioritise invasive species in Ireland or Northern Ireland. This risk assessment resulted in a series of lists for species of concern which were then in some cases the subject of practical action, education and awareness activities, greater data gathering on distribution and the establishment of an alert list for high impact species not yet recorded in the wild in Ireland or Northern Ireland.

The 2007 methodology, which was not the subject of an accompanying report, formed the basis of the methodology discussed herein. The now updated methodology supersedes the previous version which is withdrawn from public circulation.

3.1   Overview of methodology

3.1.1   Structure

This risk assessment was developed using MS Access. It consists of answering ten questions designed to assess the relative level of risk and allocate the species into high, medium and low risk categories. Scores are justified with a comment or reference to published evidence. Each species was scored by an assessor and the risk rating was calculated from the sum of the responses given by assessors. The results from the initial round of assessments were plotted in a frequency bar chart and the cut off point for each category was decided in conjunction with policy makers:
- High risk species scored 18 and above;
- Medium risk species 14 – 17; and
- Low risk species scored 0 – 13.

Separate assessments are carried out for species recorded (Table 1) on the island of Ireland and species which have not yet been recorded in the wild (hereafter referred to as 'potential species') (Table 2). While the recorded and potential species risk assessments are similar they evaluate the risk from different stages of the invasion process:

- For species recorded in Ireland, the risk assessment is based on questions relating to the species current status here, its ability to colonise successfully, invasion history, associated impacts, and management.
- For potential invasive species the risk assessment includes the likelihood of a species arriving in Ireland and Northern Ireland, its ability to survive in respect to suitable climate and habitat, its ability to spread and have an impact on the conservation goals and economy of an area.

Both the recorded and potential species assessments take into account control measures and societal factors that may limit or facilitate the spread of the species.

Table 1: Assessment criteria and scoring system for species that have been recorded in Ireland and/or Northern Ireland ('Recorded Species').

Factor	Assessment criteria	Maximum score
Invasion history	Does the species currently have a widespread recorded distribution on the island of Ireland?	3
	Is the species currently expanding its range on the island of Ireland?	2
	Is the species in its present range (including Ireland) known to be invasive i.e. to threaten species, habitats or ecosystems?	2
Species spread potential	Is there potential for this species to be spread intentionally or unintentionally across Ireland?	2
Availability of suitable habitats	How widespread are suitable habitats to allow establishment of the species?	2
Impact assessment	Where the species has become established has it impacted upon the conservation objectives for the area?	4
	Is the species poisonous, or does it pose a risk to plant and animal health?	2
	Is the species poisonous, or does it pose a risk to human health due to its parasites, pathogens or other intrinsic factor?	2
	Has the species directly or indirectly caused economic losses in Ireland or elsewhere?	3
Management	Are there acceptable and effective control method/s that can be applied? Assessors are asked to consider control methods for similar or related species in their assessment.	3

Table 2: Assessment criteria and scoring system for species that have not been recorded in Ireland and/or Northern Ireland ('Potential Species').

Factor	Assessment criteria	Maximum score
Identification of nearest donor region	In which of the following donor regions is the nearest population to the island of Ireland?	3
Occurrence in similar climate	Does the species occur in a similar climatic region to the island of Ireland? (click appropriate map below)	2
Pathway of introduction	Is there a realistic pathway for unintentional introduction to Ireland?	2
	Is there potential for this species to be introduced intentionally?	2
Suitability of	Are habitats in Ireland and/or Northern Ireland suitable to allow	2

Factor	Assessment criteria	Maximum score
habitats	establishment of the species?	
Impact assessment	Where the species has become established has it impacted upon the conservation objectives for the area?	4
	Is the species poisonous, or does it pose a risk to plant and animal health?	2
	Is the species poisonous, or does it pose a risk to human health due to its parasites or pathogens or other intrinsic factor?	2
	Has the species directly or indirectly caused economic losses at its home range or where it has become invasive?	2
Management	Are there acceptable and effective control method/s that can be applied?	3

3.1.2   Species selection

Species lists were compiled by searching international, European and domestic online and published (grey and peer reviewed sources) databases and literature on invasive species distributions and impacts.

A variety of relevant databases were examined for information on species already recorded in Ireland and species likely to arrive. Sources used were: ALARM (Assessing Large scale Risks for biodiversity with tested Methods), DAISIE (Delivering Alien Invasive Species Information for Europe), GISP (Global Invasive Species Project), ISSG (Invasive Species Specialist Group), EPPO (European and Mediterranean Plant Protection Organisation) alert lists (EPPO 2008), Alien Plants in Ireland database, National Biodiversity Data Centre, and Habitas. Additional sources of information were reference literature on individual taxonomic groups.

The DAISIE, NOBANIS, and GISP databases were interrogated for potentially invasive non-native species that are present in neighboring North Western European regions. Data on non-native species found in GB but not in Ireland or Northern Ireland was also obtained from the GB NNSS and reports published on their website (www.nonnativespecies.org).

3.1.3   Recorded species data sources

Not all non-native species present in Ireland were included in the database and subject to a risk assessment. Additionally, some species that are not currently recorded from the wild but are known to be in trade, either in Ireland or Northern Ireland, were included in the risk assessment under the recorded species. This approach recognises that it is not always possible to define at what state in the invasion process a species is at particularly in the absence of baseline datasets or surveys to assess individual species populations/viability.

A species is considered as established as soon as it is able to reproduce consistently in the wild and sustain populations over several life-cycles through sexual or asexual modes without direct intervention by man (self-perpetuating populations)[11]. However, particularly when referring to

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[11] http://ias.biodiversity.be/documents/ISEIA_protocol.pdf

species at an early stage in the invasion process, it is not always clear if a self-sustaining population is present in the wild. Once a species is in trade within the risk assessment area it increases the relative risk of that species escaping and becoming established.

3.1.3.1 Native or non-native species

For many species, we do not have sufficient data to decide with certainty if a species arrived in Ireland by natural means or was facilitated by man. This refers to both historic times (for example see Woodman, 1997[12] for information on mammalian species) and current times (some invertebrate species arriving to Ireland in recent times may be natural colonisers or associated with human activity). This situation is not unique to Ireland. For other species, the arrival associated with human activities is clear and unequivocal (Muntjac deer could not have arrived here via natural dispersal). Some species have attained cultural and ecological significance and are now widely accepted to be part of the native flora and fauna of Ireland (example; red deer (see Carden, 2012[13])). It is not the purpose of this report to shed light on the natural colonisation of Ireland. Rather, this report will set out the current understanding of the biota of Ireland in terms of policy in both Northern Ireland and Ireland.

Whether a species should be considered as a native species once it has been extirpated from Ireland and has since been re-introduced to Ireland is another key question. Wild boar (*Sus scrofa*) was found on this island in the past. Although widely regarded as a native species its natural history here is by no means certain. This species is included in this risk assessment process and covers feral pigs whether they be wild boar or wild boar hybrids. The question of whether or not it was once native to the island of Ireland is not the focus of this report. The reports of wild boar/feral pigs in Ireland are as a result of unlicensed release into the wild and not as part of a planned re-introduction programme. Licensed introductions into the wild, of any species, will not generally fall under the remit of ISI.

3.1.3.2 Natural coloniser from Europe or a non-native species

The question of natural colonisation from Europe is one that must be considered carefully. Under environmental or climatic change, it is expected that species will begin to shift their ranges in order to find suitable conditions. However, a certain amount of confusion can arise when considering this. Should we consider this species native or non-native? The approach that will be taken by Invasive Species Ireland is to acknowledge that species will arrive here from continental Europe. Some of these species may have impacts on native species and ecosystems. Species that will fall under the remit of ISI will be those whose introduction/s are facilitated by human activity. This is intended to be a pragmatic approach. This will also encompass species whose introduction to Europe in the first instance was by human activity but which may spread to Ireland *via* natural dispersal (for example, the Sacred Ibis and the ruddy duck). This is known as secondary introduction.

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[12] Woodman, P.C., McCarthy, M., Monaghan, N., 1997. The Irish Quaternary faunaproject. Quaternary Science Reviews 16, 129

[13] Carden RF, McDevitt AD, Zachos FE, Woodman PC, O'Toole P, Rose H, Monaghan NT, Campana MG, Bradley DG, Edwards CJ (2012) Phylogeographic, ancient DNA, fossil and morphometric analyses reveal ancient and modern introductions of a large mammal: the complex case of red deer (Cervus elaphus) in Ireland. Quaternary Science Reviews 42: 74-84.

3.1.3.3 Native species entering new environments

An additional consideration which is receiving an increasing amount of attention is what happens when a species that is clearly native to a country or region gets translocated by human activity to another area within the same country where they would not have been able to get to otherwise. These species are termed translocated natives. There is clear overlap in the measures to prevent the spread of invasive species which have applicability to preventing the unplanned movement of native species. Despite this, these species will lie outside of the remit of ISI and will not appear in this assessment.

3.1.4 Potential species data sources

For potential invasive species, lists of invasive species from sources such as GISP, NOBANIS and EPPO were compiled. Species from the GISP list of the 100 of the World's Worst Invaders were also included if they were found in areas with similar eco-climatic conditions. Invasive species known from Britain were included. The resulting lists were checked for duplications within datasets and between potential and recorded species.

Species that were assessed as low risk during the previous risk assessment methodology were not reassessed.

3.1.5 Overview of database structure

This section details the purpose of the individual parts of the risk assessment. The various elements can be accessed in the database and are not replicated here.

3.1.5.1 Basic Information

The basic information section has been designed to facilitate the collection of information for each species in a standard format.

3.1.5.2 Habitat data

The risk assessment has been designed to gather information on what habitats invasive species are likely to invade in a systematic way. The intention here is to provide policy makers and managers with information on habitats most likely to be invaded by a particular invasive species or a set of invasive species. This approach is based on the EUNIS Habitat Classification System. More information on EUNIS is available from http://eunis.eea.europa.eu/.

3.1.5.3 Intentional Introductions/Unintentional introductions

The methodology aims to gather information on the possible pathways an invasive species arrives in Ireland or can spread once here. The assessment was intended to enable us to identify the most common pathways for the species that have been assessed which can inform action plans.

In order to capture pathway data in a manner that can inform effective management decisions, we needed a system that categorised both pathways and vectors at an appropriate level. The pathway of introduction and vectors of spread used in the assessment follows that proposed by Maguire (2011)[14].

3.1.5.4 Introduction or spread

An attempt was made to disaggregate the pathways by which species arrive in Ireland and how they spread once here. During the population of this database and the subsequent attempt to analyse this dataset, it became apparent that often there exists limited reliable datasets which can categorically state how a species first arrived to Ireland or Northern Ireland. Many papers state how the experts believe the species first arrived but more often or not this can amount to an educated guess and the primary pathway of introduction is unclear. Given the uncertainty surrounding the primary method of introduction and how species are spread, we have not presented these results. This omission in our analysis highlights the need for research programmes into pathways of introduction to help better understand risks associated with pathways. It also highlights a need to systematically collect data on new introductions and their pathways which can be analysed in future assessments.

3.1.5.5 Climate match

For potential species, climate match is also considered. The primary mechanism is by viewing the Koppen Geiger global climate classification map as produced in Figure 2. Additional sources such as the Generated Niche Model on the Global Biodiversity Information Facility was also consulted. A model is reproduced in Figure 3 (species details are not provided as this is not the purpose of this report).

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[14] http://invasives.biodiversityireland.ie/wp-content/uploads/FInal-web-published-report_STRIVE_83_web.pdf

Figure 2: The Köppen climate classification map used in the risk assessment to help determine if Ireland provides suitable climate match for potential invasive species (http://koeppen-geiger.vu-wien.ac.at/).

Figure 3: An example of a Generated Niche Model produced from the Global Biodiversity Information Facility to help determine if Ireland provides suitable environmental conditions for a potential invasive species (http://data.gbif.org/welcome.htm).

3.1.5.6 Uncertainty

Uncertainty must be considered when undertaking any risk assessment process. However, there are different types of uncertainty in any risk assessment process. For example, uncertainty can be due to the natural unpredictability of a species and/or uncertainty can arise due to a lack of evidence or information on a particular species. How uncertainty is measured is key to the interpretation of any risk assessment and it's results. The approach taken in the current risk assessment attempts to account for uncertainty in both information available and the uncertainty in the assessment made. The measure of uncertainty is intended to be consistent and measureable in a way that attempts to remove assessor bias. In all species assessed, uncertainty is identified in the individual assessments. This has been done consistently by adding uncertainty as a distinct assessment answer. This is relevant when there is simply no data on which to base the assessment on. The second measure of uncertainty is in the overall level of data contributing to the assessment itself. Rather than requiring the assessor to rank their uncertainty in the assessment, an assessment of their level of confidence has been developed. This is as follows:

- Documented – Where there is reliable documented evidence to support the assessment made. Relevant references are added to the reference database.
- Expert Opinion – Where the assessors knowledge of a species, or that of an identified expert, provides sufficient information to support an assessment.
- Probable – Where the evidence consulted or the species characteristics indicate that the described impact could reasonably occur in Ireland or Northern Ireland.
- Uncertain – Where there is insufficient evidence to confidently make an assessment of a species.

3.1.5.7 Impact summary terminology

The impact summary terminology is derived from that used by the NOBANIS system. This is as follows:

- **Decomposition:** Entering the local food web by being a new decomposer (vertical effects).
- **Predation:** Entering the local food web by being a new predator (vertical effects).
- **Herbivory:** Entering the local food web by being a new herbivore (vertical effects).
- **Resource allocation:** Is a new resource for native or introduced species (for herbivores, predators or decomposers) (vertical effects).
- **Toxic:** Is toxic for local species, thereby displacing these.
- **Competition:** Competes with other organisms filling the same niche in the food chain (horizontal effect), physical disturbance.
- **Disease transmission:** Is a parasite or pathogen or is a reservoir for parasites or a vector for pathogen.
- **Abiotic changes:** Modification of fire regime, succession, hydrology, nutrient availability.
- **Genetic:** Hybridising with a related species or varieties, may lead to extinction by gene flow or dilution of locally adapted genepool.
- **Human health:** Human health effects by being toxic, causing diseases or allergies.
- **Socio-economic:** Fouling, clogging of waterways, leading to increased pesticide/herbicide use, control and management costs etc.

