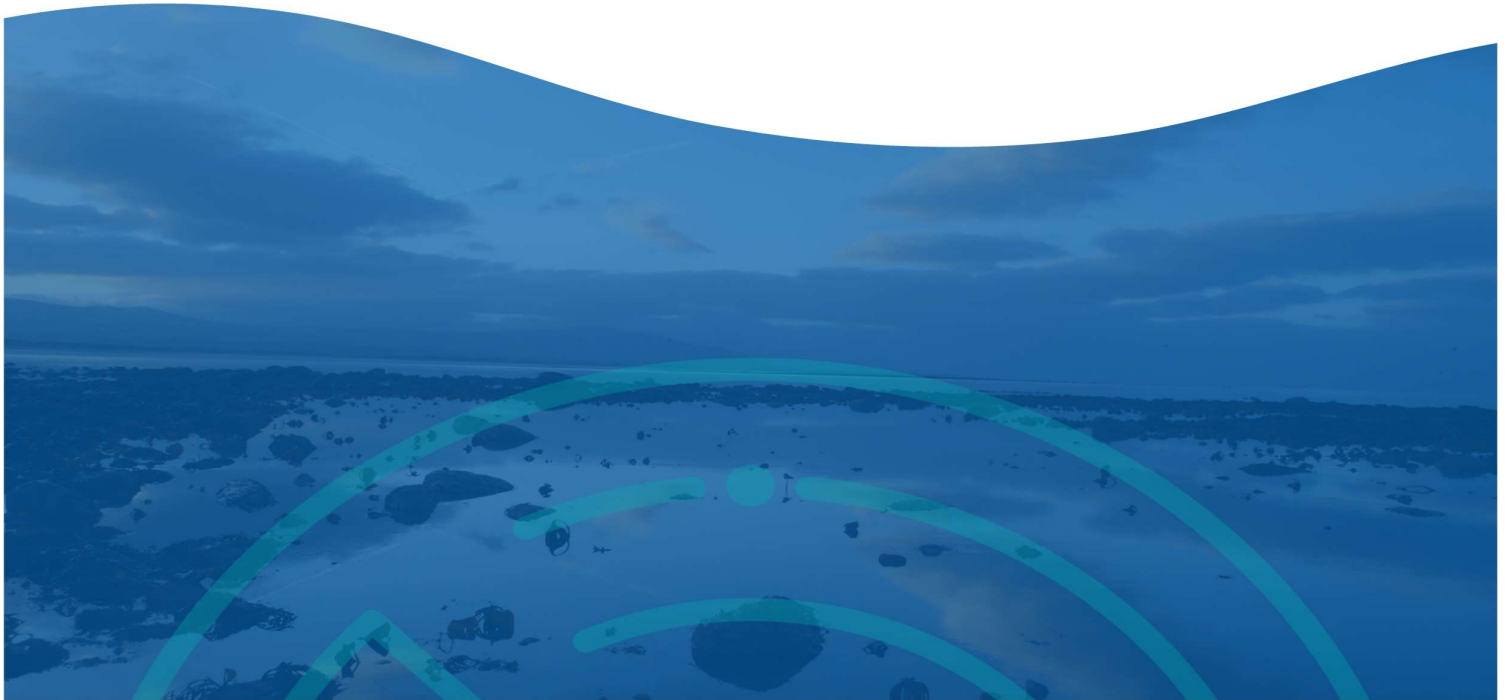


An Invasive Species Surveillance and Monitoring Framework for the Island of Ireland

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Chapter 1. A Framework for Site and Species Prioritisation



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1 Overview

This chapter supports the prioritisation and selection of sites and invasive species for monitoring across the island of Ireland. More specifically, a site prioritisation framework is presented which incorporates processes for determining the susceptibility of a site to invasive species introduction and establishment, and the sensitivity of a site to invasive species impact(s). A comprehensive list of 187 priority invasive species for monitoring, derived from legislative listings, policy targets, and horizon scanning exercises, is provided. Further, relating to the 187 priority species identified, pathway analysis is conducted to identify the most likely routes by which invasive species are introduced and spread. Finally, measures and mechanisms for improved understanding and monitoring of risks at the origin of invasive species pathways which enable timely, coordinated responses to emerging threats before species establish across the island of Ireland, are documented.

It is recommended that this document is reviewed every 3 years, following changes in legislation or policy or the risk of introduction/spread of an invasive species, and revised accordingly.

2 Site Prioritisation

2.1 Rationale

Risk-based monitoring is an effective means of targeting limited resources to achieve the greatest benefit. Prevention of invasive species introduction and rapid response to remove propagules before establishment is considered the most cost-effective means to manage the impacts of invasive species (CBD, 1992, 2010). Focusing invasive species monitoring effort at locations at the greatest risk of invasive species introduction will increase the speed and probability of invasive species detection early in the invasion process, thereby facilitating rapid response (Canavan et al., 2025). Focusing monitoring effort at locations where invasive species establishment risk is greatest further improves the likelihood of detecting invasive species when containment and eradication remain possible. Prioritising invasive species monitoring at sites most vulnerable to the impacts of invasive species, even if they are less at risk of invasive species introduction, can also contribute markedly to reducing the environmental and economic impacts of invasive species.

2.2 Site Prioritisation Framework

In contrast to species risk assessment and prioritisation approaches, site prioritisation is less well prescribed and documented. Key considerations and a simple and effective framework, using established principles, which can be adapted and implemented to prioritise sites according to their risk of invasive species introduction and impact, are outlined below.

Crucial to effective site prioritisation is a clear monitoring objective or goal. This will dictate how the proposed site prioritisation framework is implemented. Table 1 provides an overview of site prioritisation metrics according to four key monitoring objectives (baseline survey, new introductions, rapid response and spread management). The high-level process for scoring sites against each site prioritisation metric is detailed in Figure 1.

Note that 'site' in this context may represent locations of different sizes and include discrete locations with defined boundaries (such as a port or lake) or larger, more open areas (such as river systems or national parks), or pre-defined geographical areas (such as grid cells on a map). The definition of site is likely to be driven by the lowest spatial resolution of the site prioritisation afforded by the available data and the monitoring objective context.

Table 1. Priority species and considerations for site prioritisation according to the monitoring objective. Relevant site prioritisation metrics are identified for each objective. These metrics translate into components of the site prioritisation framework outlined in Figure 1, thereby facilitating its implementation.

Objective	Temporal Scale	Priority species	Priority Site considerations	Relevant site prioritisation metrics
Baseline	One-off, short term (ensuring adequate detection power, accounting for species life history etc).	Selected according to specific driver of the baseline survey	- Where have relevant species been found and where are there spatial gaps in records? - Where are relevant species likely to have been introduced and subsequently established? - Is understanding of the distribution of relevant species in sensitive sites a priority?	Absence of relevant species occurrence records - Susceptible to introduction / spread - Sensitive to invasive species impacts - Susceptible to establishment
New Introductions	Long-term	Species not already established at site or horizon species	- What pathways and sites are linked to the introduction of horizon species? - What is the level of activity associated with identified pathways? - Where are horizon species most likely to establish now and in the short to medium future?	Susceptible to introduction / spread - Sensitive to invasive species impacts
Rapid Response	Long-term	Alert species (some established, some not)	- What pathways and sites are linked to the introduction and / or spread of alert species? - What is the level of activity associated with identified pathways? - Where are horizon and alert species most likely to establish now and in the short to medium future. - Where have alert species been previously recorded (relevant if monitoring to understand the effectiveness of eradication attempts, as well as indicating risk of introduction/establishment)?	Susceptible to introduction / spread Sensitive to invasive species impacts Susceptible to long-term survival / establishment - Difficult to manage long term ('open' sites within which established populations are difficult to contain/eradicate)
Spread Management	Long-term	Widely Spread Species (WSS)	- Where are widely spread species currently established? - What sites are well connected to locations of current establishment? - In which locations is management occurring?	Susceptibility to establishment Occupied by WSS - Susceptible to spread of WSS from already occupied sites - Susceptible to impact

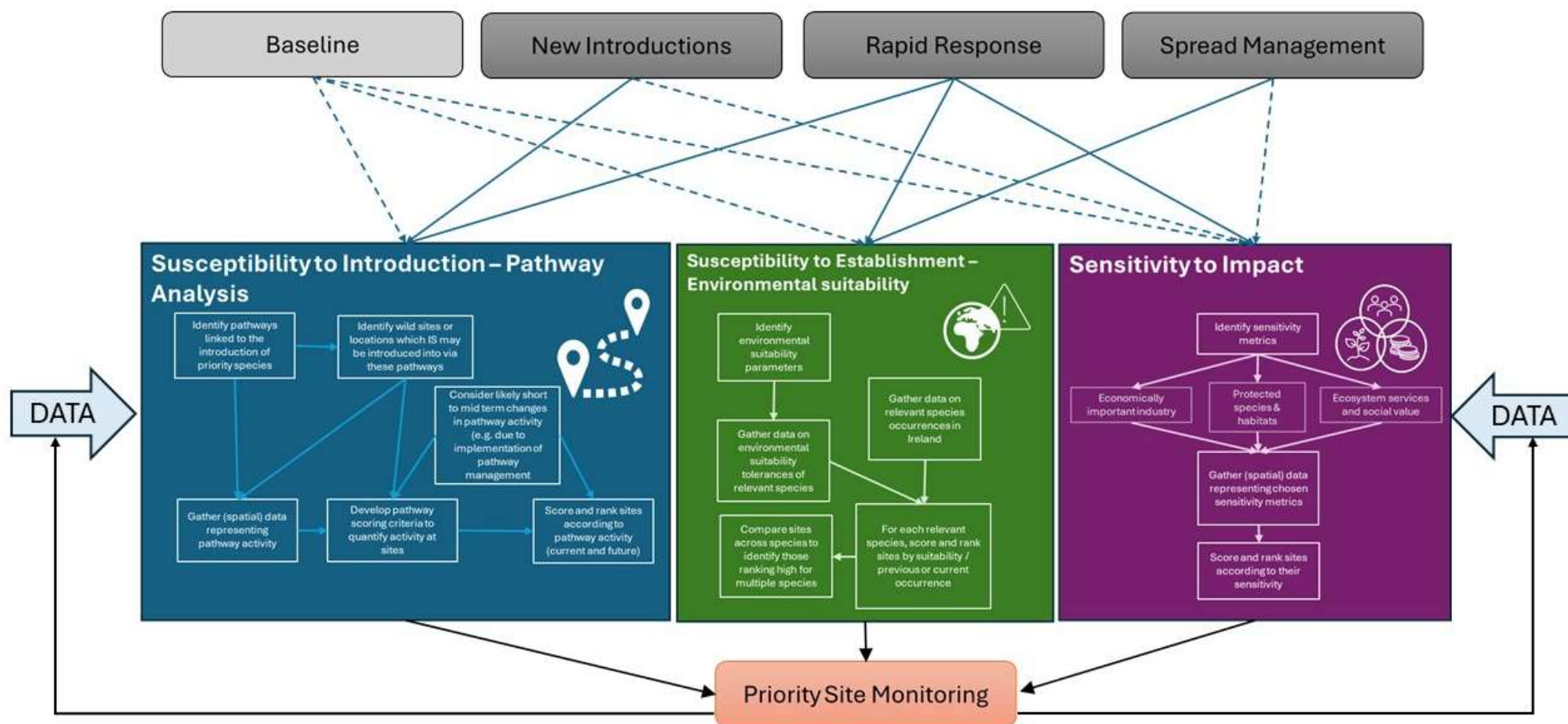


Figure 1. Site prioritisation framework for invasive species (IS) monitoring design.

