

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

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Chapter 3. Data and Field Methods



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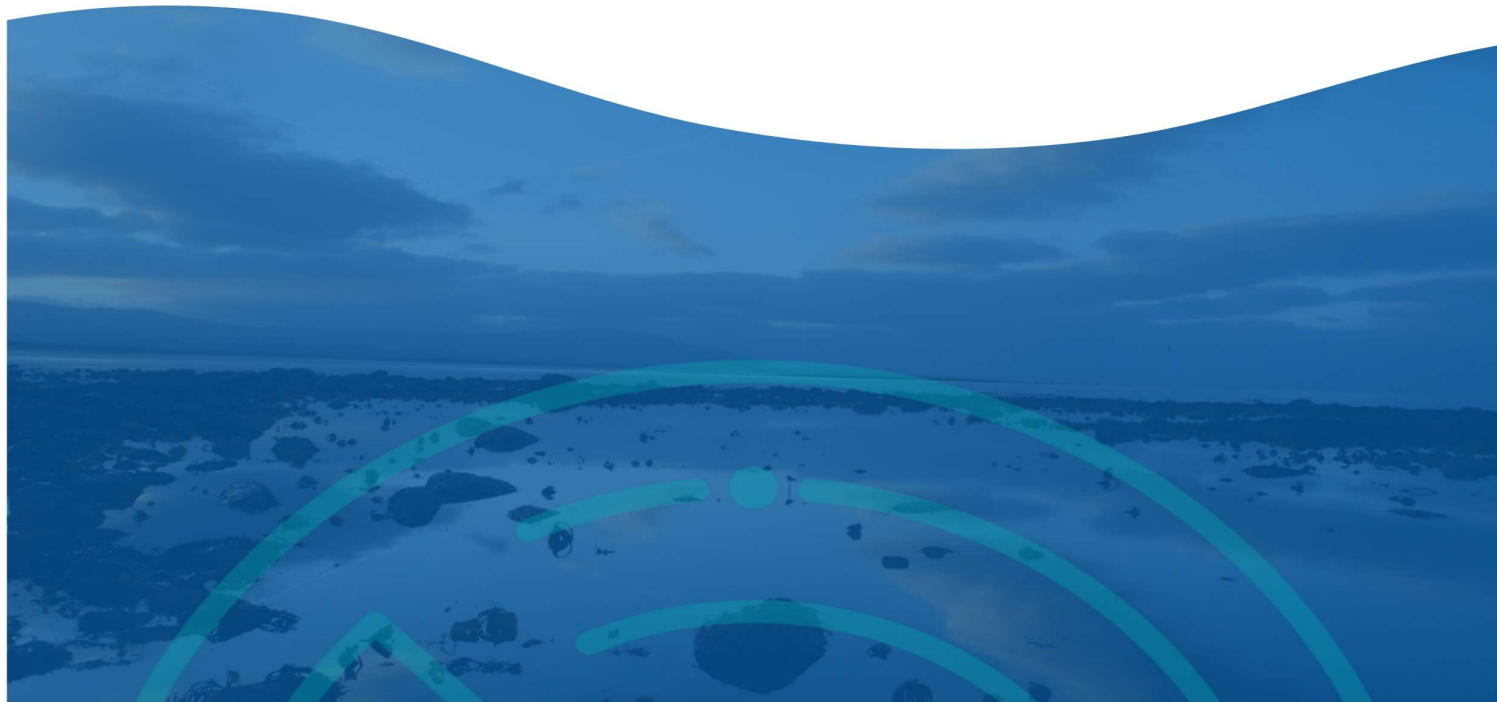


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1 Overview

An effective invasive species monitoring programme needs to include standardised and accurate data collection. Furthermore, these data need to be widely accessible to facilitate robust, timely, and accurate reporting. This first section of this chapter guides the standardisation of data collection, provides recommendations to address data flow shortfalls highlighted in Tidbury et al., (2026), and outlines an approach to monitoring data analysis which includes monitoring effort variation over time and space to help inform the interpretation of invasive species trends. The second section of this chapter provides a reference manual on invasive species surveillance and monitoring field methods. It provides a list of general considerations that should be taken into account when selecting and deploying surveillance and monitoring methods, an overview of key field methods and insight into their applicability in terms of environment and priority species types, as well as seasonal considerations for their deployment. It is intended that this chapter of the report is used alongside Chapter 1, to cross-reference applicable methods for the 187 priority species identified.

Please note that information provided, in particular relating to example equipment, does not constitute the author's endorsement.

This document is considered a live document, which is to be reviewed, revised and managed by the National Biodiversity Data Centre.

2 Data Collection and Reporting

The guidance outlines considerations for standardised invasive species data collection under key themes:

- i) data levels
- ii) taxonomic standards and species classification
- iii) metadata
- iv) data validation
- v) templates, and
- vi) information sharing.

It supports the collection of consistent, comparable, and high-quality data which can be used for reporting against legislation and to inform management, policy, and research.

2.1 Data levels

Invasive species monitoring data typically falls within three categories: i) presence/absence, ii) abundance, and iii) impact, representing the indicators and targets that monitoring is undertaken to report against.

2.1.1 Presence/absence data

The presence of an invasive species is the simplest form of invasive species survey data and requires the ability to recognise or detect the species only. Absence data is not routinely recorded but is a valuable source of information. Absence data should be recorded when the survey method and sampling design is sufficient to detect the species if present (i.e., to reduce the risk of reporting a false negative). A confidence score could be documented along with an absence record to reflect the certainty of the absence recorded (i.e., reflecting the capacity of the method to detect the species). Multiple surveys (e.g., at different times of year) should be considered to increase the confidence of the absence record. Absence data should be assessed alongside presence data to provide greater insight into the distribution of a species.