- **Extinction:** Extinction of native species, extirpation of local populations.
- **None:** Preferably based on some kind of scientific knowledge.
- **Not known:** No evidence to identify impacts or categorically state that there are no impacts.

3.2 Risk communication

Risk communication is one of the most important aspects of risk assessment. Information in large databases must be distilled in a manner which can be understood by policy makers, stakeholders, industry interests and the general public. Without an effective risk communication strategy the prioritisation process would be inaccessible and less effective at achieving its goals.

To communicate risks, the following outputs are produced:
- This report;
- Publication of the risk assessments for those species listed as high risk on www.invasivespeciesireland.com website;
- Publication of the Most Unwanted section of the website for species specifically aimed at members of the public; and
- Production of 'amber lists' for both potential invasive species and recorded invasive species which have a medium risk species and could represent a threat to conservation goals.

3.3 Results

The results presented here relate only to the species overall risk rating, as defined by the scoring system, and their association with pathways. The analysis of habitats, pathways, date of introduction and other factors will be the subject of an additional report prepared by the National Biodiversity Data Centre and ISI[15].

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[15] O'Flynn. C. and Kelly, J. (2013) Trends in introductions of invasive and non-native species in Ireland. National Biodiversity Data Centre, Ireland

3.3.1 Risk summary
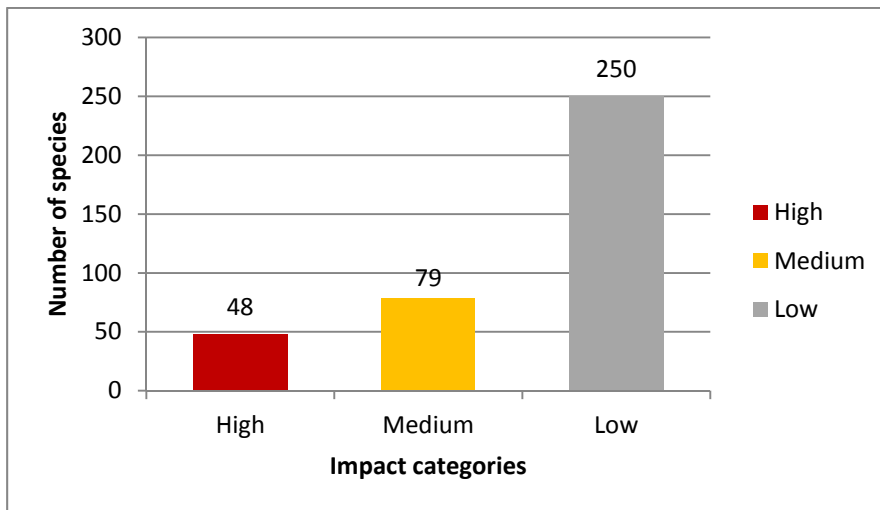
Figure 4: Number of recorded species per impact category
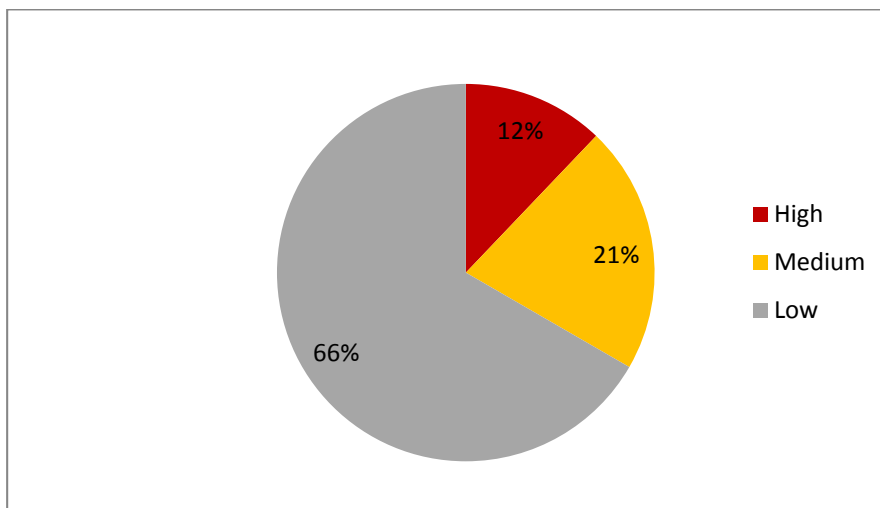
Figure 5: Percentage of species assessed in each impact category
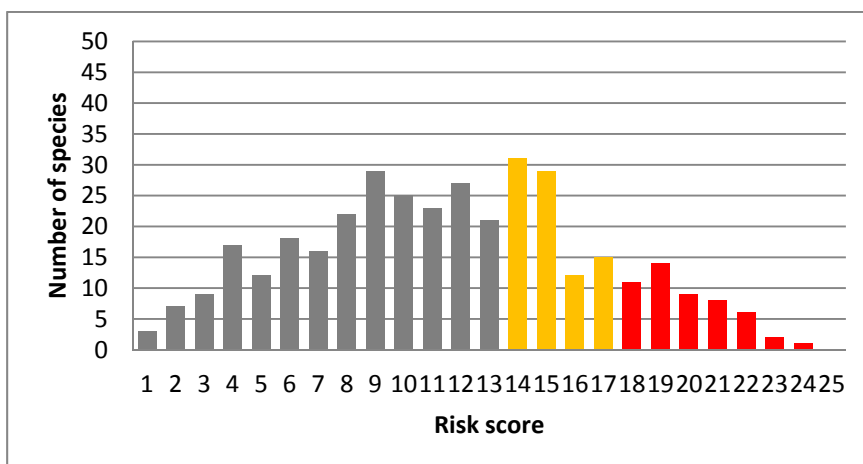
Figure 6: Distribution of scores for recorded species assessed.

In terms of prioritising species for action, this assessment has achieved what it set out to do with 12 % of species falling into the high risk category. These species are spread across marine (5), freshwater (15) and terrestrial (24 + 3 hybrids of *Fallopia*) environments. High risk species are detailed in Table 3. It is interesting to note that some of these species have a very restricted distribution and may represent prime candidate for rapid response while others are more widespread and will require long term management programmes to prevent further spread and ecological degradation associated with them. Other species such as the harlequin ladybird which still have a restricted distribution, do not lend themselves to rapid response owning to the lack of effective management measures.

Table 3: High risk recorded species, their native continent, environment and final score.

Species	Common Name(s)	Native Continent	Environment	Sum of scores
Rattus norvegicus	Brown Rat	Asia	Terrestrial	24
Phytophthora ramorum	Sudden Oak Death	Unknown	Terrestrial	23
Anguillicoloides crassus	Swimbladder Parasite of Eels	Asia	Freshwater	23
Rattus rattus	Black rat	Asia	Terrestrial	22
Cervus Nippon	Sika Deer	Asia	Terrestrial	22
Corbicula fluminea	Asian clam	Eurasia	Freshwater	22
Aphanomyces astaci	Crayfish Plague	North America	Freshwater	22
Muntiacus reevesi	Reeves's Muntjac	Asia	Terrestrial	22
Didemnum vexillum	Carpet Sea Squirt	Asia	Marine	21
Hemimysis anomala	Bloody red shrimp	Eurasia	Freshwater	21
Dama dama	European Fallow Deer	Europe	Terrestrial	21
Hydrocotyle ranunculoides	Floating Pennywort	North America	Freshwater	21
Lepus europaeus	Brown Hare	Europe	Terrestrial	21
Eriocheir sinensis	Chinese Mitten Crab	Eurasia	Freshwater	21
Crepidula fornicata	Slipper Limpet	North America	Marine	21
Sus scrofa	Wild Boar	Europe, Africa	Terrestrial	21
Sciurus carolinensis	Grey squirrel	North America	Terrestrial	20
Mus musculus	House Mouse	Africa	Terrestrial	20
Neovison vison	American Mink	North America	Terrestrial	20
Fallopia japonica and hybrids	Japanese knotweed	Asia	Terrestrial	20
Myriophyllum aquaticum	Parrot Feather	South America	Freshwater	20
Rhododendron ponticum	Rhododendron	Europe	Terrestrial	20
Crassula helmsii	New Zealand Pigmyweed	Australasia	Freshwater	20
Nymphoides peltata	Fringed Water Lily	Eurasia	Freshwater	20
Corvus splendens	Indian House Crow	Asia	Terrestrial	20
Styela clava	Leathery Sea-squirt	Asia	Marine	19
Tamias sibiricus	Siberian Chipmunk	Eurasia	Terrestrial	19
Heracleum mantegazzianum	Giant Hogweed	Eurasia	Terrestrial	19

Species	Common Name(s)	Native Continent	Environment	Sum of scores
Elodea canadensis	Canadian-Pondweed	North America	Freshwater	19
Carpobrotus edulis	Hottentot fig	Africa	Terrestrial	19
Harmonia axyridis	Harlequin Ladybird	Eurasia	Terrestrial	19
Gunnera tinctoria	Giant Rhubarb	South America	Terrestrial	19
Dreissena polymorpha	Zebra Mussel	Europe	Freshwater	19
Mustela furo	Feral Ferret	Europe	Terrestrial	19
Elodea nuttallii	Nuttalls Pondweed	North America	Freshwater	19
Lagarosiphon major	Curly waterweed	Africa	Freshwater	19
Branta canadensis	Canada Goose	North America	Terrestrial	18
Leuciscus cephalus	Chub	Europe	Freshwater	18
Prunus laurocerasus	Cherry Laurel	Europe, Africa	Terrestrial	18
Arthurdendyus triangulatus	New Zealand flatworm	Australasia	Terrestrial	18
Spartina anglica	Common Cord Grass	Europe	Marine	18
Oxyura jamaicensis	Ruddy Duck	North America	Freshwater	18
Impatiens glandulifera	Himalayan balsam	Asia	Terrestrial	18
Varroa destructor	Honey Bee Varroa Mite	Asia	Terrestrial	18
Sargassum muticum	Wire Weed	Asia	Marine	18
Fallopia sachalinensis and hybrids	Giant Knotweed	Asia	Terrestrial	18
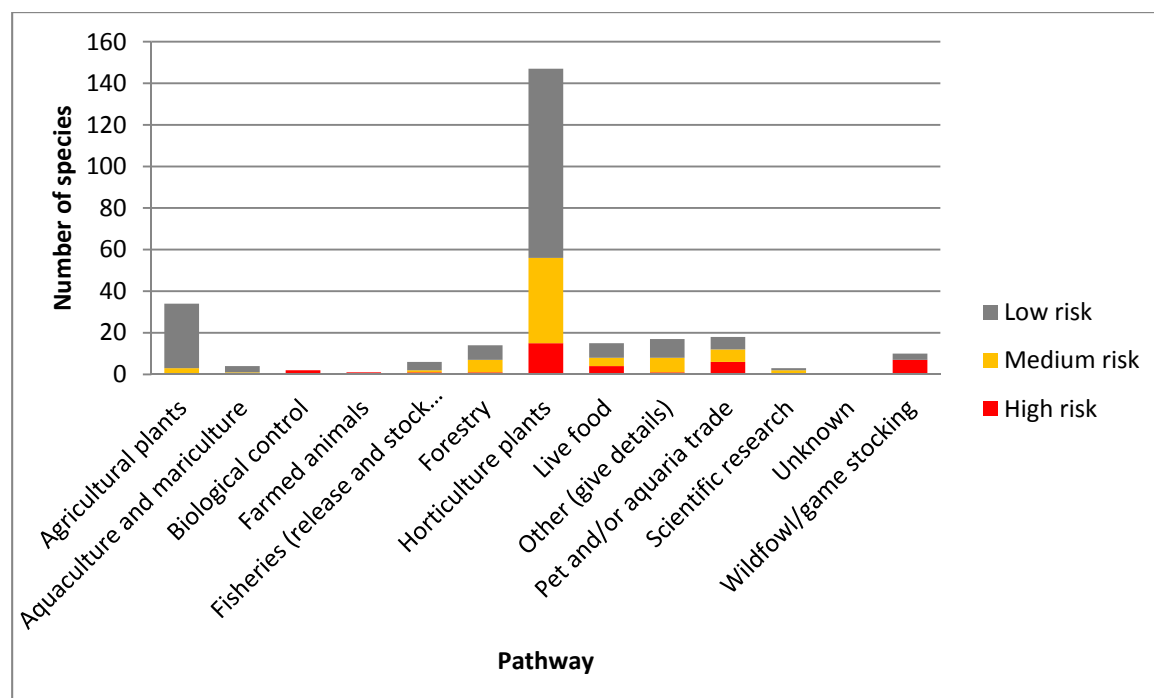
Figure 7: Intentional pathways associated with species recorded in Ireland and/or Northern Ireland.
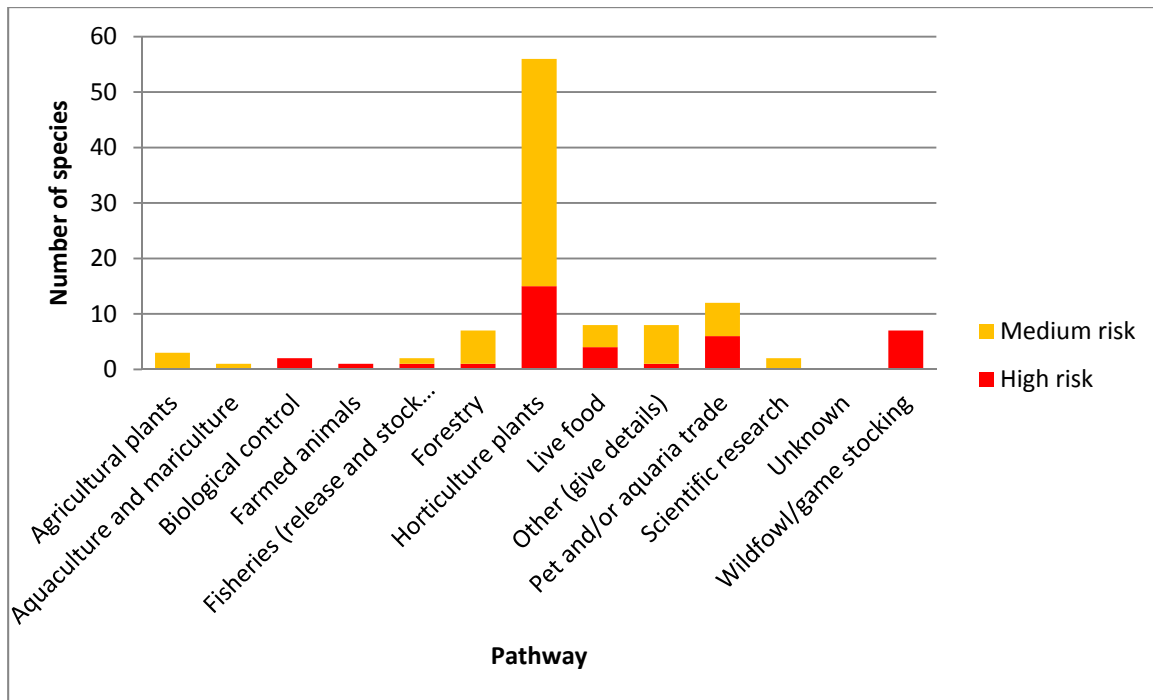
Figure 8: Intentional pathways associated with species recorded in Ireland and/or Northern Ireland excluding low risk species.