2.2.1 Metric 1 Susceptibility to Introduction –Pathway Analysis

Identification of invasive species pathways, and assessment of activity associated with these pathways, provides a means by which to estimate invasive species introduction risk into a site. Such pathway assessment often includes consideration of key risk factors, including, for example, the number of movements along a pathway (a proxy for propagule pressure) and/or the number of pathway origins (a proxy for the potential number of invasive species which could be introduced). These risk factors are incorporated into criteria against which sites are scored using available data. Sites are then ranked based on their score.

Data used for scoring needs to be of consistent resolution across the spatial scale the pathway is active to enable score normalisation and ranking. This may be restricted if data resolution varies across the pathway assessment area, highlighting, the need for harmonized collection of pathway activity data. For pathways which show marked temporal variability (i.e., due to global shifts in activity or as a result of pathway management implementation) scoring to reflect minimum, maximum and median activity levels should be considered. Assessment of temporal variability needs to be considered when requesting data to underpin pathway analysis. The time range will depend on the specific pathway and the likely scale of change and should be informed by scientific evidence and expert opinion. Temporal variability in the susceptibility of sites should also be considered alongside sampling design components, including sampling frequency. Where data allow, climate matching between pathway origins and recipient sites should be undertaken (see Metric 2 Susceptibility to Establishment - Environmental suitability, for further information on climate matching to inform site prioritisation).

There are inherent limitations to site prioritisation through pathway analysis owing to the difficulty in attributing the introduction of an invasive species to a specific pathway. However, such limitations may be most profound when site prioritisation is performed to identify priority sites for relevant to a single species, where misidentification of associated pathways could result in the wrong sites being monitored. For broader monitoring objectives, as proposed in the site prioritisation framework, which incorporate multiple species, misidentification is of less consequence. Sense checking the highest risk pathways identified against national (e.g., Haigh et al., 2024) and global (e.g., Hulme et al., 2008) assessments can improve confidence. Furthermore, site prioritisation should be repeated regularly, using the most up-to-date data and in light of any additional information on invasive species pathways.

Examples of pathway analysis to inform site prioritisation for invasive species monitoring in Ireland (IE) and Northern Ireland (NI) are known but appear to be limited to pathways relevant to the marine environment (Table 2). In particular, automated Identification System (AIS) shipping data was used to assess risk of invasive species introduction across ports in GB and the island of Ireland (Tidbury et al., 2016) and for four ports in IE (Costello et al., 2022). Further, at a GB and island of Ireland spatial resolution, recreational cruising route data, and shellfish import data has been used to infer the risk of invasive species introduction into marinas and shellfish production sites respectively (Tidbury et al., 2016).

Table 2. Pathway activity assessment examples.

Pathway	Environment / Sites	Method summary	Pathway Data	Spatial Scope	Outputs	Reference
Shipping	Marine / Ports	Shipping records were used to examine connectivity between four ports in Ireland (Dublin, Cork, New Ross and Rosslare) and other nations. Five parameters were included Cargo vessel type; Previous port; Next destination; Length of stay in port; Vessel journey time. The presence of five focal horizon INNS, known to impact aquaculture species, in origin ports was also evaluated.	Cargo shipping AIS records (9291 records from 2018 and 2019) from Marine Traffic.	IE	Introduction risk: connectivity into four ports (including number of voyages, common vessel types, origin ports, time in port, journey time). Secondary spread risk: connectivity between four ports and other ports in Ireland (NI & IE). Origin ports with focal horizon species.	Costello et al., 2022
		Shipping records were used to examine the total number of unique connections and total number of voyages into all ports. Data were also collated into 50km grid cell format to facilitate creation of pathway activity heatmaps. Cell activity intensity score = number of unique connections x number of voyages.	AIS records for all vessels (from 2012, alternative months) from Marine Traffic.	NI and IE (GB and island of Ireland included in the study).	Ports scored, ranked and mapped by number of connections and number of voyages. Grid cells scored and shaded to reflect shipping pathway activity intensity.	Tidbury et al., 2016
Recreational Boating	Marine / Marinas	Recreational cruising route information was used to estimate the total number of potential recreational cruising routes, and the intensity with which the routes are used, into 50km grid cell. Cell activity intensity score = sum of the number of recreational cruising routes x intensity.	Recreational boating cruising routes from Irish Sailing Association and Irish Cruising Club and Royal Yachting Association.	NI and IE (GB and island of Ireland included in the study).	Grid cells scored and shaded to reflect recreational boating pathway activity intensity.	Tidbury et al., 2016

Pathway	Environment / Sites	Method summary	Pathway Data	Spatial Scope	Outputs	Reference
Aquaculture Stock Movements	Marine / Shellfish Sites	Import data used to estimate the number of live imports in 2012 into each 50km grid cell. Cell activity intensity score = total number of imports.	Shellfish imports from The Fish Health Inspectorate (FHI) for England and Wales, the FHI for Scotland, Marine Institute Ireland and The Department of Agriculture and Rural Development Northern Ireland (now part of The Department of Agriculture, Environment and Rural Affairs (DAERA)).	NI and IE (GB and island of Ireland included in the study)	Grid cells scored and shaded to reflect aquaculture pathway activity intensity.	Tidbury et al., 2016

2.2.2 Metric 2 Susceptibility to Establishment - Environmental suitability

There are numerous abiotic (e.g., climate) and biotic (e.g., habitat) factors which correlate with species survival and establishment probability in a given area. Such factors may facilitate the assessment of suitability of sites for invasive species survival and establishment and hence their prioritisation. Such assessments can range in complexity from simple climatic zone matching between the recipient site locations and invasive species native and introduced regions (e.g., Tidbury et al., 2021), to complex species distribution models (SDMs) which, based on global invasive species distribution data and formulated relationships with abiotic and biotic factors, predict environmental suitability (Srivastava et al., 2019). However, the spatial resolution of outputs is often low, and the robustness of more complex models relies on the accuracy of distribution data. Indeed, the absence of an invasive species may not be due to poor environmental suitability, rather the lack of detection or the absence of dispersal pathways. Further, invasive species by their nature are unlikely to conform to pre-defined environmental suitability relationships, adapting to new conditions in areas where they have been introduced, thereby violating fundamental assumptions of traditional SDMs. While progress to overcome these limitations is being made, the current benefit of applying theoretical models to the prioritisation of sites for monitoring is likely to be somewhat limited, especially considering that the key monitoring objectives of concern here cover multiple species/species groups, rather than single species.

The framework developed herein proposes the inclusion of 'susceptibility to establishment' metrics for the monitoring objective *Rapid Response*, and focuses on evaluation of survival and establishment suitability using previous occurrence of the relevant species in the site. Incorporation of a spatial buffer around sites, and inclusion of any previous records within said buffer, will be valuable to ensure data with inaccurate spatial references is included in the metric. However, this approach falls down if data flow for invasive species occurrence records is not comprehensive and accessible occurrence data are not robust. It is therefore recommended that prior to implementing this component of the framework data flow issues are addressed.

2.2.3 Metric 3 Susceptibility to impact

The sites most sensitive to the impacts of invasive species may be prioritised for monitoring, especially where resource is extremely limited or impacts to sensitive site features are known (or have potential) to be extreme. Sensitive sites may include those occupied by protected species and habitats, as defined under The Birds Directive (2009/147/EC) and Habitats Directive (92/43/EEC) and national implementing legislation (see Legislation Summary in Supplementary Material), and islands. Sites associated with commercial industry, and sites which provide important ecosystem services and social value (e.g., tourist sites) may also be considered sensitive.

The framework developed proposes inclusion of sensitivity to impacts under all but the spread management monitoring objectives. Factors to reflect sensitivity under criteria developed for this metric may include the presence of a protected species or habitat, their spatial extent, or some qualitative measure of (economic or social) value (e.g., industry, ecosystem services). Proximity or connectedness to sensitive sites may also be incorporated into the prioritisation metric criteria to ensure potential 'feeder' sites are also considered for prioritisation. With protection designations

covering large areas, and ever increasing, their inclusion may need to be weighted to ensure adequate differentiation between sites. The definition of economically valuable industry and important ecosystem services (should these wish to be included as criteria) will need to be established to ensure standardisation and consistency.

As with all scoring, data to underpin scoring of criteria within this metric, in particular relating to protected species and habitats needs to be available and consistent across the island of Ireland to allow standardised implementation.

2.2.4 Additional site prioritisation considerations

While not a metric in its own right, the existing deployment of environmental monitoring at a site could be considered when evaluating site prioritisation outputs. This will facilitate development of the most cost-effective invasive species monitoring programme. For example, as outlined in (Tidbury et al., 2026) a number of broader environmental monitoring programmes are implemented across the island of Ireland with potential to provide a spatially and temporally comprehensive foundation for invasive species monitoring into the future.

2.2.5 Summary

The proposed framework offers a simple and effective means by which sites can be prioritised for invasive species monitoring. The individual metrics provide ‘modules’ which can be implemented according to their relevance to the monitoring objective. Furthermore, when combining metric scores, modules can be weighted differently to reflect the importance of the metric to the monitoring objective. For example, for the detection of new introductions, two metrics are proposed: ‘susceptible to introduction/spread’ and ‘sensitive to invasive species impacts’. However, a greater weighting may be given to susceptibility to introduction when combining these two metrics. Similarly, individual metric criteria can be differentially weighted to reflect their importance in the specific monitoring context. For example, criteria pertaining to the presence of protected species and habitats may be considered of greater importance to the site sensitivity metric than the presence of an economically important industry. The framework can also be implemented for a particular environment only or a particular site type only.

To allow comparable and robust scoring and subsequent prioritisation across the proposed monitoring programme sites/areas, data of similar resolution across all sites/areas is required. This is particularly challenging for the island of Ireland, which comprises two jurisdictions with their own data collection and storage systems and different stakeholders.