2.1.1.1 eDNA data considerations

eDNA is becoming more commonly deployed as an environmental monitoring method and has many advantages, in particular for species which are difficult to detect, are at low densities, or in early life stages. However, a few considerations should be noted when using eDNA data, especially its relative weighting compared to data coming from physical detections.

eDNA may yield false occurrence positives, for example due to the transport of DNA over distances from the source organism making georeferencing difficult or as a result of contamination of the sample. The use of controls can help to identify contamination issues. eDNA can give false negatives if DNA degrades (i.e., due to temperature) or sampling is insufficient. Surveys are not immune from false negatives or false positives but are considered reliable if surveyors are trained and sampling design is carefully considered (to align with when the species is likely to be most prevalent etc).

A complementary approach, combining both eDNA and traditional methods, may yield the best results, utilising eDNA for early detection and broad screening, followed by traditional visual surveys for confirmation/ validation, as well as abundance assessments.

2.1.2 Abundance data

Abundances may reflect a species' population size (total number of individuals), coverage (e.g., percentage cover) or density (e.g., individuals per m²). Standardised data collection requires that an appropriate abundance metric is defined and consistently measured. The best method will depend on the environment and the species. For example, the use of transects and quadrats are best suited to plants and sessile organisms, while catch per unit effort can be used for mobile/pelagic species.

2.1.3 Impact data

The reporting of impacts is currently relatively scarce, likely due to inherent difficulties in measuring impact in real-world systems. However, the collection of data to inform understanding of impacts should be considered, not least to provide a baseline from which future changes can be assessed, but also to better understand the impacts that invasive species can have and to inform management

prioritisation and actions. Impact data may take many forms and is, of course, dependent on the methodology deployed, the environment and the invasive species causing the impact.

A simple form of impact data and evaluation is the presence and abundance of native species in comparison to invasive species. It is recommended, as a short-term goal, that this simple form of impact data collection is incorporated as standard into invasive species monitoring data collection. More complex impact data are afforded by more complex monitoring methods. As an example, eDNA sample analysis using a metabarcoding approach can be used to generate data on whole ecosystems, facilitating understanding of species richness, and ecosystem structure and community composition in the presence and absence of invasive species. Where possible such data should be collected and its future collection should be considered as part of method selection and programme implementation.

Impact data may also come from stakeholder engagement exercises, though this is likely to be more qualitative than quantitative. For example, information can be sought from key stakeholders regarding the impact of invasive species introductions on their business, hobby etc.

2.2 Taxonomic standards:

It is important to use accepted nomenclature when recording species to ensure consistency and comparability. Taxonomic standards should also be employed to ensure that species are correctly identified. The use of a priority species list, as outlined in Chapter 1 aids consistency.

2.3 Specific data and metadata to record

The specific data and metadata which should be recorded during invasive species monitoring and data processing are as follows:

Survey information

- Date (and time, where appropriate)
- Location (e.g., GPS coordinates)
- Site name (and code where relevant)
- Surveyor name or ID
- Organisation, monitoring programme or project name

Methodology

- Survey method (e.g., visual, eDNA, trapping, quadrat)
- Sampling effort (e.g., time spent, area surveyed, number of samples)
- Detection tools or equipment used
- Species detection criteria (e.g., visual confirmation, DNA threshold)

Species data

- Species name (using accepted taxonomic standards)
- Presence/absence
- Abundance metric (e.g., count, density, percent cover)
- Life stage (if identifiable)
- Confidence level (especially for absence or eDNA detections)

This could be recorded in matrix format such that each relevant priority species is entered as a row on the recording form prior to data collection.

Environmental conditions

- Weather conditions
- Environmental parameters such as temperature, visibility, salinity, turbidity (for aquatic surveys)
- Habitat type or substrate
- Tide state or time of day (if relevant)

Quality assurance (see section 2.4 also)

- Validation status (e.g., expert-reviewed, provisional)
- Programme type (e.g., citizen science, professional survey)
- Control samples or replicates (especially for eDNA)

2.4 Quality assurance:

Training is required for all surveyors to ensure consistency in detection capacity and data accuracy. Data validation is also crucial for ensuring quality assurance. Standardised invasive species record validation protocols, including expert review, should be implemented for data collected through all programmes, including citizen science.

The application of machine learning to facilitate data validation should be explored as a means to improve cost-efficiencies and reduce the burden on experts. For example, machine learning can be used to identify data points outside the current recorded range of a species, thereby flagging priorities for expert validation.

Quality assurance is also facilitated through the use of standardised data collection sharing templates, incorporating sections relating to all necessary data, including metadata (see below), crucial to support the data being reported.

2.5 Assessment of monitoring effort

To more accurately interpret invasive species monitoring data, it is important to look at them in the context of key influences, in particular, monitoring effort. Monitoring effort across programmes, or elements of programmes capable of detecting particular species/species groups, should be quantified annually. Such quantification could take the form of the number of sites surveyed, area

surveyed or survey time. The number of invasive species records should be assessed in the context of monitoring effort to facilitate the delineation of actual trends in invasion species introduction/spread from artefacts in data resulting from changes in monitoring effort.

2.6 Data reporting and flow

All invasive species data should be centralised in a appropriate repository (e.g., National Biodiversity Data Centre or CEDaR) to ensure accessibility for national and international reporting obligations, as well as to inform management actions. The submission of data to these centralised repositories needs to occur at regular and frequent intervals.

In the long term, formal mechanisms to ensure the reporting of invasive species data to central repositories should be investigated. In the short term, the submission of data could be supported by the creation of Memoranda of Understanding (MoUs) between organisations collecting data and the data repositories, by applying reporting conditions to publicly funded data collection. Where data sensitivities exist, solutions should be discussed.

Automated transfer of data from organisation-level and national databases to centralised repositories should be investigated and implemented where possible.