Pathway of introduction is the means by which a species arrives in Ireland and/or Northern Ireland in the first instance. Many species have multiple pathways of introduction. Additionally, some species are introduced both for legitimate trade purposes but can also contaminate trade unintentionally or can be released accidentally.

It is not surprising that horticulture is presenting as the main pathway of introduction for non-native species. This reflects not just the activity along this pathway both in recent times and in previous centuries but also reflects the availability of very reliable datasets on non-native plants (see Reynolds 2002 (http://www.botanicgardens.ie/glasra/aliens.htm) and http://alienplants.ekru.eu/search.php). While it is important to note that the vast majority of plants associated with horticulture are actually ranked as low risk (91) for Ireland and Northern Ireland, it is also important to note that this pathway has contributed a high number of high and medium risk species when viewed alongside other pathways excluding low risk species (Figure 5).

When horticulture is excluded from the assessment, we can see that the main pathways of introduction are other key economic sectors such as pet trade, agriculture, forestry, and fisheries. One key pathway that appears to have contributed a disproportionate number or high risk species is the wildfowl and game stocking pathway with 7 out of the 10 species identified as associated with this pathway been considered high risk to conservation objectives.
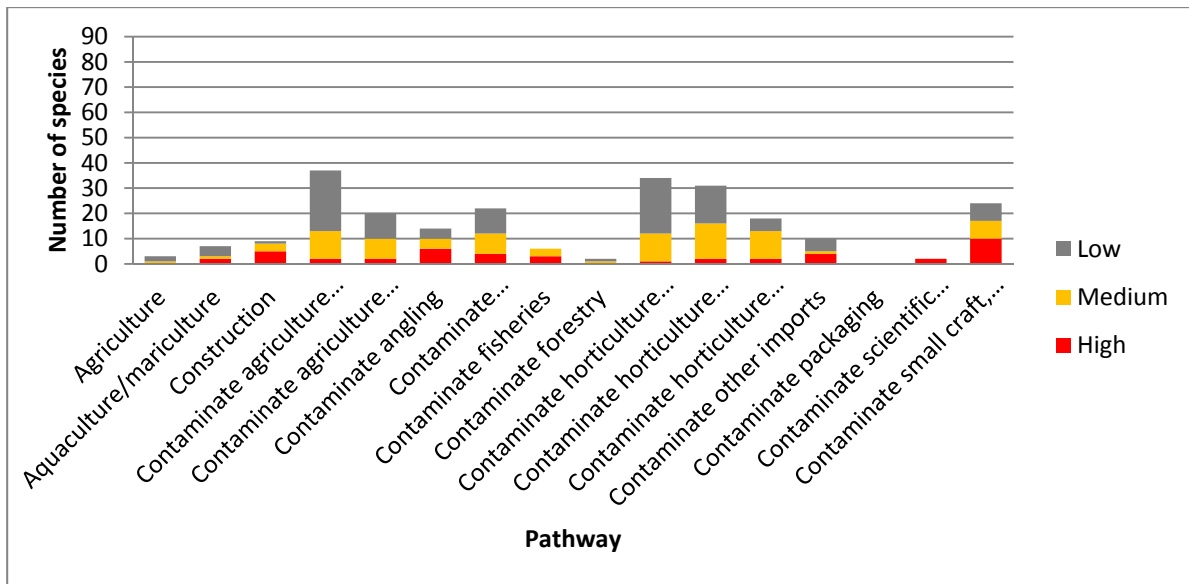
Figure 9: Unintentional pathway associated with species recorded in Ireland and/or Northern Ireland
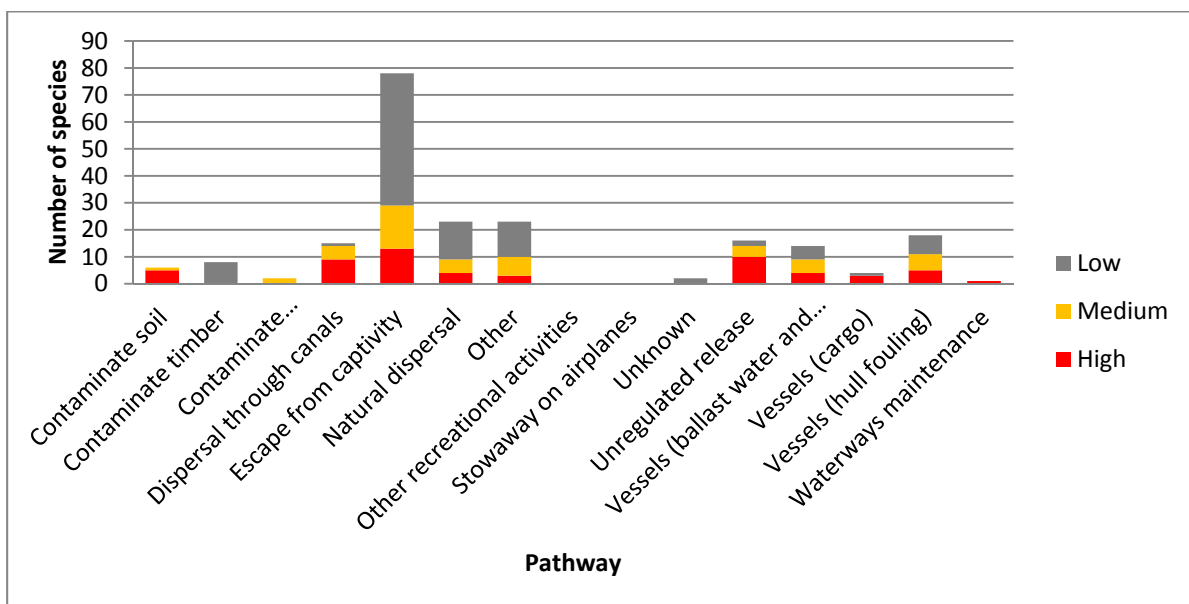
Figure 10: Recorded species unintentional pathways of introduction and spread continued

Escape from captivity is the key unintentional pathway of introduction to Ireland and Northern Ireland. Species are originally brought for legitimate trade purposes and escape from the confines they are kept in. Sometimes known as hopping the garden fence. Examples include, escapes from farms and pets, or other activity.

The activities of the key economic sectors such as agriculture, horticulture and aquaculture can contribute to the unintentional introduction and spread of invasive species through contamination. It is apparent that solutions are needed to help these sectors mitigate the risk of introducing a species unintentionally. Usually this will involve development of guidance, standard operating procedures and training where required.

There emerged no evidence of species stowing away on airplanes for Ireland or Northern Ireland. We suggest that this represents an under reporting in the scientific literature and publically available databases rather than indicating that the risk of introducing a new species along this pathway is low. For natural dispersal, species such as birds and insects, and species with marine life stages have been implicated.

3.4   Results of risk assessment of potential species
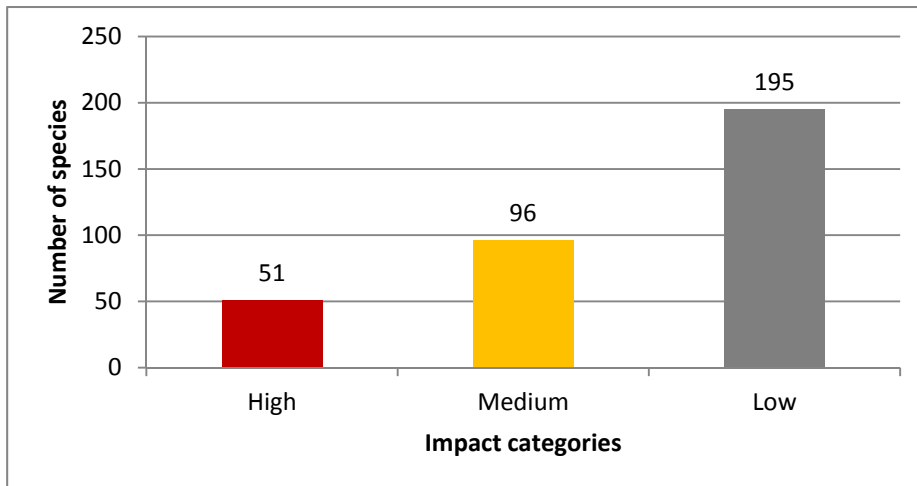
Figure 11: Number of potential species per impact category.
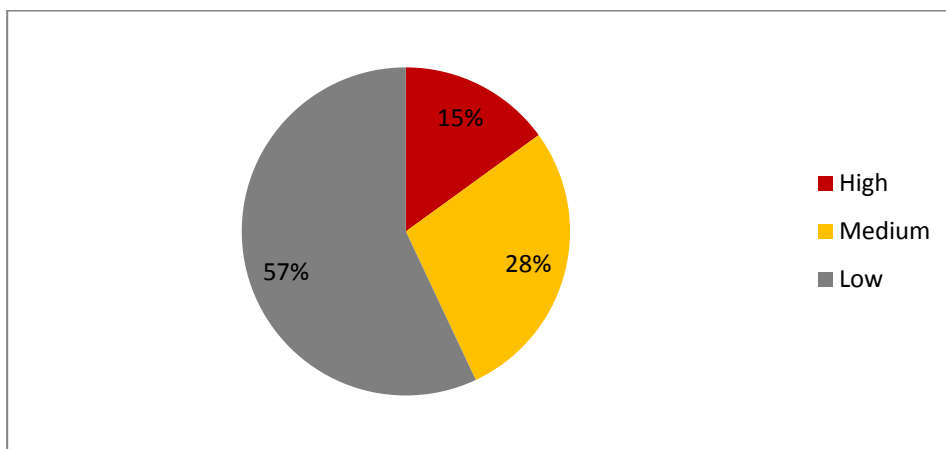
Figure 12: Percentage of potential species in each impact category.
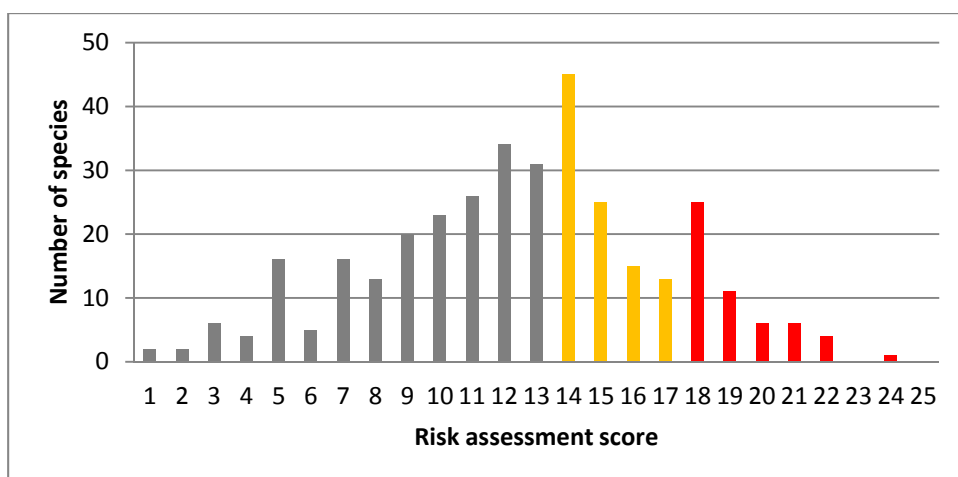
Figure 13: Distribution of scores for potential species assessed.

Similar to the recorded species assessment, in term of prioritising species for action, the assessment has achieved its goal. 15% of species assessed fall into the high risk category. These are spread across marine (7), freshwater (22 with extra 4 as semiaquatic) and terrestrial (18) environments. Species are detailed in Table 4.