Scoring against metrics should be transparent and repeatable, and (where data allows) reflect key risk factors associated with each pathway. Site prioritisation outputs should be reviewed objectively, in particular using spatial mapping and visualisation. This will facilitate the identification of large areas within which high priority sites may not occur. Inclusion of monitoring in such locations may be required to balance the speed at which an invasive species is detected against the overall probability that it is detected (see Chapter 2 – Sampling Design).

Implementation of the site prioritisation framework described herein will provide outputs to facilitate targeted monitoring based on current data availability and understanding. Positive feedback, whereby improved invasive species monitoring data will contribute to more accurate metric scores is expected, offering an opportunity for continuous improvement to site prioritisation. As data availability and understanding improves in the future, enhancement of the framework to enable more dynamic outputs will be of value.

2.2.6 Implementation – illustrative site prioritisation

Priority sites and locations for monitoring, based on metrics for which data are available, namely hotspot locations, pathway activity or invasive species risk proxies, and site sensitivity, are highlighted in Chapter 4.

3 Species Prioritisation

A number of legislative and policy drivers exist which influence the selection of priority invasive species for monitoring across the island of Ireland (See Legislation Summary in Supplementary Material). The selection (or listing) of invasive species within relevant legislation and policy is underpinned by robust risk assessment processes, which account for entry, spread, establishment, and impact risk. The listing of a species within legislation, therefore, indicates a high level of risk.

Species listed under key legislation, targeted by policy (e.g., alert species) and identified as high-risk horizon species (Lucy et al., 2020) were collated to create a comprehensive list. To facilitate the development and implementation of comprehensive invasive species monitoring for these species across the island of Ireland, we have compiled information for each species. In particular, reference to the environment(s) in which each species is most likely to be detected, and a classification to guide selection of the most appropriate monitoring method(s) is included (see appendix).

Note that these project outputs provide a foundation that NBDC can build on over the next five years, through their species prioritisation and pathway assessment workstream.

3.1 A priority species list for Ireland

In total, the list comprises 187 species (see appendix): 24 marine, 54 freshwater, 91 terrestrial, 17 which occupy habitats across both the terrestrial and freshwater environment, and one that occupies habitat across both the marine and freshwater environment. Four species have been recorded in NI only, 24 in IE only, 60 in both IE and NI and 99 have not been reported in either IE or NI. In total, 113 species are listed as a Species of Union concern under the IAS Regulations (including those added in 2025), 81 of which are incorporated into national legislation through Ireland's First Schedule under the European Union (Invasive Alien Species) Regulations 2024 (SI 374/2024). Further, 39 species are horizon species identified by Lucy et al., (2020). The list also includes the 12 species defined as widely spread by NI for management under Article 19 of the IAS Regulations, the 15 Alert species in NI and the 13 Alert species in IE. Of the 187 species, 31 species are also listed on Schedule 9 of the Wildlife (Northern Ireland) Order 1985 (as amended) 2020, though, in contrast to the IAS regulations, there is no explicit requirement for monitoring under this Order.

The priority species represent 22 different classifications, reflecting their traits. These classifications were created to guide the selection of methods for their monitoring (Table 3 and appendix). The largest proportion of terrestrial species were classified as terrestrial plants (42, 22%), while the majority of freshwater species were classified as mobile benthic (invertebrates) (16, 8.5%) and the majority of marine species were classified as sessile/fouling with no or minimal pelagic phase (7, 3.7%).

For species-specific monitoring programme design, or when optimising monitoring across the environments to ensure the deployed methods are capable of detecting priority species, species and their classifications should be cross referenced with the monitoring methods manual (see Chapter 3) to determine which methods are required.

Table 3. The number of priority species assigned to each category/classification. For breakdown by species, see appendix.

Environment	Animal/Plant	Category / Classifications	Example species	# Priority species in category
Freshwater & riparian	Animal	Mobile benthic (invertebrate)	American signal crayfish (<i>Pacifastacus leniusculus</i>)	16
		Mobile benthic (vertebrate)	<i>Perccottus glenii</i> (Amur sleeper)	10
		Mobile benthopelagic (vertebrate)	Common barbel (<i>Barbus barbus</i>)	8
		Mobile pelagic	Zander (<i>Sander lucioperca</i>)	3
		Mobile - amphibious	Red-eared terrapin (<i>Trachemys scripta</i>)	4
		Sessile	Zebra mussel (<i>Dreissena polymorpha</i>)	3
	Plant	Rafting	Floating pennywort (<i>Hydrocotyle ranunculoides</i>)	6
		Submerged	Curly waterweed (<i>Lagarosiphon major</i>)	4
		Emergent and rafting	Senegal tea plant (<i>Gymnocoronis spilanthoides</i>)	6
		Emergent and submerged	Parrot's feather (<i>Myriophyllum</i>)	3
Marine	Animal	Mobile benthic	American lobster (<i>Homarus americanus</i>)	5
		Mobile pelagic	American comb jelly (<i>Mnemiopsis leidyi</i>)	0
		Sessile/Fouling - pelagic larvae	Pacific oyster (<i>Magallana gigas</i>)	6
		Sessile/Fouling - no or minimal pelagic stage	Tufty-buff bryozoan (<i>Tricellaria inopinata</i>)	7
	Plant	Rafting	Japanese wireweed (<i>Sargassum muticum</i>)	1

Terrestrial	Animal	Attached/Anchored	Japanese kelp (<i>Undaria pinnatifida</i>)	5
		Invertebrates – flying supraterranean	Asian hornet (<i>Vespa velutina nigrithorax</i>)	9
		Invertebrates - subterranean	New Zealand flatworm (<i>Arthurdendyus triangulatus</i>)	9
		Nocturnal - land-based	Racoon (<i>Procyon lotor</i>)	12
		Diurnal - flying	Common myna (<i>Acridotheres tristis</i>)	12
		Diurnal - land-based	Roe deer (<i>Capreolus capreolus</i>)	11
		Diurnal - arboreal	Pallas's squirrel (<i>Callosciurus erythraeus</i>)	5
	Plant	Terrestrial plants*	Tree of heaven (<i>Ailanthus altissima</i>)	42

3.2 Risk Management

Future prioritisation of species for monitoring, where the intention is to implement management following the detection of a species, should incorporate evaluation of management feasibility. The risk and, importantly, the impact of a species, and the feasibility of its management are often not well correlated. Therefore, combining species' risk assessment with an evaluation of management feasibility is useful when prioritising species for monitoring (as well as management specifically), and ensures that monitoring effort is commensurate with the species anticipated ecological, economic and/or human health impact, and the potential success of management. In short, investment in the detection of a species which can be effectively managed is arguably more valuable than investment in detecting a species whose impact cannot be feasibly reduced through management.

Booy et al., (2017; 2020) developed the GB Non-Native Risk Management Scheme (NNRM) which outlines a standardised process which can be used to score species by the feasibility of their management. While the scheme focusses on eradication as an endpoint, it could be adapted and applied for other management endpoints such as containment to reduce the risk of spread. Accurate and effective management feasibility assessments require a deep understanding and a wealth of supporting data, including in relation to specific invasion scenarios, management methods, and invaded site characteristics. The implementation of comprehensive risk management, and its incorporation into species prioritisation may therefore be a mid- to long-term goal, with the management feasibility assessment for some species presenting significant challenges due to the absence of data.

4 Pathway analysis

Pathways are the routes and mechanisms by which invasive species are introduced. Pathway management is a crucial component of invasive species management, contributing to prevention of introduction and spread. Pathway management focuses on reducing transfer of species along priority pathways, often through the development and implementation pathway action plans. However, knowledge of invasive species pathways, their activity, and associated origin and receptor sites, is also valuable in the context of invasive species surveillance and monitoring, facilitating the identification of priority sites where pathway activity is high.

Invasive species pathways, to which the introduction and/or spread of the 187 priority species identified in this report have been attributed, were identified. This work builds on data collation and analysis undertaken in 2019 and 2024 under Article 13 of the EU IAS Regulation (1143/2014) (Haigh et al., 2024) and applies pathway categories as defined in the CBD (e.g., Harrower et al., 2018). Pathway information for species not already assessed (i.e., by Haigh et al., (2024)) was sought from Biodiversity Maps, EASIN, species risk assessments (national or EU level, as available), and published literature, including Lucy et al., (2020) for horizon species. Pathways associated with priority species were counted and ranked (see Table 4). Pathways for species of different priority type (i.e., Ireland's First Schedule Species (IFSS), Horizon, Alert species etc) were counted and ranked separately to provide insight into the relevance of different pathways (and associated sites) for monitoring objectives which may focus differentially on each priority species type. The analysis focused on unintentional pathways, which are more difficult to manage (i.e., via pathway management) and

prevent the introduction and spread. Further, pathways categorised as very unlikely or unlikely for species introduction into Ireland by Haigh et al., (2024) were excluded from the analysis. Note that in many cases more than one pathway was attributed to a single species, such that the sum of pathway counts is greater than the number of species.

The most prevalent pathway, for which the introduction and spread of the 187 priority species is attributed, is natural dispersal (see Table 4). Second and third are pathways associated with escape from confinement, specifically escapes of pet/aquarium/terrarium species and escapes of ornamental species (excluding horticulture species). The fourth and fifth most prevalent pathways are associated with transport contaminants, specifically on animals (excluding parasites) or habitat material such as soil or vegetation. However, the most prevalent pathways vary between priority species type. For example, introduction and spread of IFSS is more likely by hitchhiking on ship/boat (excluding ballast and biofouling), escapes from botanical gardens, zoos and aquaria (excluding domestic aquaria), angling and fishing equipment, and ship and boat hull fouling than by transportation on habitat material.

Examples of sites linked to each introduction and spread pathway were identified and are presented in Table 5. These are sites which are vulnerable to introduction via the pathway and are therefore strong candidates for prioritisation for monitoring and can be used to inform site prioritisation.

Pathway analysis is challenging because it often relies on historical and often limited data leading to overrepresentation of better-studied pathways. The role of pathways is also potentially variable through a species' introduced range, leading to low confidence when extrapolating pathway information from introduction into one region to another region. Pathway management, underpinned by voluntary or legal mechanisms, also varies across time and space. For example, the implementation of the Council Regulation (EC) No. 708/ 2007 concerning the use of alien and locally absent species in aquaculture, reduces the risk of invasive species escape from aquaculture by prohibiting their use in aquaculture if the risk of escape cannot be appropriately managed.

While evidence to attribute introduction and/or spread to a specific pathway may be limited for some species, the pathway and associated high-risk site information presented here can be used to guide targeting of particular sites for monitoring of a specific species, and also to ensure that an invasive species monitoring programme includes coverage of sites associated with the most prevalent pathways. This pathway analysis should be repeated regularly to account for updated evidence and data, particularly in relation to the island of Ireland, and any changes to the priority species list.