3 Field Method Toolbox

3.1 Method selection

Several factors require consideration when selecting methods for invasive species monitoring:

- No single monitoring method is universally effective for detecting all priority invasive species, or applicable across all environments/sites.
- The monitoring objective and goal should be considered when selecting an appropriate method, for example:
 - New introductions/ early detection – methods which determine presence/absence only, may be suitable.
 - Tracking establishment and spread – methods which determine abundance and establishment status (including detection of early life stages and assessment of reproductive status of adults), as well as presence/absence are required.
 - Assessing ecological impacts – methods which consider presence, establishment status and abundance in the context of the broader ecosystem are required.

A toolbox approach, using multiple complementary methods, is often the most effective strategy.

- When targeting a specific species, methods should be selected to account for its characteristics and ecological traits. In particular, consideration should be given to when the species is likely to be most conspicuous or abundant. For detection of early life stages, traits such as spawning season will require careful consideration.

Logistical and operational aspects, such as availability of expertise, capacity for sample handling, storage and analysis, accessibility of sites, and safety of personnel, also require consideration.

- Necessary permissions (access to private land) and licenses (e.g., crayfish trapping, drone surveys) will need to be sought prior to undertaking monitoring.

3.2 Method Descriptions

This section provides an overview of key monitoring methods deployed for the detection of invasive species, supported by best practice. The information is current at the time of writing, but scientific literature should be consulted frequently to ensure any new method developments are reflected in the invasive species monitoring programme. This is particularly important for the more novel methods (i.e., those applying eDNA, drone and ROV technologies), which are evolving relatively quickly.

3.2.1 Rapid Assessment Surveys (RAS)

Environment: Marine and Freshwater

Primary Target Species: Sessile/fouling animals, attached plants.

Rapid Assessment Survey (RAS) is a quick, cost-effective method used by trained professionals to detect invasive on hard substrates using visual identification (Arenas et al., 2006; Bishop et al., 2015; O'Shaughnessy et al., 2023). RAS are typically undertaken in marinas, ports, and rocky/pebbled intertidal zones and are optimal for detecting sessile (fouling) species on hard surfaces, but not effective for planktonic or soft-bottom habitat species.

RASs are usually conducted during the summer, over a fixed period of one hour, split into 15-minute intervals. The 15-minute window in which each target species is first observed is recorded, and an estimate of abundance is made based on the SACFOR scale (where 6 = Super abundant, 5 = Abundant, 4 = Common, 3 = Frequent, 2 = Occasional, 1 = Rare). Target species lists, including known or high-risk invasive species, help to optimise detection and recording. Data recording forms are used to standardise data across sites. If species are recorded for the first time in the last 15-minute window, additional 15-minute windows are added until no new target species are detected. If the survey is conducted by more than one surveyor, the relative abundance of each detected species is discussed and agreed upon. Photographs and physical samples, preserved appropriately, are typically taken to facilitate ID of more challenging species in the laboratory.

While typically associated with the marine environment, RAS are a valuable method for the detection of sessile/fouling species in the freshwater environment also.

Note that RAS are currently deployed for invasive species monitoring in marinas in NI led by DAERA, and IE commissioned by NPWS (Minchin & Nunn, 2013; O'Shaughnessy et al., 2023).

Useful sources of information:

Minchin, D. M. and Nunn, J. D. (2013) 'Rapid assessment of marinas for invasive alien species in Northern Ireland', *Northern Ireland Environment Agency Research and Development Series No. 13/06*. Available at https://www.invasivespeciesireland.com/wp-content/uploads/2017/01/marina_report_final.pdf

O'Shaughnessy, K., Lyons, D., Ashelby, C., Counihan, R., Pears, S., Taylor, E., Davies, R. and Stebbing, P. (2023) 'Rapid assessment of marine non-native species in Irish marinas', *Management of Biological Invasions* 14(2), pp. 245-267. Available at https://www.reabic.net/journals/mbi/2023/2/MBI_2023_OShaughnessy_etal.pdf

3.2.2 Settlement panels

Environment: Marine and Freshwater

Primary Target Species: Sessile/fouling animals, attached plants.

Settlement panels are a passive monitoring method, involving submerging a structure to become fouled, then periodically assessing the panel to determine the colonising species. Panels can be deployed at various locations/depths within the marine or freshwater environment and are removed and analysed at timed intervals. Panels should remain in place for at least one full recruitment period. Panels are usually constructed to individual specifications and are low cost. However, established approaches to construction do exist to provide spatial and temporal consistency and facilitate comparative analysis (Cook et al., 2015; HELCOM, 2019, 2021). Settlement panels are typically constructed from plastic (e.g., corrugated panels) and comprise vertical or combined vertical and horizontal designs, weighted for stability.

The placement of panels should be considered carefully. For example, while more species may encounter panels placed in exposed areas (i.e., subject to stronger currents), settlement may be reduced, and risk of detachment may be increased in these areas. Panels should be placed at multiple depths at each sampling location to facilitate detection of species which occupy different depths. In deeper water, panels are placed 1 m below the surface, mid-depth, and 1 m above the bottom. In tidal areas, placement is adjusted, typically with plates at 30 cm below the surface, 30 cm above the bottom, and one in between. Bottom weighted panels should not touch the seabed at low tide and should be deployed in spring and retrieved after 3–4 months or a full recruitment period.

Panel fouling is assessed via photographs and visual inspection, including under the microscope where needed. If molecular analysis is planned, samples should be stored in ethanol. Panels can be redeployed to increased cost-effectiveness.