Since the time of carrying out the assessment, raccoon and the alpine newt have been recorded in Ireland but it is not known yet if these represent an extant population. These species are therefore retained on this list until further data becomes available. However, the sighting of both these species in the wild highlights the activity of the pet pathway and either the unintentional (escape) or intentional ('setting free') release of these high risk species.

Table 4: High risk species not recorded from Ireland or Northern Ireland (potential species), their native continent, environment and final score.

Species	Common Name(s)	Native Continent	Environment	Final Score
Alexandrium catenella	A toxin-producing dinoflagellate	North America	Marine	24
Sander lucioperca	Zander	Europe	Freshwater	22
Orconectes limosus	Spinycheek Crayfish	North America	Freshwater	22
Pacifastacus leniusculus	Signal Crayfish	North America	Freshwater	22
Ondatra zibethicus	Muskrat	North America	Semiaquatic	22
Pseudorasbora parva	Topmouth Gudgeon	Asia	Freshwater	21
Lymantria dispar	Gypsy Moth	Eurasia	Terrestrial	21
Dikerogammarus villosus	Killer Shrimp	Europe	Freshwater	21
Pimephales promelas	Fathead minnow	North America	Freshwater	21
Procambarus clarkii	Red Swamp Crayfish	North America	Freshwater	21
Batrachochytrium dendrobatidis	Frog Chytrid Fungus	Unknown	Freshwater	21
Thaumetopoea processionea	Oak Processionary Moth	Europe	Terrestrial	20
Gyrodactylus salaris	Salmon fluke	Europe	Freshwater	20
Ludwigia peploides	water primrose	North America, South America	Freshwater	20

Ludwigia grandiflora	Water primrose	North America, South America	Freshwater	20
Myocastor coypus	Coypu	South America	Semiaquatic	20
Psittacula krameri	Ring-Necked	Africa	Terrestrial	19
Nyctereutes procyonoides	Raccoon dog	Asia	Terrestrial	19
Undaria pinnatifida	Japanese kelp	Asia	Marine	19
Alytes obstetricans	Midwife Toad	Europe	Freshwater	19
Mesotriton alpestris	Alpine Newt	Europe	Semiaquatic	19
Cercopagis pengoi	Fishhook Waterflea	Europe	Freshwater	19
Cameraria ohridella	Horse chestnut leaf miner	Europe	Terrestrial	19
Diabrotica virgifera	Western corn rootworm	North America	Terrestrial	19
Procambarus marmorkrebs	Marbled crayfish	North America	Freshwater	19
Callinectes sapidus	Blue Crab	North America, South America	Marine	19
Myiopsitta monachus	Monk Parakeet	South America	Terrestrial	19
Threskiornis aethiopicus	Sacred Ibis	Africa	Terrestrial	18
Chattonella cf. verruculosa	None identified	Asia	Marine	18
Carassius auratus	Edible Goldfish	Asia	Freshwater	18
Bemisia tabaci	Tobacco Whitefly	Asia	Terrestrial	18
Vespa velutina	Asian hornet	Asia	Terrestrial	18
Rapana venosa	Rapa whelk	Asia	Marine	18
Callosciurus erythraeus	Pallas's squirrel	Asia	Terrestrial	18
Corbicula fluminalis	Asian Clam	Asia	Freshwater	18
Hylastes ater	Black Pine Bark Beetle	Eurasia	Terrestrial	18
Bombus terrestris sp.	Bumble Bee	Eurasia	Terrestrial	18
Capreolus capreolus	Roe Deer	Europe	Terrestrial	18
Astacus astacus	Noble Crayfish	Europe	Freshwater	18
Astacus leptodactylus	Turkish Crayfish	Europe	Freshwater	18
Diuraphis noxia	Russian wheat aphid	Europe	Terrestrial	18
Geomyces destructans	bat white nosed syndrome (WNS)	Europe	Terrestrial	18
Neogobius melanostomus	Round Goby	Europe	Marine	18
Dreissena bugensis	Quagga Mussel	Europe	Freshwater	18
Rana catesbeiana	North American Bullfrog	North America	Semiaquatic	18
Procyon lotor	Raccoon	North America	Terrestrial	18
Orconectes rusticus	Rusty crayfish	North America	Freshwater	18
Orconectes virilis	Virile Crayfish	North America	Freshwater	18
Homarus americanus	American lobster	North America	Marine	18
Salvelinus fontinalis	Brook trout	North America	Freshwater	18
Frankliniella occidentalis	Western flower thrips	North America	Terrestrial	18
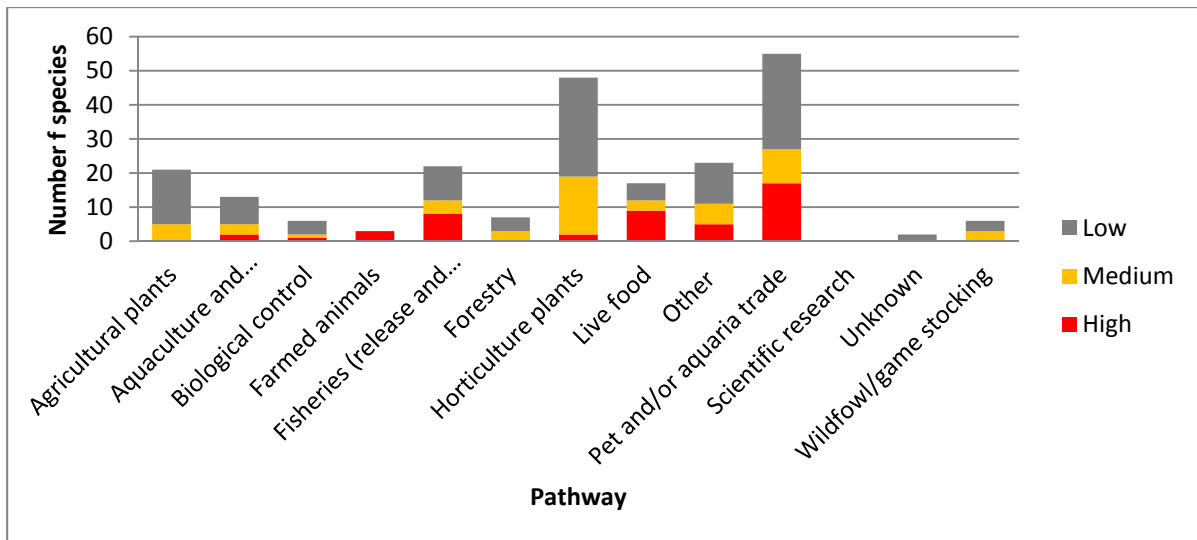
Figure 14: Intentional pathways associated with species not recorded in Ireland and/or Northern Ireland excluding low risk species.
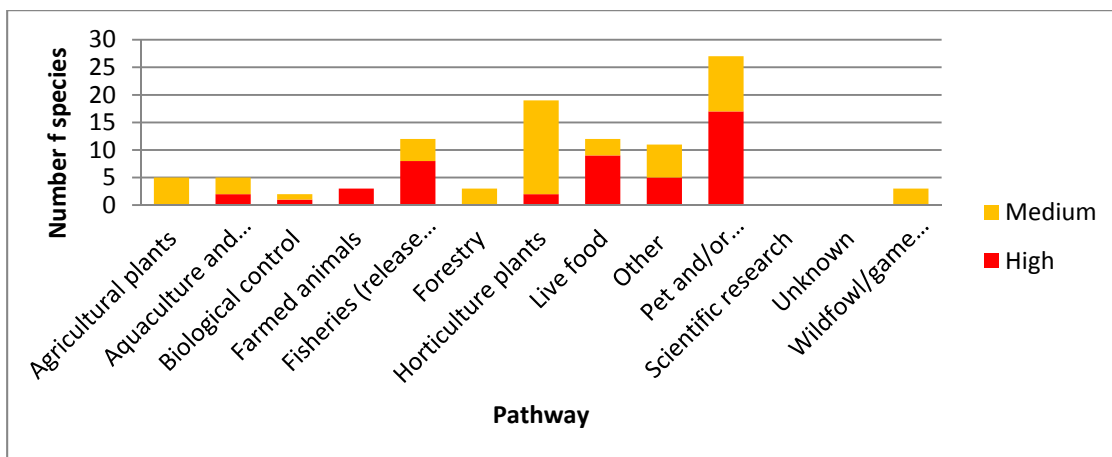
Figure 15: Intentional pathways associated with species not recorded in Ireland and/or Northern Ireland excluding low risk species excluding low risk species.

From the species lists gathered during this exercise and the analysis of the pathways associated with them, it appears that both the pet and horticulture trade represent significant risk in terms of introducing new species to Ireland. Additionally, we can see that live food trade may become more important in the future as species such as crayfish and non-native fish are traded live thus presenting a risk as an invasive species.

These datasets highlight the need for a risk assessment procedure to be put in place prior to allowing species be freely traded without restriction. However, it is clear that this needs co-ordination at an EU level given the influence of free trade laws.
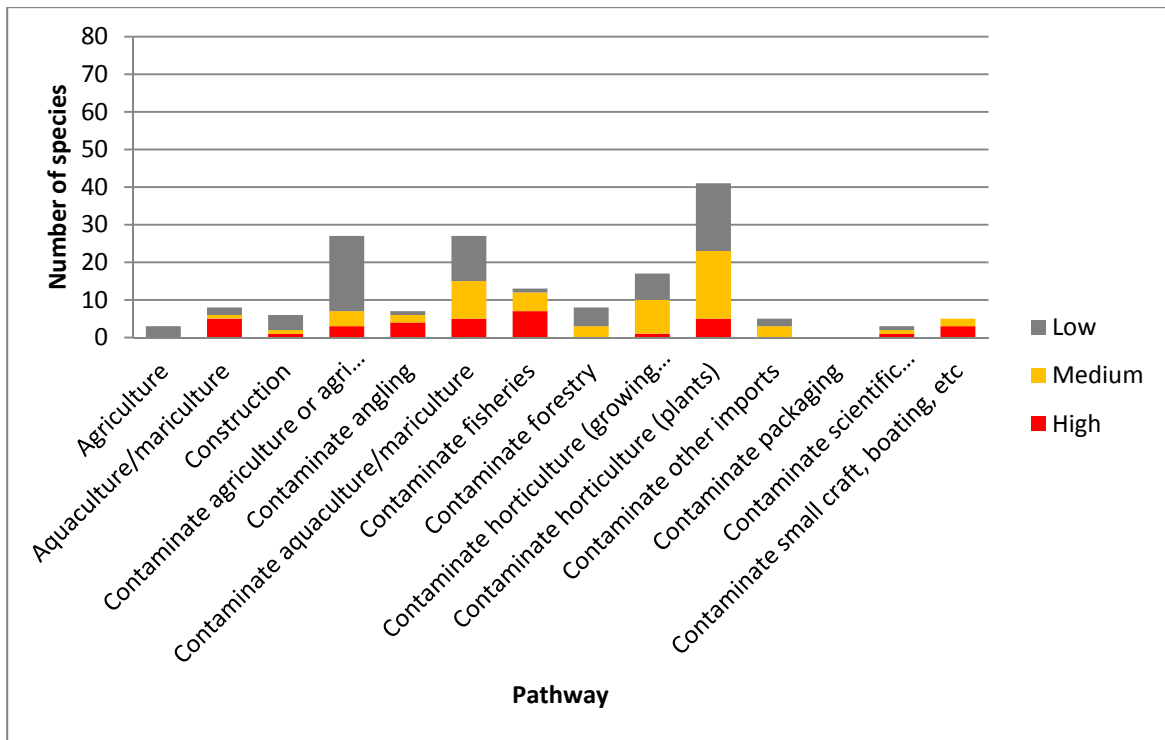
Figure 16: Unintentional pathways associated with species not recorded in Ireland and/or Northern Ireland Part 1 (continued in Figure 17).
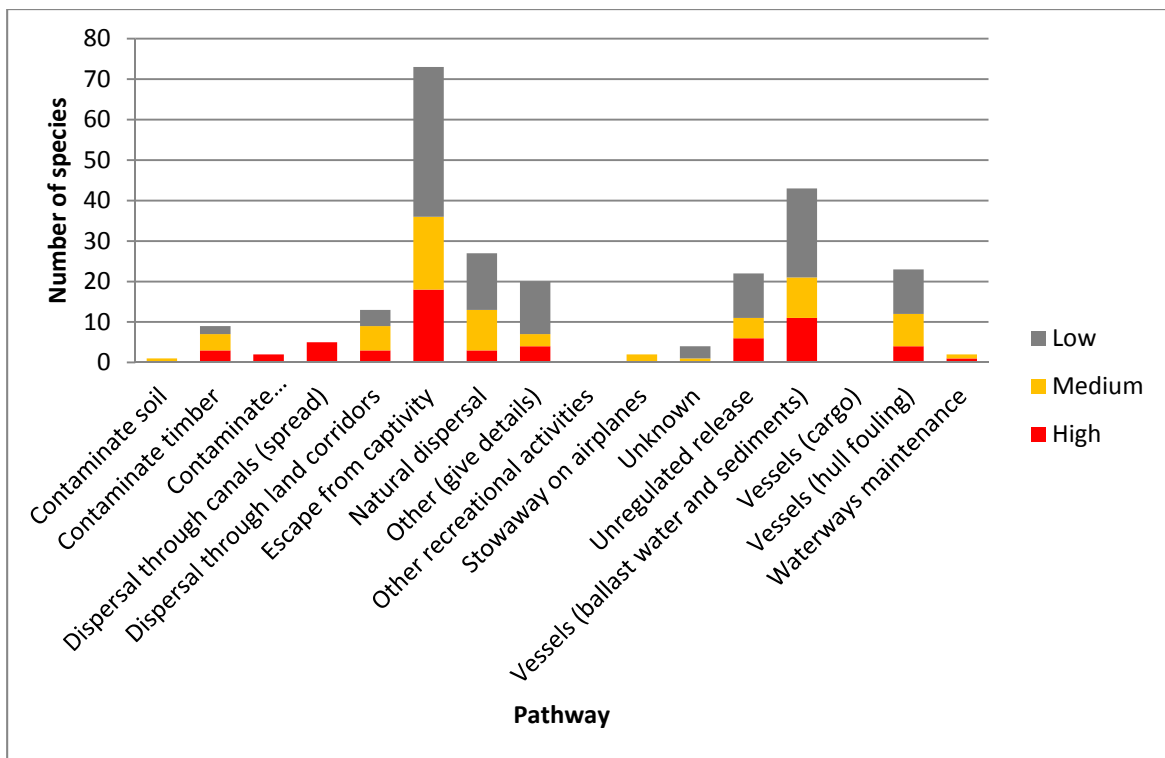
Figure 17: Unintentional pathways associated with species not recorded in Ireland and/or Northern Ireland Part 2.