Table 4. Pathways, as defined in the CBD (e.g., Harrower et al., 2018), associated with the 187 priority species (see appendix), including breakdown by species priority type. Note that more than one pathway may have been assigned to a single species such that the total pathway count exceeds the number of species. SoUc refers to Species of Union concern, IFSS refers to Ireland's First Schedule Species, WSS refers to Widely Spread Species and HS refers to horizon species.

Pathway category	Pathway subcategory	All	SoUc	IFSS	HS	WSS	Alert IE	Alert NI
Unaided	Natural dispersal across borders	78	58	37	18	12	10	13
Escape from Confinement	Pet/aquarium/terrarium species (including live food for such species)	47	36	23	11	5	5	3
Escape from Confinement	Ornamental purpose other than horticulture	27	14	15	0	4	0	0
Transport - Contaminant	Contaminant on animals (except parasites, species transported by host/vector)	25	9	13	2	0	3	2
Transport - Contaminant	Transportation of habitat material (soil, vegetation)	24	14	6	3	5	3	4
Transport - Stowaway	Ship/boat ballast water	21	4	11	7	0	3	3
Corridor	Interconnected waterways/basins/seas	20	10	11	5	2	5	6
Transport - Stowaway	Hitchhikers on ship/boat (excluding ballast water and hull fouling)	20	9	16	5	5	2	2
Escape from Confinement	Botanical garden/zoo/aquaria (excluding domestic aquaria)	19	15	8	2	2	3	2
Transport - Contaminant	Contaminant on plants (except parasites, species transported by host/vector)	16	8	3	6	2	2	2
Transport - Stowaway	Angling/fishing equipment	15	7	10	6	5	2	1
Transport - Contaminant	Contaminant nursery material	14	9	1	0	1	2	2
Transport - Stowaway	Ship/boat hull fouling	14	2	9	5	0	4	3
Escape from Confinement	Horticulture	7	0	3	2	0	0	0
Transport - Stowaway	Container/bulk	7	5	0	0	0	1	1
Transport - Stowaway	Machinery/equipment	7	5	0	0	1	1	1
Transport - Stowaway	Vehicles (car, train, ...)	7	5	0	0	0	1	1
Escape from Confinement	Aquaculture / mariculture	6	0	0	5	0	0	0
Escape from Confinement	Live food and live bait	5	4	4	4	0	1	3
Transport - Stowaway	Hitchhikers in or on airplane	5	4	0	0	0	0	0
Transport - Contaminant	Food contaminant (including of live food)	4	3	1	0	0	1	1
Transport - Contaminant	Seed contaminant	4	4	1	0	0	0	0
Corridor	Tunnels and land bridges	3	2	1	0	0	1	0
Escape from Confinement	Farmed animals (including animals left under limited control)	3	1	2	1	0	1	0
Release in Nature	Fishery in the wild (including game fishing)	3	0	3	0	0	0	0
Release in Nature	Hunting	3	0	3	0	0	0	0
Release in Nature	Other intentional release	3	0	1	0	0	0	0
Transport - Contaminant	Timber trade	3	1	1	0	0	2	2
Transport - Stowaway	People and their luggage/equipment (in particular tourism)	3	3	1	0	1	1	1
Release in Nature	Erosion control/ dune stabilization (windbreaks, hedges, ...)	2	0	2	0	0	0	0
Release in Nature	Landscape/flora/fauna "improvement" in the wild	2	0	2	0	0	0	0
Escape from Confinement	Fur farms	1	0	1	0	0	0	0
Escape from Confinement	Other escape from confinement	1	0	1	0	0	0	0

Escape from Confinement	Research and ex-situ breeding (in facilities)	1	1	0	0	0	0	0
Release in Nature	Biological control	1	0	1	0	0	0	0
Transport - Stowaway	Organic packing material, in particular wood packaging	1	0	1	0	0	0	0
Transport - Stowaway	Other means of transport	1	0	0	0	0	0	0

Table 5. Example site types and hotspot locations, for marine, freshwater and terrestrial environments, associated with invasive species pathways, as defined in the CBD (e.g., Harrower et al., 2018). Blank cells indicate that the pathway is not relevant to the environment. The top 5 (excluding Unaided, Natural Dispersal) most relevant to the priority species identified for the island of Ireland are highlighted in bold text.

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Corridor	Tunnels and land bridges	Unintentional	Widespread monitoring, all sites					
Corridor	Interconnected waterways/basins/seas	Unintentional	Widespread monitoring, all sites					
Escape from Confinement	Ornamental purpose other than horticulture	Unintentional			Residential areas with ornamental aquatic features and connected waterbodies, garden centres.	Private ponds	Residential areas with gardens or other landscaping and proximal suitable habitat, garden centres, recycling centres.	Private gardens
Escape from Confinement	Forestry (including reforestation)	Unintentional					Sites for timber production/cultivation or production of wood-derived products	Timber yard
Escape from Confinement	Botanical garden/zoo/aquaria (excluding domestic aquaria)	Unintentional	Marine aquaria and outflows	Marine aquaria	Botanical garden/zoo/aquaria sites and connected waterways	Botanical gardens, zoos, aquaria	Botanical garden/zoo/aquaria site and proximal suitable habitat	Botanical gardens, zoos
Escape from Confinement	Pet/aquarium/terrarium species (including live food for such species)	Unintentional			Fresh waterbodies in proximity to residential areas or private aquaria/pond (with potential for unauthorised release/escape)	Waterbodies (in close proximity to residential areas)	Sites in proximity to residential areas, and pet shops (with potential for escape)	
Escape from Confinement	Horticulture	Unintentional	Marine sites used for the cultivation of species for medical or ornamental purposes and proximal suitable habitat	Seaweed cultivation sites	Freshwater sites used for the cultivation of species for medical or ornamental purposes and proximal suitable habitat		Terrestrial sites for the cultivation of species for medical or ornamental purposes and proximal suitable habitat	

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Escape from Confinement	Farmed animals (including animals left under limited control)	Unintentional					Farms and proximal suitable habitat	Farms
Escape from Confinement	Aquaculture / mariculture	Unintentional	Aquatic (marine) farming facilities (e.g., seaweed farms and aquaculture sites) and proximal suitable habitat	Aquaculture sites	Aquatic (freshwater) farming facilities (e.g., fish farms) and connected waterways	Fish farms		
Escape from Confinement	Live food and live bait	Unintentional	Holding facilities for live imported species and outflows	Holding facilities	Holding facilities for live imported species, outflows and connected waterways	Holding facilities	Holding facilities for live imported species and proximal suitable habitat	Holding facilities
Escape from Confinement	Agriculture (including Biofuel feedstocks)	Unintentional					Farms, cultivations sites and proximal suitable habitat	Farms
Escape from Confinement	Research and ex-situ breeding (in facilities)	Unintentional	Research facilities and outflows	Research facilities	Research facilities, outflows and connected waterways	Research facilities	Research facilities and proximal suitable habitat	Research facilities

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Escape from Confinement	Fur farms	Unintentional					Fur farms and proximal suitable habitat	Fur farms
Escape from Confinement	Other escape from confinement	Unintentional	Widespread monitoring, all areas in proximity to sites used for commercial, recreational or residential purposes from which species could escape					
Release in nature	Erosion control/ dune stabilization (windbreaks, hedges, ...)	Intentional	Pathway Management					
Release in nature	Release in nature for use (other than above, e.g., fur, transport, medical use)	Intentional	Pathway Management					
Release in nature	Landscape/flora/fauna “improvement” in the wild	Intentional	Pathway Management					
Release in nature	Fishery in the wild (including game fishing)	Intentional	Pathway Management					
Release in nature	Hunting	Intentional	Pathway Management					
Release in nature	Other intentional release	Intentional	Pathway Management					

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Release in nature	Biological control	Intentional	Pathway Management					
Transport contaminant	Contaminant on plants (except parasites, species transported by host/vector)	Unintentional	Sites receiving plant material (e.g., seagrass restoration areas, seaweed farms) and proximal suitable habitat	Seagrass restoration sites, seaweed farms	Sites receiving plant material (e.g., ponds, ornamental lakes) and connected/proximal waterways	Ornamental lakes/ponds	Sites receiving plants or plant products (e.g., garden centres, farms, habitat restoration sites) and proximal suitable habitat	Garden centres, farms
Transport contaminant	Transportation of habitat material (soil, vegetation)	Unintentional	Sites receiving dredged material from sites of similar habitat suitability	Dredge receptor sites	Sites receiving material (sediment, macrophytes) from sites of similar habitat suitability	Dredge receptor sites	Sites receiving material (soil, vegetation) from sites of similar habitat suitability	Construction sites
Transport contaminant	Food contaminant (including of live food)	Unintentional	Landing sites, holding facilities or points of sale for imported or fished food species and outflows	Markets	Landing sites, holding facilities or points of sale for imported or fished food species and outflows	Markets	Holding facilities for imported food species and proximal suitable habitat	Warehouses, storage facilities
Transport contaminant	Seed contaminant	Unintentional	Sites receiving seeds	Seagrass restoration sites	Sites receiving seeds		Sites receiving or storing seeds and proximal suitable habitat	Farms
Transport contaminant	Contaminant on animals (except parasites, species transported by host/vector)	Unintentional	Landing sites (for commercial fishing), aquaculture sites (importing stock)	Fish landing sites	Sites receiving live animals (e.g., fish farms)	Fish farms	Sites receiving live animals (e.g., farms, trade venues, pet shops) or dead animals and animal products (e.g., factories, processing sites), or sites to which animals are brought (e.g., dog parks, commons, bridleways)	Pet shops, farms

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Transport contaminant	Contaminant nursery material	Unintentional			Commercial aquatic nursery trade sites (e.g., garden centres with aquatic stock)	Garden centres	Commercial nursery trade sites (e.g., garden centres) and proximal suitable habitat	Garden centres
Transport contaminant	Contaminated bait	Unintentional	Marine angling/fishing sites	Angling sites	Freshwater angling/fishing sites and connected waterways	Angling sites		
Transport contaminant	Parasites on animals (including species transported by host and vector)	Unintentional	Sites receiving live animals (e.g., aquaculture sites)	Aquaculture sites	Sites receiving live animals (e.g., fish farms)	Fish farms	Sites to which animals are brought (e.g., dog parks, commons, bridleways)	Public parks
Transport contaminant	Timber trade	Unintentional					Sites receiving and/or holding timber imports and proximal suitable habitat	Timber yards
Transport stowaway	Hitchhikers on ship/boat (excluding ballast water and hull fouling)	Unintentional	All sites receiving, storing or cleaning vessels (e.g., ports, harbours, marinas, chandlers, storage facilities (and outflows))	Ports, harbours, marinas	Sites hosting boating (including transport and recreational boating) (e.g., sailing lakes and rivers) and connected waterways	Sailing waterbodies		
Transport stowaway	Machinery/equipment	Unintentional	Ports, harbours and marine development sites (onshore and offshore)	Ports, harbours, marinas	Sites receiving used machinery/equipment for use in fresh waterbodies/waterways		Sites receiving and/or storing imported or transported machinery/equipment (e.g., storage depots, warehouses), especially used farming equipment	Storage facilities
Transport stowaway	People and their luggage/equipment (in particular tourism)	Unintentional	Beaches, marinas and points of entry for recreational users	Beaches, marinas	Recreational waterbodies and waterways	Recreational waterbodies	Sites frequented by people for recreational purposes (e.g., public parks, bike trails, hiking routes) and points of entry (e.g., airports, passenger ferry terminals)	Public parks, airports, ferry terminals