Useful sources of information:

Cook, E. J., Beveridge, C., Twigg, G. and Macleod, A. (2015) Assessing the effectiveness of early warning systems for the detection of marine invasive non-native species in Scottish waters. Scottish Natural Heritage Commissioned Report No. 874. Available at: <https://www.nature.scot/sites/default/files/2017-07/Publication%202015%20-%20SNH%20Commissioned%20Report%20874%20-%20Assessing%20the%20effectiveness%20of%20early%20warning%20systems%20for%20the%20detection%20of%20marine%20invasive%20non-native%20species%20in%20Scottish%20waters.pdf>

HELCOM (2019) Guidelines for non-indigenous species monitoring by extended Rapid Assessment Survey (eRAS) Available at: <https://www.helcom.fi/wp-content/uploads/2019/08/Guidelines-for-monitoring-of-non-indigenous-species-by-eRAS.pdf>.

HELCOM (2021) *Guidelines for the monitoring of marinas*. Available at: <https://helcom.fi/wp-content/uploads/2021/06/HELCOM-Monitoring-guidelines-for-marinas.pdf>.

3.2.3 Scrape samples

Environment: Marine and Freshwater

Primary Target Species: Sessile/fouling animals, attached plants.

Scrape samples refer to the scraping of biofouling from a specific area (e.g., guided by a quadrant) of a submerged structure. They can be taken from hard artificial structures using a scraper and sweep net, and either analysed in-situ or sent for microscopic examination. Scrape samples may be used as complementary methods to RAS and settlement panels. Scraped biomass is captured (e.g., with a 1mm mesh net), transferred to a storage container/bag, and either frozen or preserved in ethanol (70%).

3.2.4 Trapping

Environment: Marine, Freshwater and Terrestrial

Primary Target Species: Mobile/benthic (marine and freshwater), all terrestrial animals apart from subterranean invertebrates.

Trapping is an effective method for detecting the presence and estimating the abundance of invasive species across all environments. Accurate identification of trapped organisms is essential and should be conducted by a qualified expert. Alternatively, clear photographs of specimens may be used for later identification. The following considerations should inform trapping methodology:

3.2.4.1 *Trap type and size*

The choice of trap influences which species are captured. Consider:

- Selectivity for target species
- Deployment environment and substrate type
- Abiotic conditions
- Hand-made or commercially available
- Live-capture or kills traps for terrestrial mammals

3.2.4.2 *Bait type*

- Bait selection affects species selectivity. Some species are generalist feeders; others have specific preferences.
- If targeting a specific invasive species, research their feeding habits.
- Bait preparation methods (e.g., chopping or mincing) can enhance odour plume and effectiveness.

- Factor in bait cost and availability.

3.2.4.3 *Deployment time and duration*

- Traps should be deployed when target species are most likely to be active, ensuring that activity level is accounted for when interpreting data.
- Deployment for a short time may reduce likelihood of detection.
- Extended deployments risk predation or cannibalism within (kill) traps, potentially skewing data.
- Live capture traps for terrestrial species require more frequent checks

The trapping method deployed will need to be tailored to the target species. A couple of examples for specific species are included below.

For information on Asian hornet trapping please refer to citizen science led efforts in IE (<https://invasives.ie/asianhornet/trapping/>). Please also refer to the Asian Hornet Watch app for NI.

3.2.4.4 *Trapping example - Crayfish*

Note: crayfish trapping in IE and NI requires approval and licensing from NPWS and DAERA, respectively as the keeping and release of non-native species is prohibited under Wildlife and Invasive Species Legislation. Any non-native crayfish caught will need to be euthanised humanely and disposed of appropriately.

Baited 'trappy' traps and Artificial Refuge Traps (ARTs) are two options deployed to detect all crayfish (Figure 1). 'Trappy' traps require baiting and checking every 24 hours but are a widely used and reliable method for trapping adult life stages in still waterbodies. ARTs may take many forms, do not require bait and can be left in-situ for long periods and checked when convenient, therefore reducing resource commitment. However, ARTs are relatively untested and difficult to deploy in still waterbodies.

It is suggested that crayfish trapping is undertaken by professional environmental operatives because of the risk of crayfish, and the causative agent of crayfish plague (*Aphanomyces astaci*), being spread between waterbodies.

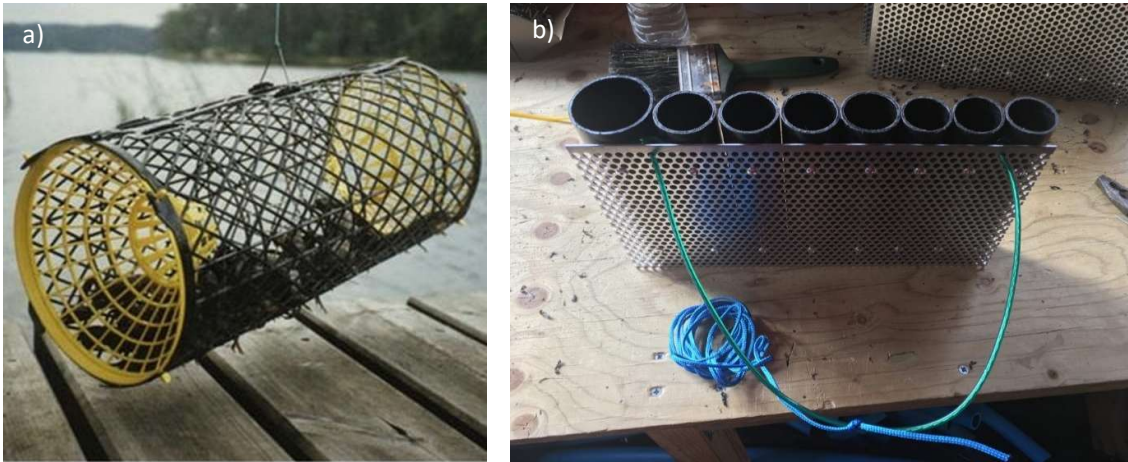


Figure 1. a) Crayfish Trappy Trap, © 2025 harnbrook Tackle and b) an example Artificial Refuge Traps (ART) design, © Nicky Green Associates 2024.