From the data gathered, species that could escape from captivity appears to be a key pathway requiring attention. These are species which are primarily brought to Ireland for one reason or

another with the unintended consequence that wild populations establish following escape or unregulated release. Contamination of the activities of key economic sectors also appears to require attention with a high number of species known to contaminate a trade or commodity.

4. DETAILED RISK ASSESSMENT

4.1 Risk assessment and prevailing trade laws

Risk assessment is one tool that can allow governments to make decisions in a transparent and traceable manner. Risk assessment however is not a clear cut process. Risk assessment means very different things to different people and is also context dependant. The process designed must be suitable for the task it sets out to achieve. For example, if a government needs to decide what species require management in the short term when faced with competing interests and limited resources, a methodology should not be so onerous as to make the decision making process slow and ineffective. If on the other hand, a government requires measures which will impact on trade of a particular species or commodity associated with a pathway then the level of effort required increases for a single species as governments must conform to international standards laid down in the General Agreement on Tariffs and Trade (GATT). For EU member states, governments must also comply with prevailing Free Trade Laws.

Economic activity has resulted in the transport and trade of plant and animal species for millennia. Indeed, a widely held defining moment in biological invasions dates as far back as 1500 AD, a period associated with the end of the Middle Ages, the European rediscovery of the Americas, global exploration, the birth of colonialism and the start of radical changes in patterns of human demography, agriculture, trade and industry[16]. Global trade and globalisation has been increasing significantly over the past number of years. Since 1950, world trade is estimated to have increased 14 fold[17]. This has brought with it an increased risk of invasion by non-native species.

Global trade laws have attempted to some degree, to account for environmental concerns. Example measures include the General Agreement on Tariffs and Trade (GATT) (1947) and the agreement of Sanitary and Phytosanitary measures (SPS). The SPS agreement allows countries to enforce measures to prevent the spread of plant, animal, or other disease agents and to prevent or control the spread of pests. These measures, however, must be based on scientific justification or on an "objective" assessment of the risks to human, animal or plant health.

4.2 Proposed detailed risk assessment schema for Ireland and Northern Ireland

The proposed risk assessment chosen by ISI to underpin trade restrictions and policy development is that of the GB NNSS. This approach has been chosen for a number of reasons including:
- To ensure consistency of approach across the entire UK and also consistency between the UK and Ireland.
- To allow UK and Irish agencies to share and develop risk assessment approaches in a co-ordinated fashion.
- Ensure value for money for agencies in the UK and Ireland by completing similar risk assessments which can be shared.

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[16] http://www.uni-landau.de/umwelt/study/content/files/archiv/H.Schulz/WS09/Biodiversitaet_und_Naturschutz/Hulme%202009.pdf
[17] http://www.wto.org/english/res_e/booksp_e/anrep_e/wtr08-2b_e.pdf

- This risk assessment is based on the internationally accepted risk assessment procedures used for plant health under the International Plant Protection Convention.
- Plant health risk assessment procedures are widely applied and already recognised by the World Trade Organisation.

Permission has been granted by the GB NNSS for this risk assessment.

4.2.1   Structure of the proposed Detailed Risk Assessment

The proposed detailed risk assessment will use the **N**on-native species **AP**plication based **R**isk **A**nalysis (NAPRA). NAPRA is a computer based tool for undertaking risk assessment of any non-native species. It has been developed by the European and Mediterranean Plant Protection Organisation (EPPO) and is based on the Computer Aided Pest Risk Analysis (CAPRA); a similar tool used by EPPO for risk assessment. Figures 18 and 19 are provided to show the reader how the assessment process looks once opened.
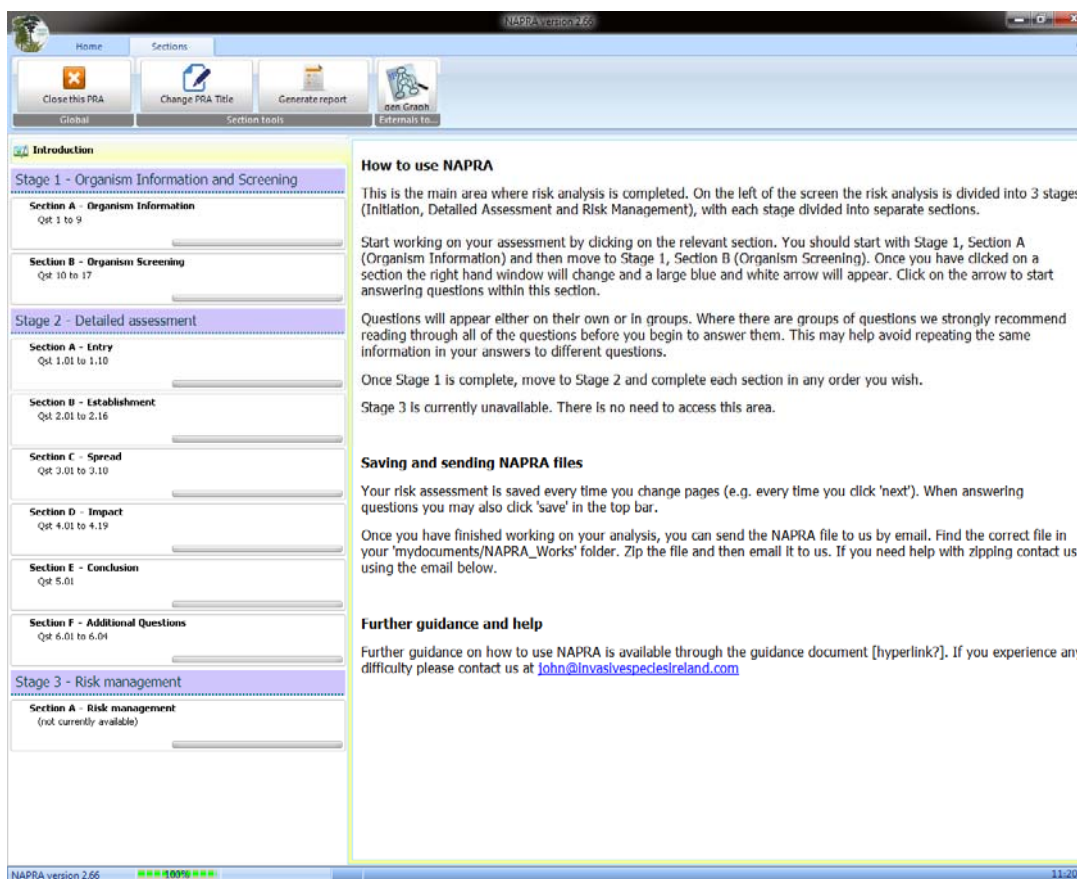
Figure 18: Screen shot of the Non-native species APplication based Risk Analysis (NAPRA) system opening page.
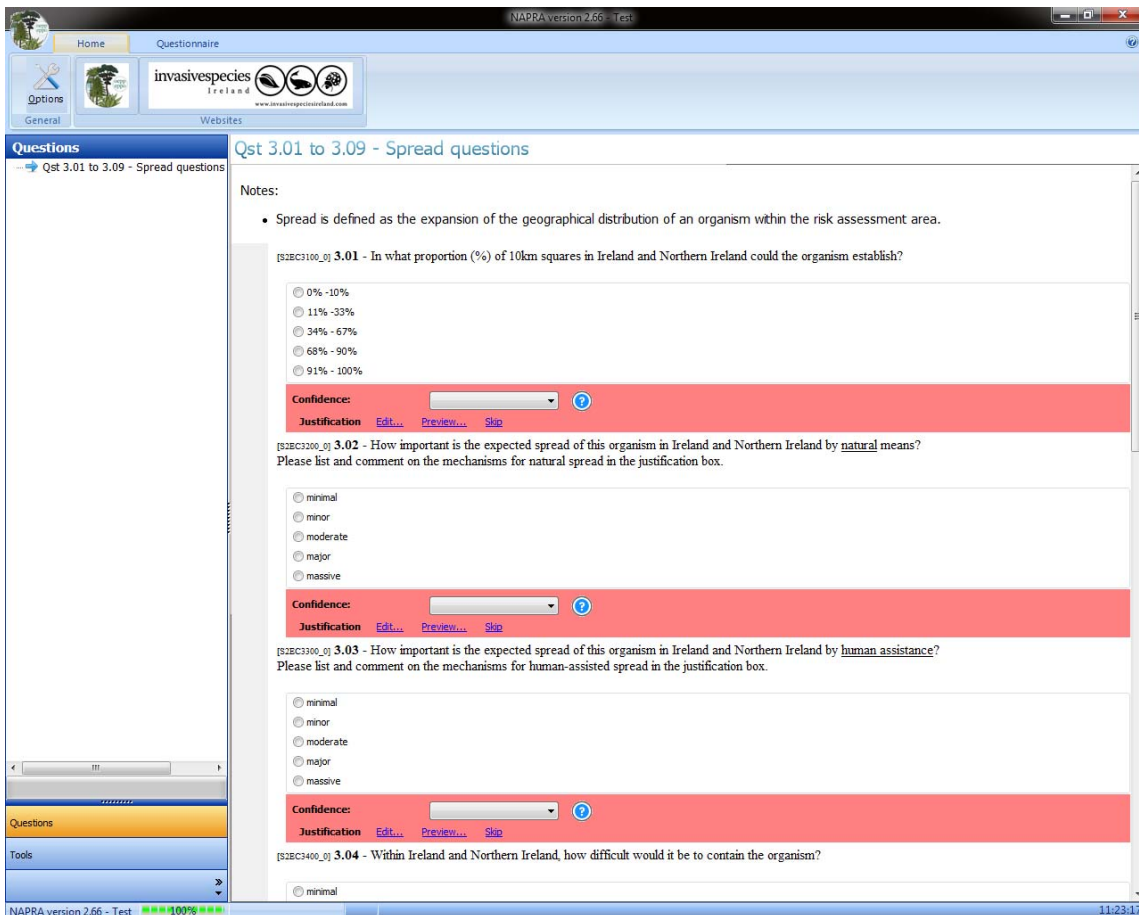
Figure 19: Screen shot of Question 3.01 to illustrate how the risk assessment looks within the NAPRA system.

The Detailed Risk Assessment can be accessed from the following weblink:

- http://invasivespeciesireland.com/toolkit/risk-assessment/detailed-risk-assessment/

An MS Word Version of this assessment is included in Appendix 2.

It should be noted by the reader that this assessment will undergo some degree of modification as risk assessments are added. It is understood that those co-ordinating the risk assessment will instigate version control of the assessment process and also include examples to help assessors complete the risk assessment as time goes by. Additionally, the module on risk management measures has not been completed. We had hoped to enter dialogue with our counterparts in Great Britain to develop this in a similar manner however time did not allow for this work prior to completion of the ISI Phase 2 contract.

5. DISCUSSION

This report describes the two systems of risk assessment for Ireland and Northern Ireland. The first is a prioritisation exercise while the second is a more detailed risk assessment which is intended for the purpose of supporting legislative developments and also allowing policy makers to gather more information if and when required to do so. This report does not provide the results of any Detailed Risk Assessments. The report does however provide for two examples of risk assessments which are for illustrative purposes and not in support of measures until they have been peer reviewed and consulted upon. See Appendix 3 and 4 (which can be requested from NIEA or NPWS).

5.1 Key lessons from the prioritisation risk assessment

As a tool to aid the prioritisation of species which should be the subject of action to manage impacts or prevent their arrival in the first place, the prioritisation risk assessment has been successful. This risk assessment process developed by ISI allows for risk impact ranking and categorisation of the non-native species assessed in to high, medium and low impact categories. The categorisation of the species provides a basis for which policy decision makes can focus their attention.

As a system, we recognise that it is by no means perfect. The system depends on availability of information for a wide range of species and taxa across marine, freshwater and terrestrial environments. This is often difficult to locate or simply does not exist. Our system does however allow for the collation of data and attempts to present this in a manner that is useful to policy makers and interested stakeholders. Our system aims to be transparent and through our working with stakeholders, aims to allow interested parties to feed into the process.

One key lesson is that invasive species issues continue to emerge. Experts continue to identify new species and indeed species that are not currently seen as invasive may begin to exhibit traits suggesting an unforeseen invasive potential. This system allows for this in that it is easily updated as new information becomes available. However, this system stands and falls on the availability of relevant data on impact and experts willingness to engage either through publication of results; direct contact with ISI; or through the various meetings held by ISI.

The assessment of species used by the various economic sectors in Ireland and Northern Ireland for legitimate reasons highlights that in some cases these species can and have become invasive. There is a need for greater controls to prevent the release, escape and translocation of species which pose a risk as invasive species. There is also a need to raise awareness of the threats posed with the various stakeholder sectors. A key lesson that should be communicated to the various groups is that it is in their interest to maintain the species under human control as it avoids the need for increased regulation.