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Transport stowaway	Vehicles (car, train, ...)	Unintentional					Sites receiving vehicles, particularly from international origins (e.g., car ferry terminals, import storage sites), train stations	Car ferry terminals
Transport stowaway	Angling/fishing equipment	Unintentional	Marine angling/fishing sites	Angling sites	Freshwater angling/fishing sites and connected waterways	Angling sites		
Transport stowaway	Ship/boat ballast water	Unintentional	Ports and harbours receiving ballasted vessels	Ports, harbours	Fresh or brackish waterways receiving ballasted vessels			
Transport stowaway	Ship/boat hull fouling	Unintentional	All sites receiving, storing or cleaning vessels (e.g., ports, harbours, marinas, chandlers, storage facilities (and outflows))	Ports, harbours, marinas	Sites hosting boating (including transport and recreational boating) (e.g., sailing lakes and rivers) and connected waterways	Sailing waterbodies		
Transport stowaway	Container/bulk	Unintentional					Container storage sites, ports and harbours, and proximal suitable habitat	Storage facilities, ports, harbours
Transport stowaway	Organic packing material, in particular wood packaging	Unintentional					Sites receiving and/or storing organic packing material (e.g., warehouses, commercial storage yards) and proximal suitable habitat	Warehouses, storage facilities
Transport stowaway	Hitchhikers in or on airplane	Unintentional					Airports, hangars, storage facilities, warehouses and proximal suitable habitat	Warehouses, storage facilities

Category	Subcategory	Intentional or Unintentional	Marine		Freshwater		Terrestrial	
			Example site types	Example hotspots	Example site types	Example hotspots	Example site types	Example hotspots
Unaided	Natural dispersal across borders of invasive alien species that have been introduced through pathways 1 to 5	Unintentional	Widespread monitoring, all sites					

4.1 Pathway origins and pre-border risk

Optimisation of monitoring benefits from an understanding of the risk level at the origin of active pathways. Given close proximity, and active trade and transport links with Ireland, invasive species pathway origins (which are distinct from the native regions of introduced invasive species) are concentrated in GB and Mainland Europe. Coupled with the fact that the establishment potential of invasive species introduced into the island of Ireland from GB and Mainland Europe is high due to strong climatic matching, knowledge and understanding of shifting risks and pressures in GB and Mainland Europe is crucial to predicting risks to Ireland. Horizon scanning exercises, incorporating evidence and expert judgement on species impacts and their likelihood of arrival and establishment, contribute to predicting risk over the mid to long term, but understanding of risk shifts in real-time is also important.

4.1.1 Pre-Border Risk Communication

Simple measures, utilising existing alert mechanisms, expert groups and/or databases can provide timely information to inform and underpin decision-making. For example, insight from pathway origin locations regarding new introductions of priority invasive species or the increased prevalence of priority species offers opportunity to respond to increased risks, for example through heightened awareness and surveillance in recipient locations.

Table 6 provides an overview of invasive species alert mechanisms and measures relevant to pre-border alerts. Where applicable, recommendations to enhance the efficacy of the alert system for pre-border intelligence for the island of Ireland are documented.

Of note is the varied mechanisms and measures in existence and the potential challenges which their collective use may pose. Many will undoubtedly overlap but gaps may also occur because alert species may differ from those identified for the island of Ireland and between the different sources of information.

To optimise the value and useability of invasive species alert data for the island of Ireland, automated and continuous acquisition of invasive species records at primary pathway origin locations, and their presentation via an interactive dashboard, should be considered as part of a long-term invasive species data and risk assessment development opportunity.

Table 6. Invasive species alert mechanisms and measures of relevance to pre-border invasive species management in Ireland.

Category	Spatial / political scope	Name	Description	Recommendations to implement/ enhance efficacy of alert mechanism
Alert System	BIC	British Irish Council (BIC) Invasive Species Alert system	The BIC invasive species alert system comprises government representatives working in the invasive species field, from eight member administrations (UK Government, Scottish Government, Welsh Government, Government of Guernsey, Government of Jersey, Government of Ireland, Northern Ireland Executive and Isle of Man Government). It provides a formalised mechanism by which species alert information can be shared and discussed between jurisdictions in close proximity and connected by invasive species pathways. It builds on country specific alert mechanisms such as that associated with GBNSIP in GB. Through timely information sharing, it aids awareness and preparedness. It also facilitates coordinated response and action, and shared learning. The invasive species Work Sector is led by the UK government and the Animal and Plant Health Agency (APHA) (i.e., the GBNSIS). The 2025-2027 Work Sector Plan lists "Alerts and Rapid Response" as a priority area.	It is not clear how species alert data is stored and whether it is openly accessible. A system which facilitates onward sharing of BIC alert system data will be valuable. This could be in the form of a dashboard which highlights current (and historic) incursions and tracks response decisions etc. An open access system removes reliance on manual information sharing and associated limitations including personnel changes and resource capacity.
	EU	European Alien Species Information Network (EASIN) notification system (NOTSYS)	NOTSYS is the official tool for EU Member States to notify the EC and other Member States, as required by The Invasive Alien Species Regulations (1143/2014). The tool facilitates notifications of new invasive species detections (Invasive Alien Species (IAS) of Union concern), related eradication measures and their effectiveness, official control detections, and derogations from the obligation of rapid eradication, as covered under Articles 15 to 18. The information, both the mandatory reporting data and any additional documents, are then used for updating the EASIN Catalogue and spatial database.	The 'Notifications search' functionality facilitates interrogation of data by Member State, type (official control detections, or early detections) species and time period. Such data, in combination with an understanding of pathways, can inform preparedness and rapid response.

Category	Spatial / political scope	Name	Description	Recommendations to implement/ enhance efficacy of alert mechanism
	Europe	AquaNIS alert System	AquaNIS is an online information system for aquatic NIS (and cryptogenic species). Information is available on species, introduction events and new arrivals. As part of AquaNIS, a regionally harmonized Early Warning System (EWS) for timely communication of findings of Harmful Aquatic Organisms and Pathogens has been developed for the Baltic Sea area, and more broadly, in accordance with the International Convention on the control and management of ships' ballast water and sediments. The alert is sent to all registered recipients designated by Member States as national focal points (e.g., port state control authorities, ministries of transport or environment).	AquaNIS has a 'New Arrivals' application which, upon request, retrieves a list of non-indigenous and cryptogenic species that are new arrivals at various geographical scales, (Olenin <i>et al.</i> , 2016).
Expert Groups	NE Atlantic	OSPAR NIS Expert Group	OSPAR is the mechanism by which 15 Governments and the EU co-operate to protect the marine environment of the North-East Atlantic. This NIS expert group comprises technical experts from member states. Its remit includes The Marine Strategy Framework Directive (MSFD) Descriptor 2 NIS indicator development, monitoring coordination and OSPAR quality status reporting. The OSPAR Data & Information Management System (ODIMS) contains open-access datasets on NIS, including locations of new records of NIS made in the OSPAR signatory countries.	This Expert Group (EG) provides a platform through which experts can share information relating to NIS. While data on new NIS introductions is shared as part of the 6 yearly reporting process, new introduction data sharing could be formalised and incorporated into EG meeting agendas and encouraged via email.
	North Atlantic Ocean, the North Sea, and the Baltic Sea	International Council for the Exploration of the Sea (ICES)	ICES has two marine NIS-related working groups: Ballast and Other Ship Vectors (BOSV) and Introduction and Transfer of Marine Organisms (ITMO). These groups comprise experts from ICES-relevant countries around the Baltic Sea, North Sea, and North Atlantic Ocean. Annual ICES Working Group reporting includes documentation of new invasive species introductions.	Current representation of Ireland within the two working groups is not known. Participation (via chair invite) into these groups would allow access to data and information on new invasive species introductions of potential relevance to Ireland.

Category	Spatial / political scope	Name	Description	Recommendations to implement/ enhance efficacy of alert mechanism
	EU	EC expert groups and panels	Bern Convention Group Group of Experts on IAS - The Bern Convention Group of Experts on IAS was established in 1992 to accompany Bern Convention Contracting Parties in designing and implementing control measures for non-endemic species, with the aim to reduce their negative impact on native biodiversity in Europe. Since its establishment, the Group, in cooperation with experts and partner organisations, has developed guidance documents, codes of conduct, actions plans and strategies on ways to control the spread of IAS species and eradicate them. Invasive Alien Species Expert Group (IASEG): Supports the implementation of the IAS Regulation by providing advice and expertise to the Commission. Invasive Species Specialist Group (ISSG): A global network of scientific and policy experts, including within Europe, working to exchange information and promote policy and technical advice. Scientific Forum on IAS: A forum for scientific discussions and exchange of information related to invasive alien species. Working Group on IAS: Facilitates coordination between stakeholders and Member States.	
	Europe	European and Mediterranean Plant Protection Organization (EPPO)	EPPO has a specific Panel on Invasive Alien Plants to address the threat of invasive species to wild plants.	While EPPO appears to focus on sharing pest risk analyses, the potential to provide information on invasive pest incursions, for incorporation into pre-border risk assessment for Ireland, could be explored.
Social Media Alerts	All	Social media platforms including X, Facebook, LinkedIn.	Social media is increasingly used to disseminate information on invasive species incursions. It is therefore a potentially valuable source of information to inform pre-border alerts and risk assessment.	There is potential to develop and implement “webscraping” methodologies to extract crucial data relating to invasive species

Category	Spatial / political scope	Name	Description	Recommendations to implement/ enhance efficacy of alert mechanism
				incursions in locations from which introduction into Ireland is possible. Such methodologies can be computationally extensive and require specialised expertise and quality control systems. It may therefore be most suited to targeted information collation, for example, relating to a specific species or location.
Import Control	EU	Trade control and expert system (TRACES) and Common Health Entry Document for Products (CHED-P) / Common Health Entry Document for Plant Products (CHED-PP)	TRACES is the EC's online platform for animal and plant health certification for the importation of animals and plants into the EU, as laid out in Regulation 2017/625. TRACES notifies Member States of movements of live animals and their products into or through different territories of Member States and helps Competent Authorities in each Member State to meet the needs of their traders and their EU animal and public health obligations. The system is used to control the movement of goods into NI and IE from non-EU countries. Importers must register on TRACES and use it to pre-notify goods (animals and plants) entering the EU. DAERA must also be notified in advance of goods arrivals through a CHED-P or CHED-PP, submitted through TRACES. DAERA may then undertake further checks on goods to verify compliance. Prohibited plants listed in EU legislation (EU 2018/2019 and Annex VI of 2019/2072) are not permitted to move from GB to NI.	TRACES provides functionality to identify high risk consignments for closer examination / inspection. More specifically, information on imported species and their origin, in combination with broader invasive species risk and distribution data, could be used to classify consignments according to their risk, and prioritise border inspection, thereby aiding reactive biosecurity.