Similar baited trapping methods can be deployed for the detection of other mobile benthic species in the marine and freshwater environment, including Chinese mitten crab (*Eriocheir sinensis*) and the American lobster (*Homarus americanus*).

3.2.4.5 Trapping example – American mink

Note: the keeping of American mink, and release of non-native species is prohibited under Wildlife and Invasive Species Legislation in both NI and IE. Any non-native American mink caught will need to be euthanised humanely and disposed of appropriately, conforming to animal welfare legislations of respective nations.

Spring (kill) and cage (live capture) traps are both options for the capture of American mink although welfare considerations and legislative restrictions may apply. Traps are often set in conjunction with monitoring equipment (i.e., mink monitoring rafts) to target the semi-aquatic nature of American mink. They can be set up un-baited, working with the inquisitive nature of the species, or baited with food or scent lures. Use of tunnels or excluder devices is also often required to eliminate the capture of native species, and as otters and mink share the same habitat, this often limits the use of spring traps.

Cage traps are made of strong steel mesh with a spring-loaded door, operated by a treadle which is sprung when an animal stands on the treadle plate (e.g., Figure 2). They can be versatile in their

placement targeting where mink have been recorded both on floating mink rafts and on bankside areas.

Non-target captures can be released unharmed, while any mink (or other invasive species) captured are required to be dispatched humanely, such as with air weapons (subject to NI/IE regulations).



Figure 2. American mink in a cage trap. Image © Scottish Invasive Species Initiative

3.2.4.6 Trapping example – Birds

Mist nets are commonly deployed to capture birds (and bats), and are particularly valuable for monitoring birds which are difficult to ID from a distance or which occupy hard to access areas, including dense vegetation. Similar to other traps, the net type and mesh size will need to be selected according to the target species size and flight behaviour. Selected mist nets should be high quality nylon or polyester and resistant to UV damage. Nets are stretched between two poles and secured with rubber ropes to ensure the net is stable and secure and to help prevent stretching in high winds. As with all traps, the size of the net and its placement will need to be considered in the context of the target species and the monitoring site. In particular, nets should be positioned where the target species is likely to fly, including near feeding sites or in habitat corridors. The mist net traps birds which fly into the into it and become gently entangled before being swiftly extracted and identified by an expert.

Note: mist netting requires training to ensure adherence to animal welfare regulations, and a permit from NPWS and Northern Ireland Environment Agency, in IE and NI, respectively.

Useful sources of Information:

Invasive Species Ireland – SOP for American mink control: <https://invasivespeciesni.co.uk/wp-content/uploads/2021/10/21.22.105-DAERA-Standard-Operating-Procedures-for-Control-of-American-Mink.pdf>

Game and wildlife conservation trust: <https://www.gwct.org.uk/advisory/guides/mink-raft-guidelines/traps-suitable-for-use-with-rafts/>

Midland's Mink Eradication: <https://minkeradication.ie/>

Charles Darwin University Mist netting protocol: https://www.cdu.edu.au/files/2021-11/DPAW%20SOP%2003.2021%20Mist%20net%20trapping%20for%20birds_0.pdf

3.2.5 Zooplankton trawls

Environment: Marine and Freshwater

Primary Target Species: Pelagic, including pelagic early life stages

This method involves deployment of plankton nets. These nets comprise a wide mouth which captures water, a mesh cone which retains organisms passed through the net (mesh size is selected according target species), and a cod-end into which organisms captured in the mesh are funnelled. Nets can be towed either vertically whereby the net is lowered to a certain depth and slowly pulled upwards, or horizontally whereby the net is towed horizontally through the water column for a specific duration or distance. The sample in the cod-end is transferred to a container and preserved, e.g., in Industrial Methylated Spirit (IMS). Samples then require laboratory analysis using microscopy.

3.2.6 Benthic sampling

Environment: Marine and Freshwater

Primary Target Species: Benthic

A variety of methods are used to detect benthic aquatic invasive species. These include:

Bottom dredges are lowered to the bottom (i.e., the seabed, riverbed etc), and on contact with the bottom a trigger mechanism causes the dredge to close, capturing sediment and its inhabitants. The closed dredge and its contents is then brought to the surface. A process of sorting and sieving is then undertaken, and organisms present are identified through laboratory analysis.

Ekman grabs comprise two hinged buckets mounted on a frame, held open by a spring-loaded mechanism. The grab is lowered to the bottom. When the grab touches the bottom, a trigger is pulled and the grab closes collecting the sediment sample. Samples are sieved and organisms identified, through laboratory analysis. This type of grab is best suited to soft, muddy, finer sediments.

Mini Hamon grabs comprise a mechanical box like scoop which pivots 90 degrees on contact with the bottom, collecting sediment before sealing against a rubber-sealed plate. This type of grab is best suited to coarse sediment (see Figure 3).

Kick sampling is deployed in shallow, flowing streams and rivers. It involves the placement of a fine-mesh net downstream of location where the bed is agitated by the surveyor's foot (i.e., kicking). Dislodged organisms are swept downstream by the current and captured by the net. The contents of the net is transferred to a sorted tray filled with water, and organisms examined and identified. Magnifying glasses are often required. Samples can also be transferred to containers (containing ethanol if deemed necessary) for subsequent analysis in the laboratory.

Sweep netting involves sweeping a net vigorously through the water following agitation of the bottom using one's foot to dislodge organisms (as per kick sampling). The contents of the sweep net is then examined in situ or in the laboratory. This method can also be deployed to capture flying insects and other invertebrates (i.e., terrestrial subterranean invertebrates) from terrestrial vegetation.