It is clear that there is a history of illegal or unlicensed introductions into the wild by members of the public in both Ireland and Northern Ireland. There is also a history of species been moved

around the island once they have been introduced. Measures are required to address these issues. The legislation is already in place in both jurisdictions to prohibit releases therefore there is a need for enforcement and better awareness of the consequences of illegal introductions.

Accidental introductions are a key concern and one of the most difficult to address. Pathway based approaches are required to address these mechanisms. The assessment of pathways allows for a prioritised approach to preventing accidental introductions. Education and awareness campaigns are required for the key pathways. To date, the work of ISI has led to the implementation of the Be Plant Wise campaign targeting the garden pond plant trade; the Check Clean Dry campaign targeting recreational water users; and the Be Pet Wise information on the www.invasivespeciesireland.com website.

5.2   Key lessons from the detailed risk assessment development

The most valuable lesson we have learnt during this process is the benefit of working with our counterparts in Great Britain. This has yielded substantial gains in terms of developing a system and helping to ensure policy approach in the UK and Ireland remain consistent and adhere to the strictures of free trade regulations. As risk assessments are carried out for Ireland and Northern Ireland, we would envisage a need for greater collaboration between GB and Ireland in this regard.

From our discussions with various actors in this arena in Ireland and Northern Ireland, the need for detailed risk assessment is not always apparent to most. This may present a problem to policy makers who take a slower approach to enacting trade restrictions than most environmental interest groups would prefer. However, for the reasons outlined earlier, this process is necessary to avoid failure of trade restrictions and also to ensure that the policy response is fair to those that will be affected most by these trade restrictions.

Recognising that there are currently limited guidelines from the European Commission on the subject of risk assessment relating to invasive species, it is important for Ireland and the UK to continue to engage with colleagues across Europe on this subject. Additionally, environmental experts would benefit greatly from continued liaison with plant health colleagues on the subject of risk assessment.

5.3   Recommendations

5.3.1   Relating to risk assessment

Recommendation 1: Risk assessments are required prior to implementing any trade restrictions. Initially, detailed risk assessments should be undertaken in two broad stages. The first stage of risk assessments should include those species used by trade sectors in Ireland or Northern Ireland which are listed on forthcoming regulations in Ireland. It would be advantageous to proceed slowly with this process, undertaking risk assessments for a small number of species first, refining the process and building expertise in this area for Ireland and Northern Ireland. The second stage in risk assessment procedures should be at the discretion of the Invasive Species

Ireland steering group and/or NIEA and NPWS as per their needs. This group should dictate what species risk assessments are required and the reasons for their assessment.

Recommendation 2: A process is required for pre-screening intentional introductions into Ireland and Northern Ireland. This includes species which are intended for trade and keeping in private collections or in zoos. In the first instance, this could be run by a voluntary process through codes of practice with trade and industry. If a statutory model is chosen, then advice should be sought from the Directorate General for Trade of the European Commission on how this would operate in free trade market of the European Union.

Recommendation 3: Detailed risk assessments should be conducted for species traded in Ireland and Northern Ireland which have a reasonable chance of establishing a wild population and where appropriate trade restrictions brought forward only when this is the best management option and does not unduly jeopardise businesses or result in a switch to a potentially more invasive species. These species include but not limited to species traded for horticulture and as pets.

5.3.2   Management of invasive species

Recommendation 4: There is a need for a dedicated funding stream for invasive species management particularly when there is a viable option to eradicate the species either at the site level or at the national level.

Recommendation 5: The Department of Agriculture, Food and the Marine and the Department of Agriculture and Rural Development should publish guidance on the role farmers should play to prevent their stock from escaping and establishing wild populations. This could be facilitated by NIEA and NPWS or any future ISI initiative.

Recommendation 6: Education and awareness campaigns such as the Be Plant Wise and Check Clean Dry campaigns should be provided a dedicated funding stream and refreshed on a regular basis. It may be beneficial to have similar education and awareness campaigns across EU Member States but with particular attention given to standard approaches across the UK and Ireland. This reflects the fact that the UK and Ireland are major trading partners.

Recommendation 7: From our experience, current awareness raising efforts are inadequate for fish and game species; pet species; species kept in zoos and at various points of contact with the public in zoos. Education and awareness campaigns should be developed for these sectors.

Recommendation 8: A database of species traded in the pet sector in Ireland and Northern Ireland should be established to allow authorities to assess the risks associated with pet species.

Recommendation 9: Invasive predatory small mammals such as rats and mink have been ranked as high risk due to their impact on islands and on breeding bird sites. There is a lack of

eradication efforts in Ireland and Northern Ireland to control these species on islands to date. Funding of projects to remove these species from islands should be made available.

5.3.3 Knowledge gaps

Recommendation 10: A major gap in our knowledge exists in that apart from some key exceptions (e.g. voluntary work by experts) we do not have access to datasets on species that are contaminating trade, cargo and other key infrastructures at ports of entry. Research and surveillance and monitoring programmes are required on this in Ireland, Northern Ireland, UK and at an EU level.

APPENDIX 1: SPECIES NOT REASSESSED FOLLOWING ASSESSMENT IN ISI 1

All species listed here were assessed as having a low risk to conservation goals during the first risk assessment process and were not reassessed during the current process.

Species	Group	Common Name	Overall Score[18]	Comment on impacts
Adoxa moschatellina	Plant	Moschatel	6	
Aegopodium podagraria	Plant		11	None described
Allium carinatum	Plant	Keeled garlic	11	Present in Ireland for a while, with no discernible recent spread.
Alnus incana	Plant	Grey alder	9	
Antirrhinum majus	Plant		8	Habitat is described aswalls, rock faces, disturbed ground, cliffs, quarries
Antithamnionella spirographidis	Alga		9	Minor
Armoracia rusticana	Plant	Horse radish	9	
Barbarea intermedia	Plant		8	tilled fields, roadsides, waste ground
Brassica napus	Plant	Rape	11	Found on roadsides, waste ground and ports
Bryonia dioica	Plant	White Bryony	10	
Calystegia pulchra	Plant	Hairy bindweed	8	No evidence of problem found in GB
Calystegia silvatica	Plant	Large bindweed	8	No evidence of problem found in GB
Carduus nutans	Plant	Musk Thistle	7	No impacts reported
Chelidonium majus	Plant	Greater Celandine	9	No evidence found
Chenopodium bonus-henricus	Plant	Good King Henry	8	No effects described
Chenopodium murale	Plant	Nettle-leaved goosefoot	9	Arable weed
Chenopodium polyspermum	Plant	Many seeded-goosefoot	7	Arable/waste ground annual.
Chrysanthemum segetum	Plant	Corn Marigold	8	No effects described that would indicate a negative impact on conservation goals
Cicerbita macrophylla	Plant	Common Blue-sow-thistle	10	Unlikely given the habitat of the species

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[18] Low risk species scored 0-12, medium risk species 13-19 and high risk species greater than 19

Species	Group	Common Name	Overall Score[18]	Comment on impacts
Cirsium oleraceum	Plant	Cabbage thistle	9	Not seed as a threat to the goals of domestic and EU legislation
Clymenella torquata			13	None describe
Colpomenia peregrina	Alga	Oyster Thief	10	It has negligible effects on the environment
Corophium sextonae	Crustacean		9	No recorded impacts
Crepis vesicaria	Plant	Beaked hawk's beard	10	Unlikely
Cruciata laevipes	Plant	Crosswort	8	None anticipated
Cryptonemia hibernica	Alga		11	Unlikely to threaten the goals of the WFD
Draba muralis	Plant	Wall Whitlowgrass	6	No effects described and occurs only in man-made habitats, especially stone walls
Elminius modestus	Crustacean		12	Can outcompete *Semibalanus balanoides* but this is not a listed species
Epilobium ciliatum	Plant		10	Unlikely as habitat is described as waste ground, ports, railways, disturbed ground, roadsides, stream sides, walls, nurseries, woods, garden weed
Epilobium pedunculare	Plant		9	No evidence to suggest that this species would impact on conservation goals
Epilobium tetragonum	Plant	Square-stalked Willowherb	7	
Erigeron karvinskianus	Plant		11	A garden plant now established on stone walls in a few sites eg the boundary wall of the Mount Stewart estate in the Ards Peninsula. Origin: Mexico
Erinus alpinus	Plant	Fairy Foxglove	10	No ill effects on biodiversity described. Species is described as a living on stone walls

Species	Group	Common Name	Overall Score[18]	Comment on impacts
Erysimum cheiranthoides	Plant	Treacle-mustard	10	
Erysimum cheiri	Plant		8	Not seen as a threat to the goals of domestic and EU legislation
Fuchsia magellanica	Plant	Fuschia	12	Uncertain
Fumaria bastardii	Plant	Tall Ramping-fumitory	7	Unlikely to impact on the goals of these
Fumaria muralis	Plant	Common Ramping-fumitory	8	Cultivated and wasteground
Geranium phaeum	Plant		9	No effects on the environment described
Geranium pyrenaicum	Plant	Hedgerow crane's-bill	9	No description of significant threats to ecosystems found
Gobio gobio	Fish	Gudgeon	12	Widespread and considered as a component of the Irish fish populations
Hesperis matronalis	Plant	Sweet rocket	10	No effects described that would indicate a deleterious effect on conservation goals
Hieracium gougetianum	Plant		9	Not seen as a threat
Hieracium grandidens	Plant		8	Unlikely
Hieracium maculatum	Plant		8	Unlikely to be a threat
Hirschfeldia incana	Plant	Hoary Mustard	10	Not seen as a threat to biodiversity
Hordeum murinum	Plant		8	Not seen as a threat
Inula helenium	Plant		8	the species preferred habitat suggests that it will not affect conservation goals
Juncus tenuis	Plant		8	Preferred habitat suggests that this species will not have an impact on the conservation goals of NI and ROI
Kickxia elatine	Plant		9	Not seen as a threat to conservation goals

Species	Group	Common Name	Overall Score[18]	Comment on impacts
Lamiastrum galeobdolon subsp.argentatum	Plant	Yellow Archangel	8	is found as a persistent alien on rubbish dumps and waste ground - derived from discarded garden rubbish - and is also naturalised in a few estates or parks
Lamium album	Plant	Dead-nettles	7	This species is a rather infrequent plant of dumps and disturbed soils
Larix decidua	Pinaceae		8	No foreseen impacts on conservation goals
Lepidium draba	Plant		10	Unlikely to impact on goals of legislation
Lilioceris lilii	Invertebrate	Lily Beetle	11	Unlikely to impact on conservation goals.
Limnoria tripunctata	Crustacean	wood boring isopod	13	Not seen as a threat (wood boring species)
Linaria purpurea	Plant	Purple Toadflax	8	This is an herbaceous perennial garden plant which is increasingly seen on roadsides or rubbish dumps, presumably derived from garden throw-outs
Malva neglecta	Plant	Common Mallow	7	Unlikely to impact goals of legislation
Medicago arabica	Plant		8	Unlikely to impact on goals of legislation
Medicago sativa subsp. Varia	Plant		11	Unlikely
Melilotus albus	Plant		10	Unlikely
Mentha × villosa	Plant	Apple mint	9	Disturbed ground
Mercurialis annua	Plant	Annual Mercury	10	Habitat not associated with goals of legislation obligations
Misopates orontium	Plant		9	Habitats not associated with conservation goals
Myrrhis odorata	Plant	Sweet Cicely	8	Not seen as a threat to conservation goals
Noemacheilus barbatulus	Freshwater	Stoneloach	9	No threat to habitats described
Papaver somniferum	Plant	Opium Poppy	11	No evidence of threat found
Pentaglottis sempervirens	Plant		9	Habitat not generally associated with conservation goals
Persicaria campanulata	Plant	Lesser Knotweed	8	

Species	Group	Common Name	Overall Score[18]	Comment on impacts
Peucedanum ostruthium	Plant	Masterwort	8	Unlikely
Phallusia mammillata	Tunicate		7	no recorded impacts
Phoxinus phoxinus	Fish	Minnow	10	Widespread and considered as a component of the Irish fish populations
Pilosella aurantiaca	Plant	Fox-and-cubs	9	Unlikely
Plantago media	Plant		8	unlikely
Poa compressa	Plant	Flattened Meadow-Grass	12	Not seen as a threat to goals of legislation
Polysiphonia harveyi	Alga		9	Not seen as a threat to the goals of biodiversity legislation
Polysiphonia subtilissima	Alga		11	Not a threat to the goals of legislation
Raphanus raphanistrum subsp. Raphanistrum	Plant	Sea Radish	9	Unlikely given the habitat
Rapistrum rugosum	Plant	Bastard Cabbage	7	Not seen as a threat to biodiversity legislation
Reseda alba	Plant		10	not seen as a threat to biodiversity
Rumex pulcher	Plant	fiddle dock	7	Unlikely to impact conservation goals
Salix fragilis	Plant	Crack Willow	9	None described
Sambucus ebulus	Plant	Dwarf Elder	9	Unlikely to impact conservation goals
Sedum dasyphyllum	Plant	Thick-leaved Stonecrop	9	Not seen as a threat to conservation goals given the habitat
Senecio fluviatilis	Plant	Broad-leaved Ragwort	10	Unlikely to impact conservation goals in light of habitat
Senecio squalidus	Plant		8	Unlikely to interfere with conservation goals
Senecio viscosus	Plant	Sticky Groundsel	9	unlikely to impact conservation goals
Sinapis alba	Plant	White Mustard	8	Unlikely to impact conservation goals
Sisymbrium orientale	Plant	Eastern Rocket	10	Unlikely to interfere with conservation goals
Soleirolia soleirolii	Plant		10	Unlikely to impact conservation goals
Solidago gigantea	Plant		8	No ecological threats described