5 Appendix - Priority invasive species for monitoring across the island of Ireland

Table 7. Invasive species which are priorities for monitoring across the island of Ireland. Species associated with each priority type are denoted using a Y. The recording of each species with respect to NI and IE is also denoted using a Y. Note that crayfish plague and salmon fluke have been removed from the list given that they are a pathogen and parasite, respectively, and are therefore outwith the scope of this project, according to the definition of invasive species being applied. SoUc refers to Species of Union concern, IFSS refers to Ireland's First Schedule Species, WSS refers to widely spread species (for further information on relevant legislation see Supplementary Material). Species on Schedule 9 of the Wildlife (Northern Ireland) Order 1985 (as amended) – 2020, are also highlighted though, there is no explicit requirement for monitoring under this Order.

Scientific Name	Common Name	Group	M	FW	T	SoUc	IFSS	Schedule 9	Horizon	WSS	Alert NI	Alert IE	Recorded in NI	Recorded in IE
<i>Acacia mearnsii</i>	Black wattle	Flowering plant			Y	T Terrestrial plant	Y (2025 update)							
<i>Acacia saligna</i> (<i>Acacia cyanophylla</i>)	Golden wreath wattle	Flowering plant			Y	T Terrestrial plant	Y							
<i>Acridotheres cristatellus</i>	Crested myna	Bird			Y	T Diurnal - flying	Y (2025 update)							
<i>Acridotheres tristis</i>	Common myna	Bird			Y	T Diurnal - flying	Y							
<i>Agrilus anxius</i>	Birch borer	Insect - beetle			Y	T Invertebrates - supraterranean			Y					
<i>Agrilus planipennis</i>	Emerald ash-borer	Insect - beetle			Y	T Invertebrates - supraterranean			Y					
<i>Ailanthus altissima</i>	Tree of heaven	Flowering plant			Y	T Terrestrial plant	Y							Y
<i>Allium triquetrum</i>	Three-cornered leek	Flowering plant			Y	T Terrestrial plant		Y					Y	Y
<i>Alopochen aegyptiaca</i>	Egyptian goose	Bird		Y	Y	T Diurnal - flying	Y				Y		Y	Y
<i>Alternanthera philoxeroides</i>	Alligator weed	Flowering plant		Y		FW Aquatic - Emergent and Submerged	Y							
<i>Ameiurus melas</i>	Black bullhead catfish	Bony fish (Actinopterygii)		Y		FW Mobile vertebrate pelagic	Y							
<i>Amphibalanus improvisus</i>	Bay barnacle	Crustacean	Y			M Sessile/Fouling - pelagic larvae			Y				Y	Y
<i>Andropogon virginicus</i>	Broomsedge bluestem	Flowering plant			Y	T Terrestrial plant	Y							

<i>Anser anser</i>	Greylag goose	Bird	Y	Y	T Diurnal - flying	Y		Y	Y
<i>Aponogeton distachyos</i>	Cape pondweed	Flowering plant	Y		FW Aquatic - Rafting	Y		Y	Y
<i>Arthurdendyus triangulatus</i>	New Zealand flatworm	Flatworm (Turbellaria)		Y	T Invertebrates - subterranean	Y		Y	Y
<i>Asclepias syriaca</i>	Milkweed	Flowering plant		Y	T Terrestrial plant	Y			
<i>Astacus astacus</i>	Noble crayfish	Crustacean	Y		FW Mobile benthic	Y	Y	Y	
<i>Astacus leptodactylus</i>	Narrow-clawed crayfish	Crustacean	Y		FW Mobile benthic	Y - Entry as 'all crayfish except white-clawed'	Y		
<i>Asterias amurensis</i>	Northern Pacific seastar	Echinoderm	Y		M Mobile benthic	Y (2025 update)			
<i>Axis axis</i>	Chital / spotted deer	Terrestrial mammal		Y	T Diurnal - land-based	Y			Y
<i>Azolla filiculoides</i>	Water fern	Fern	Y		FW Aquatic - Rafting	Y	Y	Y	Y
<i>Baccharis halimifolia</i>	Eastern Baccharis	Flowering plant		Y	T Terrestrial plant	Y			
<i>Barbus barbus</i>	Barbel	Bony fish (Actinopterygii)	Y		FW Mobile vertebrate pelagic		Y		
<i>Bipalium kewense</i>	Arrowhead worm	Flatworm (Turbellaria)		Y	T Invertebrates - subterranean	Y (2025 update)			Y
<i>Brachyponera chinensis</i>	Asian needle ant	Insect – hymenoptera		Y	T Invertebrates - subterranean	Y (2025 update)			
<i>Branta canadensis</i>	Canada goose	Bird	Y	Y	T Diurnal - flying	Y	Y	Y	Y
<i>Broussonetia papyrifera</i>	Paper mulberry	Flowering plant		Y	T Terrestrial plant	Y (2025 update)			
<i>Bufo bufo</i>	Common toad	Amphibian	Y		FW Mobile - amphibious	Y		Y	Y
<i>Cabomba caroliniana</i>	Green cabomba	Flowering plant	Y		FW Aquatic - Submerged	Y	Y		
<i>Callosciurus erythraeus</i>	Pallas's squirrel	Terrestrial mammal		Y	T Diurnal - arboreal	Y			
<i>Callosciurus finlaysonii</i>	Finlayson's squirrel	Terrestrial mammal		Y	T Diurnal - arboreal	Y			
<i>Caprella mutica</i>	Japanese skeleton shrimp	Crustacean	Y		M Sessile/Fouling - no or minimal pelagic stage	Y	Y	Y	Y
<i>Capreolus capreolus</i>	Roe deer	Terrestrial mammal		Y	T Diurnal - land-based	Y	Y		Y
<i>Cardiospermum grandiflorum</i>	Balloon vine	Flowering plant		Y	T Terrestrial plant	Y			

<i>Carpobrotus edulis</i>	Hottentot-fig	Flowering plant	Y	T Terrestrial plant	Y	Y	Y	Y
<i>Caulacanthus okamurae</i>	Pom-pom weed	Alga	Y	M Attached/Anchored		Y		Y
<i>Celastrus orbiculatus</i>	Oriental bittersweet	Flowering plant	Y	T Terrestrial plant	Y			
<i>Celtodoryx ciocalyptoides</i>	Sponge	Sponge (Porifera)	Y	M Sessile/Fouling - no or minimal pelagic stage		Y		
<i>Cervus nippon</i>	Sika deer	Terrestrial mammal	Y	T Diurnal - land-based	Y (2025 update)	Y	Y	Y
<i>Channa argus</i>	Northern Snakehead	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y			
<i>Cherax destructor</i>	Common yabby	Crustacean	Y	FW Mobile benthic	Y (2025 update)	Y - Entry as 'all crayfish except white-clawed'		
<i>Cipangopaludina chinensis</i>	Chinese mystery snail	Mollusc	Y	FW Mobile benthic (invertebrate)	Y (2025 update)			
<i>Cochlicella barbara</i>	Pointed snail	Mollusc	Y	T Invertebrates - supraterranean		Y		
<i>Corbicula fluminea</i>	Asian clam	Mollusc	Y	FW Mobile benthic (invertebrate)		Y	Y	Y
<i>Cortaderia jubata</i>	Purple pampas grass	Flowering plant	Y	T Terrestrial plant	Y			
<i>Corvus splendens</i>	Indian house crow	Bird	Y	T Diurnal - flying	Y		Y	Y
<i>Crassula helmsii</i>	New Zealand pigmyweed	Flowering plant	Y	FW Aquatic - Emergent and Submerged	Y (2025 update)	Y	Y	Y
<i>Crepidula fornicata</i>	Slipper limpet	Mollusc	Y	M Sessile/Fouling - pelagic larvae		Y	Y	Y
<i>Cyprinus carpio</i>	Carp	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic		Y		Y
<i>Dama dama</i>	Fallow deer	Terrestrial mammal	Y	T Diurnal - land-based		Y		Y
<i>Delairea odorata</i>	Cape ivy	Flowering plant	Y	T Terrestrial plant	Y (2025 update)			Y
<i>Didemnum vexillum</i>	Carpet sea squirt	Tunicate (Urochordata)	Y	M Sessile/Fouling - no or minimal pelagic stage		Y	Y	Y
<i>Dikerogammarus haemobaphes</i>	Demon shrimp	Crustacean	Y	FW Mobile invertebrate pelagic			Y	
<i>Dikerogammarus villosus</i>	Killer shrimp	Crustacean	Y	FW Mobile invertebrate pelagic		Y	Y	
<i>Dreissena polymorpha</i>	Zebra mussel	Mollusc	Y	FW Sessile		Y	Y	Y