Figure 3. Deployment of a Mini Hamon grab at sea. Image © APEM Ltd.

3.2.7 Fish surveys

Environment: Freshwater (and transitional zones)

Primary Target species: Pelagic

Several methods can be deployed to target the detection of invasive fish species:

Point Abundance Sampling by Electric fishing (PASE) can be undertaken in the littoral margins of reservoirs. PASE targets juvenile life stages occupying marginal habitats. The method involves immersing the anode and sweeping with a net to collect stunned fish at each sampling point. This method requires specialist equipment (Figure 4) and specific training.

Seine netting using a 50m fine mesh net in water body margins to target pelagic (and sometimes benthic) species (e.g., Figure 5).

Fyke netting is another commonly used method to assess fish populations. Fyke nets, deployed overnight and retrieved in the morning, are effective for fish and can also trap some mobile benthic species such as crayfish.

Invasive non-native fish species such as zander (*Sander lucioperca*), ruffe (*Gymnocephalus cernua*), topmouth gudgeon (*Pseudorasbora parva*), and common carp (*Cyprinus carpio*) can be detected with the above techniques.



Figure 4. Electrofishing equipment. Image © Halltech Aquatic.



Figure 5. Seine net installed downstream of a river. Image ©APEM Ltd.

3.2.8 Imaging

Environment: All

Primary Target Species: All species

Images and digital footage can be used for invasive species monitoring across all environments. The sophistication of in-situ imaging can vary from hand-held devices to baited stations, to remotely operated vehicles (see section 3.2.9) and drones (see section 3.2.10).

Handheld devices including cameras, GoPro's and mobile phones, can be hugely valuable and cost-effective for invasive species monitoring. Quadrats can be used alongside imaging, where quadrat of known size (e.g., 25 × 25 cm) are placed on substrate, and species present within are identified and counted.

3.2.8.1 Baited camera traps

Baited camera stations are most commonly deployed for the detection of terrestrial mammals and birds (Figure 6). They capture still images of birds/animals. Placement of cameras within baited boxes facilitates the detection of smaller mammals and reduces the likelihood of camera trigger by vegetation or non-target organism. Detection of small mammals using cameras negates some of the issues with live trapping such as risk of mortality and animal welfare concerns, the need for skilled handlers and resources for regular checking. Camera placement is strategic, based on evaluation of the monitoring site and the target species. For example, information including habitat type, availability of food and water, and site topography is used to inform trap placement. Camera traps can be placed on the ground or suspended (i.e., in trees) as appropriate for detection of the target invasive species.

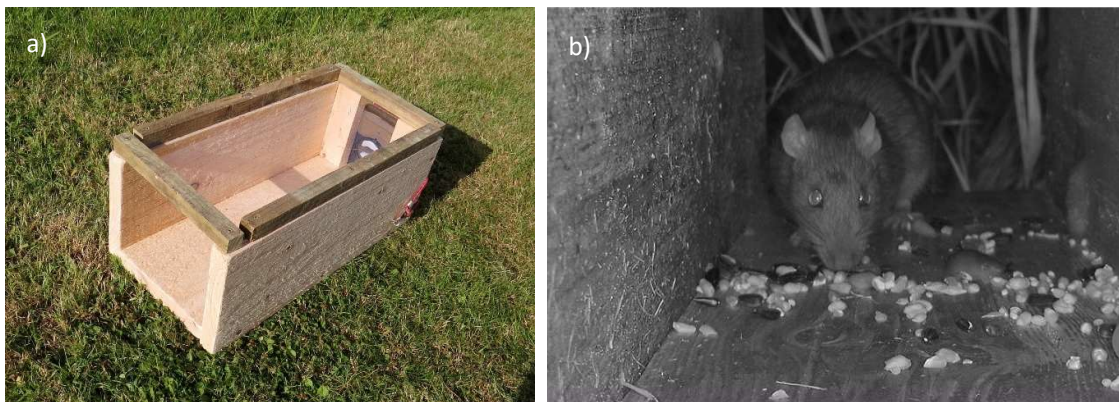


Figure 6. a) Mammal box with front-mounted camera. Image © Mammal Society and b) camera footage of a rat in a baited box. Image © Sarah Atkinson.

3.2.8.2 *Baited Remote Underwater Video*

Baited Remote Underwater Video (BRUV) systems, consisting of a video camera and mounted bait system (e.g., a perforated cannister containing bait) can also be deployed in the aquatic environment. These can be deployed temporarily from a boat or left in situ to record passing species. The BRUV is retrieved and footage reviewed, providing insight into benthic and pelagic populations of predatory species. Suspected invasive species can be verified with follow-up methods like trapping.

3.2.8.3 *Fixed point photography*

Fixed point photography involves the positioning of a camera at a fixed location and angle to capture images of the same area repeatedly. Photographs are taken manually or using an automated system, at regular intervals. GPS coordinates to ensure consistency. This imaging method provides consistent, repeatable visual records of a specific location over time.

3.2.8.4 *General good practice*

It is advisable to check camera bait stations during the deployment phase to ensure their placement is still correct and bait is still available. Environmental factors such as light levels, and turbidity (form imaging in the aquatic environment).

Images should be standardised where possible. Additionally, the clarity and detail of the images will impact the robustness of species identification. The following should be considered:

1. Images should be taken of the wider environment for context.
2. Check focus – ideally use a camera stand to keep it still. Consider macro setting if available. For trail cameras/ camera boxes the use of a close-focus lens on the camera can be added.
3. Check lighting – natural light is best where possible. Avoid shadows and bright light. Such as placing trail cameras in terrestrial environments to point north, rather than south, to avoid glare.
4. Take photo of the organism in the natural environment before moving it.
5. Take multiple images at various angles to capture the species' features and aid in identification.
6. Use a scale - indicate the size of the organism, e.g., using a ruler, coin, pen, hand, foot, or in-built measuring equipment.