Species	Group	Common Name	Overall Score[18]	Comment on impacts
Tanacetum parthenium	Plant	Feverfew	8	Effects not described. Likely to cause minimal ecological disturbance
Tanacetum vulgare	Plant	Tansy	8	unlikely
Thlaspi arvense	Plant	Field Penny-cress	8	Unlikely to impact conservation goals
Trifolium hybridum	Plant	Alsike Clover	11	Unlikely to impact conservation goals due to species habitat
Urtica urens	Plant	Small Nettle	9	Waste ground and not very common
Verbascum virgatum	Plant	Twiggy Mullein	11	Unlikely due to habitat
Verbena officinalis	Plant	Vervain	10	Not seen as a threat due to species habitat
Veronica peregrina	Plant	American Speedwell	8	Unlikely
Veronica persica	Plant	Common Field-speedwell	9	Unlikely
Vicia sativa subsp. segetalis	Plant	Common Vetch	8	Unlikely to impact conservation goals

APPENDIX 2: IRELAND AND NORTHERN IRELAND NON-NATIVE SPECIES RISK ASSESSMENT MS WORD VERSION

Stage 1 - Organism Information and Screening - Section A - Organism Information

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

Screen: BEGIN-Initiation		
1 - What is the reason for performing the risk assessment?		
2 - Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?		
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)		
4 - Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	Yes | No	
Screen: s5-Earlier RA		
5 - If there is an earlier risk assessment is it still entirely valid, or only partly valid?	Yes | No | Partial	
Screen: s6-Distribution and invasiveness elsewhere		
6 - Where is the organism native?		
7 - What is the current <u>global distribution</u> of the organism (excluding Ireland and Northern Ireland)?		
8 - What is the current distribution of the organism in <u>Ireland and Northern Ireland</u>?		
9 - Is the organism known to be invasive anywhere in the world?	Yes | No	
Screen: s5end-Existing Risk Assessment		
In that case a new RA is not necessary and the analysis can stop.		
Screen: END-END		
End of the module, continue with the next module		

Stage 1 - Organism Information and Screening - Section B - Organism Screening

The aim of this section is to screen out species for which detailed assessment is unlikely to be necessary. The screening section should only be completed if this has been specifically requested.

Screen: BEGIN-Screening required?		
10 - Have you been asked to carry out a screening assessment?	Yes | No	
Screen: s11-Organism screening		
11 - Does the organism have intrinsic attributes that indicate that it could be invasive? (refer to Pheloung WRA, FSK, etc.)	Yes | No	
12 - Is the organism present in the Risk Assessment Area in containment from which it is likely to escape?	Yes | No	
13 - Are there conditions present in the Risk Assessment Area that would enable the organism to survive and reproduce? Comment on any special conditions required by the species.	Yes | No	
14 - Does the global distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment Area or sufficiently similar for the organism to survive and thrive? Subnote:	Yes | No	
15 - Has the organism established viable (reproducing) populations anywhere outside of its native range?	Yes | No	
16 - Can the organism spread rapidly by natural means or by human assistance?	Yes | No	
17 - Could the organism as such, or acting as a vector, cause economic, environmental or social harm in Ireland and/or Northern Ireland?	Yes | No	
Screen: END-END		
End of the module, continue with the next module		

Stage 2 - Detailed assessment - Section A - Entry

This section evaluates the probability of entry of an organism into Ireland and Northern Ireland.

Screen: BEGIN-Instructions

Important instructions		
• For organisms which are already present in Ireland and/or Northern Ireland, only complete the entry section for <u>currently active</u> pathways of entry and <u>potential future pathways</u>. The entry section <u>need not be completed</u> for pathways which have allowed an organism to enter in the past but which are no longer active. Notes: • Entry is defined as the movement of an organism from outside of Ireland and Northern Ireland into Ireland and Northern Ireland, either into the wild or into containment. • A pathway is defined as any means that allows the entry or spread of an organism • Examples of pathways include shipping, escape from wildlife collections, horticulture trade, pet trade, etc.		

1.01 - How many active/future pathways are relevant to the potential entry of this organism? Subnote: If there are no currently active pathways or potential future pathways respond N/A and move to the Establishment section	N/A | very few | few | moderate number | many | very many	low | medium | high | very high
Screen: S2SA1200-Identification of pathways		
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	
Screen: S2SA1300-Choice of pathway		
1.02b - Select a pathway to assess.	1	
Screen: S2SA1400-Pathway questions		
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 | Accidental	low | medium | high | very high
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? Subnote: If the pathway is unintentional, in your comment discuss how likely the organism is to get onto the pathway in the first place.	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
1.05 - How likely is the organism to enter Ireland and Northern Ireland undetected or without the knowledge of relevant competent authorities?	very unlikely | unlikely | moderately likely | likely |	low | medium | high | very high

	very likely	
Screen: S2SA1700-Pathway questions		
1.06 - How likely is the organism to survive during passage along the pathway? Subnote: Take note of and comment on existing management practices along the pathway that may be relevant (e.g. fumigation of imported goods). In your comment consider whether the organism could multiply along the pathway.	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
1.07 - How likely is the organism to arrive during the months of the year appropriate for establishment?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
Screen: S2SA1900-Pathway questions		
1.08 - How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
1.09 - Estimate the overall likelihood of entry into Ireland and Northern Ireland based on this pathway?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
Screen: S2SA2100-Consideration of further pathways		
1.10 - Do other pathways need to be considered?	Yes | No	
Screen: S2SA2200-Overall likelihood entry		
1.11 - Estimate the overall likelihood of entry into Ireland and/or Northern Ireland based on all pathways (comment on the key issues that lead to this conclusion).	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
Screen: END-END		
End of the module, continue with the next module		

Stage 2 - Detailed assessment - Section B - Establishment

This section evaluates the probability of establishment of an organism within Ireland and Northern Ireland.

Screen: BEGIN-Instructions		
Important instructions: • For organisms which are already well established in Ireland and Northern Ireland there is no need to complete this section - move straight to the Spread section. If it is unclear whether the organism should be considered 'well established' contact Invasive Species Ireland, The National Biodiversity Data Centre and/or CEDaR for further information. Notes: • Establishment is defined as the perpetuation, for the foreseeable future, of an organism within an area after entry.		
2.01 - Is the organism well established in Ireland and Northern Ireland (if there is any uncertainty answer 'unsure')?	Yes | No | Unsure	
Screen: S2SB2200-Establishment questions		
2.02 - How likely is it that the organism will be able to establish in Ireland or Northern Ireland based on the similarity between local <u>climatic conditions</u> and the organism's current global distribution?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.03 - How likely is it that the organism will be able to establish in Ireland and Northern Ireland based on the similarity between other local <u>abiotic conditions</u> and the organism's current global distribution?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.04 - How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland and Northern Ireland?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.05 - How likely is it that establishment will occur despite competition from existing species in Ireland and Northern Ireland?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.06 - How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland and Northern Ireland?	very unlikely | unlikely | moderately likely | likely |	low | medium | high | very high

	very likely	
2.07 - How likely is it that establishment will occur despite existing management practices?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.08 - How likely is it that management practices in Ireland and Northern Ireland will facilitate the establishment of the organism?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
Screen: S2SB2900-Establishment questions		
2.09 - How likely is it that biological characteristics of the organism would allow it to survive eradication campaigns in Ireland and Northern Ireland?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.10 - How likely is it that the biological characteristics of the organism will facilitate its establishment?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.11 - How likely is it that the organism's capacity to spread will facilitate its establishment?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.12 - How likely is it that the organism's adaptability will facilitate its establishment?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.13 - How likely is it that the organism could establish despite low genetic diversity in the founder population?	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.14 - Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in Ireland and Northern Ireland? If possible, specify the instances of invasion elsewhere in the justification box.	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
2.15 -	very unlikely |	low |

If the organism does not establish, then how likely is it that transient populations will continue to occur? Subnote: Red-eared Terrapin, a species which is understood not to re-produce in Ireland or Northern Ireland but is present because of continual release, is an example of a transient species.	unlikely | moderately likely | likely | very likely	medium | high | very high
Screen: S2SB3600-Overall likelihood of establishment		
2.16 - Estimate the overall likelihood of establishment. Mention any key issues in the justification box.	very unlikely | unlikely | moderately likely | likely | very likely	low | medium | high | very high
Screen: END-END		
End of the module, continue with the next module		

Stage 2 - Detailed assessment - Section C - Spread

This section evaluates the probability of spread of an organism within Ireland and Northern Ireland.

Screen: BEGIN-Spread questions		
Notes: • Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.		
3.01 - In what proportion (%) of 10km squares in Ireland and Northern Ireland could the organism establish?	0% -10% | 11% -33% | 34% - 67% | 68% - 90% | 91% - 100%	low | medium | high | very high
3.02 - How important is the expected spread of this organism in Ireland and Northern Ireland by <u>natural</u> means? Please list and comment on the mechanisms for natural spread in the justification box.	minimal | minor | moderate | major | massive	low | medium | high | very high
3.03 - How important is the expected spread of this organism in Ireland and Northern Ireland by <u>human assistance</u>?	minimal | minor |	low | medium |

Please list and comment on the mechanisms for human-assisted spread in the justification box.	moderate | major | massive	high | very high
3.04 - Within Ireland and Northern Ireland, how difficult would it be to contain the organism?	minimal | minor | moderate | major | massive	low | medium | high | very high
3.05 - What proportion (%) of the area in Ireland and Northern Ireland is suitable for establishment, if any, has already been colonised by the organism?	0% -10% | 11% - 33% | 34% - 67% | 68% - 90% | 91% - 100%	low | medium | high | very high
3.06 - What proportion of the area in Ireland and Northern Ireland is 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% | 11% - 33% | 34% - 67% | 68% - 90% | 91% - 100%	low | medium | high | very high
3.07 - What other timeframe would be appropriate to estimate any significant further spread of the organism? Please comment on why this timeframe is chosen.	10 years | 20 years | 40 years | 80 years | 160 years	low | medium | high | very high
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% | 11% - 33% | 34% - 67% | 68% - 90% | 91% - 100%	low | medium | high | very high
3.09 - Based on the answers to questions on the potential for establishment and spread in Ireland and Northern 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.		low | medium | high | very high
Screen: S2SC4000-Overall potential for future spread		
3.10 - Estimate the overall potential for future spread for this organism in Ireland and Northern Ireland. Use the justification box to indicate any key issues.	very slowly | slowly | moderately | rapidly | very rapidly	low | medium | high | very high
Screen: END-END		
End of the module, continue with the next module		

Stage 2 - Detailed assessment - Section D - Impact

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

Screen: BEGIN-Economic Impact

Important instructions:

- When assessing potential future impacts, climate change should <u>not</u> be taken into account. This is done in later questions at the end of the assessment.
- Where one type of impact may affect another (e.g. diseases associated with the organism may also cause economic impact) the assessor should try to separate the effects (e.g. in this case discuss the economic impact of disease under the disease question only).

Notes:

- The initial questions in this section are provided in groups relating to economic impact, environmental impact and social impact. The first question in each group related to evidence of impacts anywhere in the world. The subsequent questions relate to impacts in Ireland and Northern Ireland and are usually grouped into questions about impacts that have happened (up to the present day) and potential future impacts.

4.01 - How great is the economic loss caused by the organism within its global distribution (excluding Ireland and Northern Ireland), including the cost of any current management?	minimal | minor | moderate | major | massive	low | medium | high | very high
4.02 - How great has the economic cost of the organism been in Ireland and Northern Ireland from the <u>time of introduction to the present</u>? Exclude any costs associated with managing the organism from your answer.	minimal | minor | moderate | major | massive	low | medium | high | very high
4.03 - How great is the economic cost of the organism likely to be in the <u>future</u> in Ireland and Northern Ireland? Exclude any costs associated with managing the organism from your answer.	minimal | minor | moderate | major | massive	low | medium | high | very high
4.04 - How great have the economic costs of managing this organism been in Ireland and Northern Ireland from the <u>time of introduction to the present</u>?	minimal | minor | moderate | major | massive	low | medium | high | very high
4.05 - How great is the economic cost of managing this organism likely to be in the <u>future</u> in Ireland and Northern	minimal | minor |	low | medium |

Ireland?	moderate | major | massive	high | very high

Screen: S2SD4600-Environmental Impact		
4.06 - How important is environmental harm caused by the organism within its global distribution?	minimal | minor | moderate | major | massive	low | medium | high | very high
4.07 - How important has the impact of the organism on biodiversity* been in Ireland and Northern Ireland from the time of introduction to the present? *e.g. decline in native species, changes in community structure, hybridisation	minimal | minor | moderate | major | massive	low | medium | high | very high
4.08 - How important is the impact of the organism on biodiversity likely to be in the <u>future</u> in Ireland and Northern Ireland?	minimal | minor | moderate | major | massive	low | medium | high | very high
4.09 - How important has alteration of ecosystem function* caused by the organism been in Ireland and Northern Ireland from the time of introduction to the present? *e.g. habitat change, nutrient cycling, trophic interactions	minimal | minor | moderate | major | massive	low | medium | high | very high
4.10 - How important is alteration of ecosystem function caused by the organism likely to be in Ireland and Northern Ireland in the <u>future</u>?	minimal | minor | moderate | major | massive	low | medium | high | very high
4.11 - How important has decline in conservation status* caused by the organism been in Ireland and Northern Ireland from the time of introduction to the present? *e.g. sites of nature conservation value, WFD classification, etc.	minimal | minor | moderate | major | massive	low | medium | high | very high
4.12 - How important is decline in conservation status caused by the organism likely to be in the <u>future</u> in Ireland and Northern Ireland?	minimal | minor | moderate | major | massive	low | medium | high | very high
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 | minor | moderate |	low | medium | high | very

	major | massive	high

Screen: S2SD5400-Social Impact		
4.14 - How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within Ireland and Northern Ireland?	minimal | minor | moderate | major | massive	low | medium | high | very high

Screen: S2SD5600-Other impact		
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 | minor | moderate | major | massive	low | medium | high | very high
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 | minor | moderate | major | massive	low | medium | high | very high
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 | minor | moderate | major | massive	low | medium | high | very 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 and Northern Ireland?	minimal | minor | moderate | major | massive	low | medium | high | very high
4.19 - Indicate any parts of Ireland and Northern 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 | medium | high | very high

Screen: S2SD6100-Overall Impact		
4.20 - Estimate the overall potential impact of this organism in Ireland and Northern Ireland. Use the justification box to indicate any key issues.	minimal | minor | moderate | major | massive	low | medium | high | very high

Screen: END-END
End of the module, continue with the next module

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.