<i>Dreissena rostriformis bugensis</i>	Quagga mussel	Mollusc	Y	FW Sessile	Y	Y	Y	Y	Y
<i>Ehrharta calycina</i>	Perennial veldtgrass	Flowering plant	Y	T Terrestrial plant	Y				
<i>Eichhornia crassipes</i>	Water hyacinth	Flowering plant	Y	FW Aquatic - Rafting	Y				
<i>Elodea nuttallii</i>	Nuttall's waterweed	Flowering plant	Y	FW Aquatic - Submerged	Y	Y	Y	Y	Y
<i>Elodea spp</i>	Waterweeds	Flowering plant	Y	FW Aquatic - Submerged	Y - select species	Y		Y	Y
<i>Ensis leei</i>	American razor-clam	Mollusc	Y	M Sessile/Fouling - pelagic larvae		Y		Y	
<i>Erinaceus europaeus</i>	Hedgehog	Terrestrial mammal	Y	T Nocturnal - land-based	Y	Y		Y	Y
<i>Eriocheir sinensis</i>	Chinese mitten crab	Crustacean	Y	FW Mobile benthic	Y	Y	Y	Y	Y
<i>Faxonius immunitis</i>	Calico crayfish	Crustacean	Y	FW Mobile benthic	Y (2025 update)	Y - Entry as 'all crayfish except white-clawed'			
<i>Faxonius immunitis</i>	Calico crayfish	Crustacean	Y	FW Mobile benthic	Y (2025 update)	Y - Entry as 'all crayfish except white-clawed'			
<i>Faxonius rusticus</i>	Rusty crayfish	Crustacean	Y	FW Mobile benthic	Y	Y	Y		
<i>Fundulus heteroclitus</i>	Mummichog	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y				
<i>Gambusia affinis</i>	Mosquitofish	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y				
<i>Gambusia holbrooki</i>	Eastern Mosquitofish	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y				
<i>Grateloupia doryphora</i>	A red alga	Alga	Y	M Attached/Anchored	Y				
<i>Gunnera manicata</i>	Brazilian giant-rhubarb	Flowering plant	Y	T Terrestrial plant	Y				Y
<i>Gunnera tinctoria</i>	Chilean rhubarb	Flowering plant	Y	T Terrestrial plant	Y	Y	Y	Y	Y
<i>Gymnocoronis spilanthoides</i>	Senegal tea plant	Flowering plant	Y	FW Aquatic - emergent and rafting	Y				
<i>Hakea sericea</i>	Silky hakea	Flowering plant	Y	T Terrestrial plant	Y				
<i>Harmonia axyridis</i>	Harlequin Ladybird	Insect - beetle	Y	T Invertebrates - supraterranean	Y			Y	Y
<i>Hemigrapsus sanguineus</i>	Asian shore crab	Crustacean	Y	M Mobile benthic		Y			
<i>Hemigrapsus takanoi</i>	Brush-clawed shorecrab	Crustacean	Y	M Mobile benthic		Y			

<i>Heracleum mantegazzianum</i>	Giant hogweed	Flowering plant	Y	T Terrestrial plant	Y	Y	Y	Y	Y
<i>Heracleum persicum</i>	Persian hogweed	Flowering plant	Y	T Terrestrial plant	Y				
<i>Heracleum sosnowskyi</i>	Sosnowski's hogweed	Flowering plant	Y	T Terrestrial plant	Y				
<i>Herpestes javanicus</i>	Small Asian mongoose / Javan mongoose	Terrestrial mammal	Y	T Diurnal - land-based	Y				
<i>Hesperibalanus fallax</i>	Warm-water barnacle	Crustacean	Y	M Sessile/Fouling - pelagic larvae			Y		
<i>Hippophae rhamnoides</i>	Sea-buckthorn	Flowering plant	Y	T Terrestrial plant		Y	Y	Y	Y
<i>Homarus americanus</i>	American Lobster	Crustacean	Y	M Mobile benthic			Y		Y
<i>Humulus scandens</i>	Japanese hop	Flowering plant	Y	T Terrestrial plant	Y				
<i>Hyacinthoides hispanica</i>	Spanish bluebell	Flowering plant	Y	T Terrestrial plant		Y	Y	Y	Y
<i>Hydrocotyle ranunculoides</i>	Floating pennywort	Flowering plant	Y	Y	FW Aquatic - Rafting	Y	Y	Y	Y
<i>Hydropotes inermis</i>	Chinese water deer	Terrestrial mammal	Y	T Diurnal - land-based		Y	Y		
<i>Hylastes ater</i>	Black pine bark beetle	Insect - beetle	Y	T Invertebrates - supraterranean			Y		Y
<i>Impatiens glandulifera</i>	Himalayan balsam	Flowering plant	Y	T Terrestrial plant	Y	Y	Y	Y	Y
<i>Juncus planifolius</i>	Broad-leaved rush	Flowering plant	Y	T Terrestrial plant		Y			Y
<i>Koenigia polystachya</i>	Himalayan knotweed	Flowering plant	Y	T Terrestrial plant	Y	Y	Y	Y	Y
<i>Lagarosiphon major</i>	Curly waterweed	Flowering plant	Y	FW Aquatic - Submerged	Y	Y	Y	Y	Y
<i>Lampropeltis getula</i>	Common kingsnake	Reptile	Y	T Diurnal - land-based	Y				
<i>Lepomis gibbosus</i>	Pumpkinseed	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y				
<i>Lepus europaeus</i>	Brown hare	Terrestrial mammal	Y	T Diurnal - land-based		Y	Y	Y	Y
<i>Lespedeza cuneata</i> (<i>Lespedeza juncea</i> var. <i>sericea</i>)	Chinese bushclover	Flowering plant	Y	T Terrestrial plant	Y				
<i>Leuciscus leuciscus</i>	Dace	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic		Y			Y
<i>Limnoperna fortunei</i>	Golden mussel	Mollusc	Y	FW Sessile	Y				
<i>Lithobates (Rana) catesbeianus</i>	North American bullfrog	Amphibian	Y	Y	FW Mobile - amphibious	Y	Y		
<i>Ludwigia grandiflora</i>	Water primrose	Flowering plant	Y	Y	FW Aquatic - Rafting	Y	Y	Y	Y

<i>Ludwigia peploides</i>	Floating primrose willow	Flowering plant	Y	Y	FW Aquatic - Rafting	Y	Y				
<i>Lygodium japonicum</i>	Vine-like fern	Fern		Y	T Terrestrial plant	Y					
<i>Lysichiton americanus</i>	American skunk cabbage	Flowering plant	Y	Y	T Terrestrial plant	Y	Y	Y	Y	Y	Y
<i>Marisa cornuarietis</i>	Colombian ramshorn	Mollusc	Y		T Invertebrates - supraterranean	Y (2025 update)					
<i>Microstegium vimineum</i>	Japanese stiltgrass	Flowering plant		Y	T Terrestrial plant	Y					
<i>Microtus agrestis</i>	Field vole	Terrestrial mammal		Y	T Nocturnal - land-based		Y		Y	Y	Y
<i>Microtus arvalis</i>	Orkney vole	Terrestrial mammal		Y	T Diurnal - land-based		Y		Y	Y	Y
<i>Misgurnus anguillicaudatus</i>	Pond loach	Bony fish (Actinopterygii)	Y		FW Mobile vertebrate pelagic	Y (2025 update)					
<i>Misgurnus bipartitus</i>	Asian weatherfish	Bony fish (Actinopterygii)	Y		FW Mobile vertebrate pelagic	Y (2025 update)					
<i>Morone americana</i>	White Perch	Bony fish (Actinopterygii)	Y		FW Mobile vertebrate pelagic	Y					
<i>Mulinia lateralis</i>	Dwarf surf clam	Mollusc	Y		M Sessile/Fouling - pelagic larvae	Y (2025 update)					
<i>Muntiacus reevesii</i>	Muntjac deer	Terrestrial mammal		Y	T Diurnal - land-based	Y	Y		Y	Y	Y
<i>Mustela erminea hibernicus</i>	Irish stoat	Terrestrial mammal		Y	T Nocturnal - land-based		Y	Y		Y	Y
<i>Myiopsitta monachus</i>	Monk parakeet; Greyheaded parakeet	Bird		Y	T Diurnal - flying		Y			Y	
<i>Myocastor coypus</i>	Coypu	Terrestrial mammal	Y	Y	T Nocturnal - land-based	Y	Y		Y	Y	Y
<i>Myriophyllum aquaticum</i>	Parrot's feather	Flowering plant	Y	Y	FW Aquatic - Emergent and Submerged	Y	Y	Y		Y	Y
<i>Myriophyllum heterophyllum</i>	Broadleaf watermilfoil	Flowering plant	Y	Y	FW Aquatic - Emergent and Submerged	Y		Y			
<i>Nanozostera japonica</i>	Dwarf eelgrass	Flowering plant	Y		M Attached/Anchored	Y (2025 update)	Y	Y			
<i>Nasua nasua</i>	Coati	Terrestrial mammal		Y	T Diurnal - land-based	Y					
<i>Neogale vison; Neovison vison</i>	American mink	Terrestrial mammal		Y	T Nocturnal - land-based		Y	Y		Y	Y
<i>Nyctereutes procyonoides</i>	Raccoon dog	Terrestrial mammal		Y	T Nocturnal - land-based	Y				Y	
<i>Nymphoides peltata</i>	Fringed water-lily	Flowering plant	Y		FW Aquatic - Rafting		Y	Y		Y	Y
<i>Obama nungara</i>	Nungara flatworm	Flatworm (Turbellaria)		Y	T Invertebrates - subterranean	Y (2025 update)		Y	Y		

<i>Ocinebrellus inornatus</i>	Japanese oyster drill	Mollusc	Y	M Sessile/Fouling - no or minimal pelagic stage	Y				
<i>Oncorhynchus gorbuscha</i>	Pacific Pink Humpback Salmon	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic		Y	Y	Y	
<i>Oncorhynchus mykiss</i>	Rainbow trout	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic		Y		Y	Y
<i>Ondatra zibethicus</i>	Muskrat	Terrestrial mammal	Y	T Nocturnal - land-based	Y	Y	Y		Y
<i>Orconectes limosus</i> (<i>Faxonius limosus</i>)	Spiny-cheek crayfish	Crustacean	Y	FW Mobile benthic	Y	Y	Y		
<i>Orconectes virilis</i> (<i>Faxonius virilis</i>)	Virile crayfish	Crustacean	Y	FW Mobile benthic	Y	Y	Y		
<i>Oxyura jamaicensis</i>	Ruddy duck	Bird	Y	Y	T Diurnal - flying	Y	Y	Y	Y
<i>Pacifastacus leniusculus</i>	Signal crayfish	Crustacean	Y	FW Mobile benthic	Y	Y	Y	Y	
<i>Parthenium hysterophorus</i>	Whitetop weed	Flowering plant	Y	T Terrestrial plant	Y				
<i>Pennisetum setaceum</i>	Crimson fountaingrass	Flowering plant	Y	T Terrestrial plant	Y				
<i>Percottus glenii</i>	Chinese sleeper / Amur sleeper	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y				
<i>Perophora japonica</i>	Creeping sea squirt	Tunicate (Urochordata)	Y	M Sessile/Fouling - no or minimal pelagic stage	Y			Y	Y
<i>Persicaria perfoliata</i> (<i>Polygonum perfoliatum</i>)	Asiatic tearthumb/Mile-a-minute weed	Flowering plant	Y	T Terrestrial plant	Y	Y			
<i>Pistia stratiotes</i>	Water lettuce	Flowering plant	Y	FW Aquatic - Rafting	Y				
<i>Platydemus manokwari</i>	New Guinea flatworm	Flatworm (Turbellaria)	Y	T Invertebrates - subterranean	Y (2025 update)				
<i>Plotosus lineatus</i>	Striped eel catfish	Bony fish (Actinopterygii)	Y	M Mobile benthic	Y				
<i>Procambarus clarkii</i>	Red swamp crayfish	Crustacean	Y	FW Mobile benthic	Y	Y			
<i>Procambarus fallax f. virginalis</i> (<i>Procambarus virginalis</i>)	Marbled crayfish	Crustacean	Y	FW Mobile benthic	Y	Y			
<i>Procyon lotor</i>	Raccoon	Terrestrial mammal	Y	T Nocturnal - land-based	Y	Y	Y	Y	Y
<i>Prosopis juliflora</i>	Mesquite	Flowering plant	Y	T Terrestrial plant	Y				
<i>Pseudorasbora parva</i>	Stone moroko (topmouth gudgeon)	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y	Y			