Images (see Figure 6b for example camera footage) are analysed to determine the presence and abundance of the target organism. Target organism behaviours may also be observed and used to inform management where relevant (see also section 3.2.8 on in-situ imaging). Image analysis should be carried out by persons with taxonomic or identification expertise.

The role of artificial intelligence (AI) and machine learning in image analysis is being increasingly explored and should be considered when designing monitoring through camera traps, though human validation is crucial to ensure accuracy of results (see section 3.2.17 for further insight into the potential application of AI).

Useful sources of information:

The mammal Society - [Camera trapping for small mammals — Mammal Society](#)

Littlewood et al. (2021). Use of a novel camera trapping approach to measure small mammal responses to peatland restoration. *European Journal of Wildlife Research* 67(1).

<https://link.springer.com/article/10.1007/s10344-020-01449-z>

3.2.9 Remotely Operated (underwater) Vehicles (ROVs)

Environment: Marine and Freshwater

Primary Target Species: Mobile, sessile/fouling animals, anchored attached plants

Remotely Operated Vehicles (ROVs) are increasingly being deployed for environmental surveys, including invasive species monitoring (Figure 7).

ROVs can be deployed for standardised survey transects, or to inspect submerged substrate. ROVs can detect a wide range of species, including, but not limited to submerged macrophytes (e.g., *Elodea nuttallii*) aquatic invertebrates like signal crayfish (*Pacifastacus leniusculus*) and zebra mussels (*Dreissena polymorpha*), and fish, such as topmouth gudgeon (*Pseudorasbora parva*). Although ROVs can be deployed year-round, surveys are best conducted in clear conditions—avoiding high turbidity and periods following heavy rain. This method requires trained professionals to plan transects and operate the ROV. ROVs may be costly to purchase and maintain.



Figure 7. Example Underwater Inspection Remote Operated Vehicle (ROV). Image © UST.COM

3.2.10 Digital Aerial Surveys using Drones

Environment: Terrestrial (also used for riparian zone and for detection of abundant floating aquatic species).

Primary Target Species: Terrestrial plants

Traditional ground surveys such as walkovers, while common, may be costly, time-consuming, and limited in scope. Unmanned aerial vehicles, commonly referred to as drones, can provide a powerful and efficient solution for surveying invasive species over large areas (Figure 8).

Several key advantages include:

- Capture real-time high-quality aerial imagery and video footage to help identify is at low abundance/density
- Can deployed for the survey of many different landscapes, including forests, wetlands, and steep terrains, which are often inaccessible for traditional ground surveys;
- Using GPS and LiDAR, drones can create detailed 3D maps of ecosystems, facilitating accurate assessment of changes in invasive species presence and abundance over space and time.
- Disruption to sensitive habitats is reduced when using drones.

Operators will require the necessary certification and licenses. Restrictions such as legal height limits, distances from people and areas where you must not fly require consideration. High-quality drones are an expensive outlay.



Figure 8 Mapping using drone technology ©2025, MKO Ireland.

3.2.11 Bioacoustic monitoring

Environment: Terrestrial

Target species: Mammals and birds?

Bioacoustics monitoring is most frequently used for recording of bats and occasionally birds using either handheld or static devices which collect sonograms (a visual output unique to each species) for later acoustic analysis and species identification (Abrahams et al., 2022). However, a range of other species, particularly small mammals, are also frequently captured on sonograms. While not necessarily the intended usage, the potential for recording mammals when at low density/ early invasions and at remote sites is high. Previous research has indicated that this method can be effective on seabird islands to detect rats (*Rattus norvegicus*) (Newson et al., 2023; Newson & Pearce, 2022). While still somewhat limited, the library of species' (native and invasive species) calls and identities is continually expanding, providing improved capacity for detection of invasive into the future.

Useful sources of information:

Abrahams, C., Ashington, B., Baker, E., ... and Metcalf, O. (2022) 'Good practice guidelines for long-term ecoacoustic monitoring in the UK.', *UK Acoustics Network*. Available at: <https://www.britishecologicalsociety.org/applied-ecology-resources/document/20230136742/>

Newson, S. E. and Pearce, H. (2022) 'The potential for acoustics as a conservation tool for monitoring small terrestrial mammals.', *JNCC Report No. 708. JNCC, Peterborough, ISSN 0963-8091*. Available at: <https://jncc.gov.uk/resources/ca3e0044-8a1a-482e-a504-af83f7cff69b>

Newson, S. E., Else, R., Crymble, J., Gilbert, G., Tosh, D. and Booth Jones, K. (2023) 'Bioacoustics as a novel approach for detecting the presence of Brown Rats on seabird islands. BTO Research Report 755 BTO, Thetford.', *BTO Research Report 755 BTO, Thetford*. Available at: https://www.bto.org/sites/default/files/publications/rr_755_newson_et_al_2023_rathlin_web.pdf

3.2.12 Walkover surveys

Environment: Terrestrial and Freshwater (including the riparian zone)

Primary Target Species: Terrestrial and freshwater plants

Walkovers can provide rapid and repeatable invasive species surveys and comprise a simple walk of the survey sites, over a pre-defined distance, during which the presence of invasive species visible to the surveyor are recorded. The use of binoculars can facilitate survey of less accessible areas. The use of a boat should also be considered when the riparian zone is difficult to access (e.g., steep banks or dense riparian vegetation) to allow the surveyor to view the bank and shallows from the water. Detection of submerged macrophytes can be undertaken by wading and using a glass-bottomed viewing bucket or via grapnel from the banks. The SACFOR or DAFOR scale (Dominant, Abundant, Frequent, Occasional, Rare) can be used to provide additional detail on relative abundance of species, identified via this method.