Screen: BEGIN-Conclusion		
5.01 - Estimate the overall risk of this organism in Ireland and Northern Ireland.	low | medium | high	low | medium | high | very high
Screen: END-END		
End of the module, continue with the next module		

Stage 2 - Detailed assessment - Section F - Additional considerations

This section is used to gather information about the potential effect 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.

Screen: BEGIN-Climate change		
6.01 - What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?		low | medium | high | very high
6.02 - What is the likely timeframe for such changes?	5 years | 10 years | 20 years | 50 years | 100 years	low | medium | high | very high
6.03 - What aspects of the risk assessment are most likely to change as a result of climate change?		low | medium | high | very high

Screen: S2SF6400-Research		
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.		

Screen: END-END
End of the module, continue with the next module

Stage 3 - Pathway risk management - Section G - Risk management

This section is in development. All text printed is draft until this notice is removed. J. Kelly March 2012. The risk management stage is the third stage in the risk analysis process. It provides a structured analysis of the measures that can be recommended to minimise the risks posed by an invasive species or pathway. The risk management part may be used to consider measures to prevent entry, establishment or spread of a pest. It explores options that can be implemented (i) at origin or in the exporting country, (ii) at the point of entry or (iii) within the importing country or invaded area.

Screen: BEGIN-Introduction
Before beginning the risk management stage or at certain points throughout the process, it may be advisable to consult other interested bodies. For example, discussions may be needed with the exporters to determine what is possible, with the importers to clarify what is cost-effective, with government officials concerning international trade issues and with pest-control experts to determine which methods of control are available, their efficacy and the extent to which eradication is possible.

Before considering the available risk management options, a judgement on the acceptability of the risk posed by the pest or pathway is required. In this scheme, the methods whereby risk management options are selected differ according to whether the introduction is intentional or unintentional, whether the organism is absent or already present in the risk assessment area and the type of entry pathway. Options to prevent unintentional entry on commodities are distinguished from options to prevent natural spread/movement or entry with other pathways such as passenger luggage. It should be noted that measures recommended for intentional introductions are often restricted to prohibiting imports and to actions that can be taken in the importing country.

The scheme requires a judgement on the reliability of each potential measure identified and an assessment of uncertainty. A reliable measure is understood to mean one that it is efficient, feasible and reproducible. Limitations of application in practice should be noted. Once all potential measures have been identified, the extent to which they are cost-effective and can be combined with other measures is evaluated. A species may enter by many different pathways and a pathway may transport many species. It is

therefore important to repeat the process for all relevant species and pathways of concern.

DELETE THIS

Screen: s701-Acceptability of the risk

A decision has to be made to determine whether the risk from any species/pathway combination is an acceptable risk. This decision will be based on the relationship between the level of risk identified in the risk assessment stage (i.e. the combination of the probability of introduction and the potential economic impact) and the importance/desirability of the trade that carries the risk of introduction of the species.

- Is the risk identified in the Risk Assessment stage for all species/pathway combinations an acceptable risk?	Yes | No	

Screen: s702a-Natural spread

- Is natural spread one of the pathways? The pathways identified in the entry section were: result:=getlistpathways(1); Subnote: Natural spread includes movement of the species by flight (of an insect or bird), wind or water dispersal, transport by vectors such as insects or birds, natural migration, rhizomial growth.	Yes | No	
- Is natural spread the major pathway?	Yes | No | Not applicable	

DELETE

Screen: s702b-Measures at origin to prevent natural spread to risk assessment area

- Is the species already entering the risk assessment area by natural spread or likely to enter in the immediate future?	Yes | No	low | medium | high | very high
- Is natural spread the major pathway?	Yes | No	low | medium | high | very high
- Could entry by natural spread be reduced or eliminated by control measures applied in the area of origin? Subnote: The uncertainty should relate to the efficacy of the control measures in the country of origin	Yes | No	low | medium | high | very high

Screen: s703-Assessment of anthropogenic pathways

7.06p - Please select the anthropogenic pathway/s : Subnote: You do not need to consider natural spread in this part of the risk management module.	1	

Screen: s704-Trade, commodity or contaminant of trade		
- Is the species a commodity or traded in any way? Subnote: To answer yes, there must be evidence that the species in question is traded legally in Ireland, Northern Ireland and/or the EU. Examples of species which are currently traded legally include: • Pet species (animals) • Species used in agriculture (plants and animals) • Horticultural plants (plants)	Yes - species is traded | No - species is not traded legally	
- Is the species associated (contaminant) with trade? Subnote: Contaminant of trade in this sense includes contamination of the following activities: • Ornamental plants • Growing media • Pet trade • Live food • Aquaculture • Forestry • Agriculture • Fisheries • International shipping • Recreational boating and water use (activity) • Construction	Yes | No	
- Pathways **do not** conform to the trade/contaminant categories. Subnote: Examples of this pathway would be: • Deliberate introduction into the wild to establish the species (either legally or unlicensed) • Contamination of scientific equipment/persons	Pathways conform trade/contaminant categories | Pathways do not conform to the trade/contaminant categories	low | medium | high | very high
Screen: s705a-Assessment of existing risk management measures for species that are not traded and not associated with trade		
- Are there any existing management measures applied on the pathway that could prevent the introduction of the species? (if yes, specify the measures in the justification)	Yes | No	
- Are the measures likely to change in the foreseeable future? Subnote: Note that this question is particularly relevant	Yes | No	

in the framework of a pathway analysis when the country of origin of the pathway and the pathway itself are well defined and information from the exporting country is available. When dealing with multiple origins "no" is very likely to be answered.		
- Do you make any recommendations to improve existing risk management measures?	Yes | No	
- Do you recommend that other measures should be considered in addition to the already described measures?	Yes | No	low | medium | high | very high

DELETE

Screen: s705b-Assessment of existing risk management options for species that are traded

- Are there any existing management measures applied on the pathway that could prevent the introduction of the species? (if yes, specify the measures in the justification)	Yes | No	low | medium | high | very high
- Are the measures likely to change in the foreseeable future?	Yes | No	low | medium | high | very high
- Do you make any recommendations to improve existing risk management measures? Subnote: Uncertainty in this instance should refer to your level of certainty that measures would be successful.	Yes | No	low | medium | high | very high
- Do you recommend that other measures should be considered in addition to the already described measures?	Yes | No	

Screen: s705c-Assessment of existing risk management measures to prevent contamination of trade or an activity

- Can the species, which is a contaminant of trade or an activity, be reliably detected by visual inspection at the place of production? Subnote: If the answer is yes specify the period and if possible appropriate frequency, if only certain stages of the species can be detected answer yes as the measure could be considered in combination with other measures in a Systems Approach.	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high
- Can the pest be reliably detected by testing at the place of production? (if only certain stages of the pest can be detected by testing answer yes as the measure	Yes as standalone measure | Yes in a System Approach |	low | medium | high | very

could be considered in combination with other measures in a Systems Approach)	No	high
- Can the association with the commodity be reliably prevented by treatment? Subnote: Please describe the treatment measures required.	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high
- Can the association with the commodity or activity be reliably prevented under specified conditions? Subnote: Plant examples: protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc. Animal examples: Marine examples: Freshwater examples:	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high
- Can association with the commodity be reliably prevented by undertaking activities or trade only at certain times of the year? Subnote: Example: at specific crop ages or growth stages for species associated with plants.	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high
- Can the association with the commodity or activity be reliably prevented by production in a certification scheme (i.e. official scheme)?	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high
Screen: s706-Consideration of additional measures		
- Do you conclude that other measures should be considered?	Yes - additional options required to prevent contamination of trade | Yes - additional options required to prevent illegal release/escape | No	
Screen: s707a-Additional risk management options to prevent entry into risk assessment area of species that contaminate trade		
- Can the species be reliably detected by visual inspection at the place of production prior to import into the risk assessment area (if the answer is yes specify the period and if possible appropriate frequency, if only certain stages of the species can be detected answer yes as the measure could be considered in combination with other measures in a Systems Approach)?	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high

- Can the species be reliably detected by testing at the place of production? Subnote: If only certain stages of the pest can be detected by testing answer yes as the measure could be considered in combination with other measures in a Systems Approach.	Yes as standalone measure | Yes in a System Approach | No	low | medium | high | very high
Screen: s707b-Additional risk management measures for species that are traded and or are associated with trade		
- Describe any additional options to prevent entry into risk assessment area of species that are known to escape from captivity or become released into the wild.		
- Describe any additional options to prevent entry into risk assessment area of species that are illegally released into the wild		
- Describe any additional options to prevent entry into risk assessment area of species that are known to contaminate trade.		
Screen: s707c-Additional risk management options for species that are not associated with trade		
- Describe any additional measures which can be deployed to prevent the introduction of the species to the risk assessment area.		low | medium | high | very high
Screen: s708a-Evaluation of measures		
This section evaluates the risk management options selected and considers in particular their cost effectiveness and potential impact on international trade.		
- Have any measures been identified during the present analysis that will reduce the risk of introduction of the species?	Yes | No	
- Do the proposed or existing measures (as standalone or in a System Approach) reduce the risk to an acceptable level? Subnote: If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest.	Yes as standalone measure | Yes in a System Approach | No	
- Is the species present in the risk assessment area? Subnote:	Yes | No	
Screen: s708b-Evaluation of measures when species is already present in the risk assessment area		
- With the species already present in the risk		low |

assessment area, consider the efficacy of any proposed pathway risk management measures in reducing the risks.		medium | high | very high
Screen: s708c-Evaluation of measures that may impact on trade		
- Have measures (or combination of measures) been identified that reduce the risk for this pathway, and **<u>do not</u>** unduly interfere with international trade, are cost-effective and have no undesirable social or environmental consequences?	Yes | No	low | medium | high | very high
- Estimate to what extent the measures (or combination of measures) being considered interfere with international trade.	Yes | No	low | medium | high | very high
Screen: s709-Relative importance of pathways		
7.03 - Consider the relative importance of the pathways identified in the conclusion to the entry section of the pest risk assessment. Subnote: The relative importance of the pathways is an important element to consider in formulating regulation and in decision making. Regulation of pathways presenting similar risks should be consistent.	1	
Screen: s710-Conclusions		
Monitoring and review Performance of measure(s) should be monitored to ensure that the aim is being achieved. Information supporting the risk analyses should be reviewed periodically by the risk analysts to ensure that any new information that becomes available does not invalidate the decision taken.		
- Summarize the conclusions of the Risk Management stage. List all potential management options and indicate their effectiveness. Uncertainties should be identified.		
Screen: END-END		
End of the module, continue with the next module		

Stage 4 - Impact reduction - Section H - Identification of impact reduction options

Generally speaking, four actions can be considered for invasive species:

1. **No action:** advisable if the risk reduction options available will result in a more negative effect on the environment than without action, when no effective risk reduction options are available, the species is already too widespread for cost-effective action or the pest is not likely to cause damage or will die out without intervention, e.g. because it cannot reproduce. Surveillance and monitoring may still be advisable, even if no management measures are undertaken.
2. **Eradication**
3. **Containment**
4. **Suppression**

You are asked to make a judgement on the risk reduction measures suitable in the context of this risk assessment. Firstly, please identify which of the following control methods can be used for the purpose of risk/impact reduction either on their own or in combination (e.g. by using Integrated Pest Management (IPM) which integrates methods to minimise the disturbance to
the ecosystem).

- **Physical and mechanical control** (e.g. temperature treatment of the soil to kill soil pests, diseases or weeds; cutting and burning of plants or infested plant parts)
- **Biologically based control methods**
  -
    o Biological control (e.g. the release of natural enemies / antagonists of pests, diseases or weeds in the natural environment for permanent reduction of their populations);
    o Semiochemical control (e.g. arthropod control with attractants, repellants, antifeedants, pheromones, kairomones or hormones);
    o Genetic control (e.g. the use of sterile insects to prevent/reduce the reproduction of the pest);

- **Chemical control**
- **Other methods** primarily aimed at preventing the movement of pests, pathogens or plants from cultivated habitats to natural environments, e.g. by regulations, legislation, codes of conduct, restrictions on sale, restrictions on movement, prohibitions to release in unintended habitats, publicity and the obligation to report findings.

Screen: s801-Assessment of methods appropriate to reduce the impacts in the context of this risk assessment

- Identify appropriate physical and mechanical control methods which can be used in the context of this risk		

assessment. Subnote:		
- Identify appropriate biological control based methods which can be used in the context of this risk assessment.		
- Identify appropriate chemical control methods which can be used in the context of this risk assessment.		
- Identify any other methods which can be used in the context of this risk assessment. Subnote: Please consider any research requirements which maybe required to support these methods.		
Screen: s802-Recommendation for management goal		
- Following your risk assessment, please make recommendation as to what the management goal should be in the context of this risk assessment. Please justify your recommendation.	No management action | Eradication | Containment | Suppression | Other	low | medium | high | very high
Screen: END-END		
You have now completing your risk assessment. If you were asked to complete this risk assessment by Invasive Species Ireland please now forward the result to ISI.		