<i>Psittacula krameri</i>	Ring-necked parakeet	Bird	Y	T Diurnal - flying	Y	Y	Y	Y
<i>Pueraria montana</i> var. <i>lobata</i> (<i>Pueraria lobata</i>)	Kudzu vine	Flowering plant	Y	T Terrestrial plant	Y			
<i>Pycnonotus cafer</i>	Red-vented bulbul	Bird	Y	T Diurnal - flying	Y			
<i>Pycnonotus jocosus</i>	Crested bulbul	Bird	Y	T Diurnal - flying	Y (2025 update)			
<i>Rapana venosa</i>	Asian rapa whelk	Mollusc	Y	M Sessile/Fouling - pelagic larvae	Y			
<i>Rattus norvegicus</i>	Brown rat	Terrestrial mammal	Y	T Nocturnal - land-based	Y	Y		Y
<i>Rattus rattus</i>	Black rat	Terrestrial mammal	Y	T Nocturnal - land-based	Y	Y		Y
<i>Reynoutria × bohemica</i>	Bohemian knotweed	Flowering plant	Y	T Terrestrial plant	Y (2025 update)	Y - select species		Y
<i>Reynoutria japonica</i> ; <i>Fallopia japonica</i>	Japanese knotweed	Flowering plant	Y	T Terrestrial plant	Y (2025 update)	Y	Y	Y
<i>Reynoutria sachalinensis</i> ; <i>Fallopia sachalinensis</i>	Giant knotweed	Flowering plant	Y	T Terrestrial plant	Y (2025 update)	Y	Y	Y
<i>Rhododendron ponticum</i> (including <i>R. x superponticum</i>)	Rhododendron	Flowering plant	Y	T Terrestrial plant	Y			Y
<i>Rubus spectabilis</i>	Salmonberry	Flowering plant	Y	T Terrestrial plant	Y	Y		Y
<i>Rugulopteryx okamurae</i>	A brown seaweed	Alga	Y	M Attached/Anchored	Y			
<i>Rutilus rutilus</i>	Roach	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic	Y			Y
<i>Salvelinus fontinalis</i>	Brook trout; Brook charr; Sea trout	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic		Y		Y
<i>Salvinia molesta</i> (<i>Salvinia adnata</i>)	Salvinia moss	Fern	Y	FW Aquatic - Rafting	Y	Y		
<i>Sander lucioperca</i>	Zander; Pikeperch	Bony fish (Actinopterygii)	Y	FW Mobile vertebrate pelagic		Y		
<i>Sargassum muticum</i>	Wireweed; Japanese seaweed	Alga	Y	M Rafting	Y	Y		Y
<i>Sciurus carolinensis</i>	Grey squirrel	Terrestrial mammal	Y	T Diurnal - arboreal	Y	Y	Y	Y
<i>Sciurus niger</i>	Fox squirrel	Terrestrial mammal	Y	T Diurnal - arboreal	Y			
<i>Solenopsis geminata</i>	Tropical fire ant	Insect – hymenopteran	Y	T Invertebrates - subterranean	Y			
<i>Solenopsis invicta</i>	Red imported fire ant	Insect – hymenopteran	Y	T Invertebrates - subterranean	Y			

<i>Solenopsis richteri</i>	Black fire ant	Insect – hymenopteran	Y	Y	T Invertebrates - subterranean	Y				
<i>Spartina (all species and hybrids)</i>	Cord-grasses	Flowering plant	Y	Y	T Terrestrial plant	Y	Y		Y	Y
<i>Squalius cephalus</i>	Chub	Bony fish (Actinopterygii)	Y		FW Mobile vertebrate pelagic	Y	Y			Y
<i>Styela clava</i>	Stalked sea squirt	Tunicate (Urochordata)	Y		M Sessile/Fouling - no or minimal pelagic stage	Y	Y		Y	Y
<i>Sus scrofa</i>	Wild Boar	Terrestrial mammal	Y		T Nocturnal - land-based	Y			Y	Y
<i>Tamias sibiricus</i>	Siberian chipmunk	Terrestrial mammal	Y		T Diurnal - arboreal	Y	Y	Y	Y	Y
<i>Thaumetopoea processionea</i>	Oak Processionary Moth	Insect - moth	Y		T Invertebrates - supraterranean				Y	Y
<i>Threskiornis aethiopicus</i>	Sacred ibis	Bird	Y	Y	T Diurnal - flying	Y		Y		Y
<i>Thymallus thymallus</i>	Grayling	Bony fish (Actinopterygii)	Y		FW Mobile vertebrate pelagic		Y			
<i>Trachemys scripta</i>	Pond slider / Red-eared terrapin	Reptile	Y	Y	FW Mobile - amphibious	Y		Y	Y	Y
<i>Trapa natans</i>	Water chestnut	Flowering plant	Y		FW Aquatic - Rafting	Y	Y			
<i>Triadica sebifera (Sapium sebiferum)</i>	Chinese tallow	Flowering plant		Y	T Terrestrial plant	Y				
<i>Undaria pinnatifida</i>	Japanese kelp	Alga	Y		M Attached/Anchored		Y		Y	Y
<i>Urosalpinx cinerea</i>	Atlantic oyster drill	Mollusc	Y		M Sessile/Fouling - no or minimal pelagic stage	Y				
<i>Vespa mandarinia</i>	Asian giant hornet	Insect – hymenopteran	Y		T Invertebrates - supraterranean	Y (2025 update)				
<i>Vespa velutina nigrithorax</i>	Asian hornet	Insect – hymenopteran	Y		T Invertebrates - supraterranean	Y			Y	Y
<i>Vulpes vulpes</i>	Fox	Terrestrial mammal	Y		T Nocturnal - land-based	Y	Y		Y	Y
<i>Wasmannia auropunctata</i>	Electric ant	Insect – hymenopteran	Y		T Invertebrates - subterranean	Y				
<i>Xenopus laevis</i>	African clawed frog	Amphibian	Y	Y	FW Mobile - amphibious	Y				

6 Reference List

- Booy, O., Mill, A. C., Roy, H. E., Hiley, A., Moore, N., Robertson, P.,...Wyn, G. (2017). Risk management to prioritise the eradication of new and emerging invasive non-native species. *Biological Invasions*, 19(8), 2401-2417. <https://doi.org/10.1007/s10530-017-1451-z>
- Booy, O., Robertson, P. A., Moore, N., Ward, J., Roy, H. E., Adriaens, T.,...Mill, A. C. (2020). Using structured eradication feasibility assessment to prioritize the management of new and emerging invasive alien species in Europe. *Global Change Biology*, 26(11), 6235-6250. <https://doi.org/10.1111/gcb.15280>
- Canavan, S., Canavan, K., Kumschick, S., Gordon, D. R., Wilson, J. R. U., Lieurance, D.,...Lieurance, D. (2025). Invasive species risk assessment in practice: Insights from a survey of practitioners. *NeoBiota*, 99. <https://doi.org/10.3897/neobiota.99.153010>
- CBD. (1992). United Nations Convention on Biological Diversity (CBD).
- CBD. (2010). Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting. The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets. UNEP/CBD/COP/DEC/X/2, 29 October 2010.
- Costello, K. E., Lynch, S. A., McAllen, R., O'Riordan, R. M., & Culloty, S. C. (2022). Assessing the potential for invasive species introductions and secondary spread using vessel movements in maritime ports. *Marine Pollution Bulletin*, 177, 113496-113496. <https://doi.org/10.1016/J.MARPOLBUL.2022.113496>
- Haigh, A., Kelly, J., & O'Flynn, C. (2024). Pathway Analysis and Prioritisation for the Unintentional Introduction and Spread of 39 Invasive Alien Species (IAS) of Union Concern. Ireland's pathway analysis and prioritisation report for the second and third IAS of Union concern list updates. Report prepared by the National Biodiversity Data Centre, Waterford, on behalf of National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Dublin, Ireland.
- Harrower, C. A., Scalera, R., Pagad, S., Schonrogge, K., & Roy, H. E. (2018). Guidance for interpretation of CBD categories on introduction pathways. *Invasive alien species guidance for interpretation of the categories on introduction pathways under the Convention on Biological Diversity*.
- Hulme, P. E., Bacher, S., Kenis, M., Klotz, S., Kühn, I., Minchin, D.,...Vilà, M. (2008). Grasping at the routes of biological invasions: a framework for integrating pathways into policy. *Journal of Applied Ecology*, 45(2), 403-414. [https://doi.org/10.1111/J.1365-2664.2007.01442.X@10.1111/\(ISSN\)1365-2664.KEYPERS](https://doi.org/10.1111/J.1365-2664.2007.01442.X@10.1111/(ISSN)1365-2664.KEYPERS)
- Lucy, F., Davis, E., Anderson, R., Booy, O., Bradley, K., Britton, J.,...Trodd W. (2020). Horizon scan of invasive alien species for the island of Ireland. *Management of Biological Invasions*, 11(2), 155-177. <https://doi.org/https://doi.org/10.3391/mbi.2020.11.2.01>
- Srivastava, V., Lafond, V., & Griess, V. C. (2019). Species distribution models (SDM): applications, benefits and challenges in invasive species management. *CABI Reviews*. <https://doi.org/10.1079/PAVSNNR201914020>
- Tidbury, H., Houghton, R., Lintott, L., Rees, J., & Stebbing, P. (2026). Invasive Species Surveillance and Monitoring: A Comprehensive Review of Existing Programmes and Initiatives. A report commissioned by National Biodiversity Data Centre and completed by APEM Ltd.

- Tidbury, H. J., Copp, G. H., Davison, P. I., Olsson, K., Graham, J. A., Hill, T. W.,...Stebbing, P. D. (2021). Non-native marine species risk screening and vector analysis to inform conservation management in the southern Caribbean. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 31(12), 3564-3579. <https://doi.org/10.1002/AQC.3712>
- Tidbury, H. J., Taylor, N. G. H., Copp, G. H., Garnacho, E., & Stebbing, P. D. (2016). Predicting and mapping the risk of introduction of marine non-indigenous species into Great Britain and Ireland. *Biological Invasions*, 18(11), 3277-3292. <https://doi.org/10.1007/S10530-016-1219-X>