These surveys are best suited for terrestrial species such as Rhododendron (*Rhododendron ponticum*), and riparian and aquatic macrophytes such as Himalayan balsam (*Impatiens glandulifera*), giant hogweed (*Heracleum mantegazzianum*) and Japanese knotweed (*Reynoutria japonica*).

Although this method can be executed by all survey operatives, the number of species detected will likely correlate with the surveyor's experience and expertise, which must be considered both when planning surveys and interpreting data. Walkovers can be supported by in situ imaging, including via drones (see section 3.2.10).

3.2.13 Tracks and signs surveys

Environment: terrestrial

Primary Target Species: Land-based animals

Methods which focus on identification of field tracks and signs, are also deployed for the detection of elusive mammals such as American mink (*Neogale vison*). These methods need to be executed by surveyors trained in track and sign identification.

Wax blocks and footprint ink tunnels can be used to support tracking for smaller mammals such as rodents or small mustelids. Tunnels are placed along suspected mammal trails and baited with peanut butter to attract small mammals. As animals pass through, they leave footprints on paper strips after stepping on an ink pad (Figure 9). International best practice suggests that tunnels are arranged in lines of 5–10, spaced ~30 m apart. Wax blocks are scented and flavoured to encourage chewing, allowing identification using tooth marks. Paper strips and wax blocks are replaced after each check and can be collected/photographed for closer inspection.

Larger tunnels, on specially built floating platforms are also designed and available for American mink monitoring in aquatic environments. These utilise soft clay rather than paper and ink for capturing footprints, however the principal is the same. These rafts can also detect native species such as otters so are useful for rare or elusive species monitoring too.



Figure 9. Example footprint tunnel with mammal footprints. Image © 2025 Wildlife Online.

3.2.14 Detection dogs

Environment: All (although most effective in freshwater, terrestrial and intertidal)

Target species: All

Highly trained and specialist detection dogs and their handlers are becoming increasingly seen as a powerful tool in the conservation sector (Bennett et al., 2022), facilitating detection of rare and elusive species. Dogs can be trained to detect a variety of invasive species in all environments. For example, specialist companies offer services for the detection, by dogs, of rhizome fragments of Japanese knotweed and mammals during eradication/ management or incursion response operations. Training can be on live or dead specimens of a target species, as well as odour and

faeces (scat). Detection dogs are best used alongside other, more traditional tools and are relatively less cost-effective compared to other methods, when the target species is abundant or easy to detect. Detection dogs require specialist training and qualified handlers to ensure consistency and efficiency in detection rates.

Use source of information:

Bennett, E., Jamieson, L. T., Florent, S. N., Gill, N., Hauser, C. and Cristescu, R. (2022) 'Detection dogs provide a powerful method for conservation surveys', *Austral Ecology*, 47(4). Available at: <https://onlinelibrary.wiley.com/doi/full/10.1111/aec.13162?msocid=02e8aafecb4f6af30aa4bf30ca4b6bb5>

3.2.15 Citizen science

The term “citizen science” refers to the collection of data by members of the general public, to contribute to advances in scientific research or understanding. While not a monitoring method per se (and applying methods detailed above), it is included because citizen science projects can complement more formal monitoring programmes (Figure 10). Citizen science provides valuable data at low cost, and is a useful means by which to engage interested members of the public. However, support is still required, for example in terms of method description and training and the data may vary in accuracy and be prone to strong biases in terms of the locations, ecosystems or taxa surveyed (Thompson et al., 2023). Validation mechanisms can help to ensure the robustness of citizen science data.

For more information on citizen science projects undertaken across Ireland see (Tidbury et al., 2026).



Figure 10. Bioblitz survey underway in Ireland, ©NBDC.

3.2.16 Environmental DNA

Environment: All (though primarily deployed in aquatic environments)

Primary Target Species: All species

The application of environmental DNA (eDNA) for environmental monitoring has increased markedly over the last decade. Molecular monitoring, using eDNA, includes both targeted methods for the detection of specific species, and more passive approaches, using eDNA combined with high throughput sequencing, to assess whole communities (also known as eDNA metabarcoding).

Molecular monitoring methods for detection of invasive species have been applied to both water and sediment samples from the aquatic environment. Water samples are taken from the aquatic environment using a sterile container. The sample is then passed through a filter, onto which DNA particles attach. Filtering is usually done in the field or very soon after sample collection to avoid degradation of the DNA. Filters are also much easier to store (taking up less room) than the samples themselves. Filters are stored in the fridge or freezer to ensure DNA preservation. In the laboratory, DNA is extracted from the filter (using commercially available kits) and amplified using a primer. The targeted monitoring approach uses species-specific primers to detect the presence of a single invasive species by polymerase chain reaction (PCR). For metabarcoding, primers for predetermined

taxa groups (order or family level) can be used to provide community coverage while reducing the number of non-target organism detected. For metabarcoding, amplified DNA is sequenced and compared against reference libraries to determine which species are present. For sediment samples, the same process is applied but extraction is conducted using a kit designed specifically for extraction of DNA from sediment.

Given the limited number of priority invasive species likely to be detected in soil and air samples, eDNA analysis of soil and air samples are much less common and standardised.

Molecular monitoring can be particularly helpful in the detection of organisms and life stages that are hard to identify using visual techniques, or that are at low density (Darling, 2019). However, protocols for molecular monitoring involve many stages (Figure 11) and considerations and are continuously evolving, creating challenges for standardisation and consistency. As well as considerations regarding the specific method deployed, there are a number of considerations (and potential limitations) for the reliability of eDNA, such as population density, DNA shedding rate (which differs between organisms and seasonally for the same organism), decay and dispersal of DNA in the environment (e.g., Lamb et al., 2022; Silva et al., 2025). A recent study highlighted variation in eDNA detections according to taxa, with a high number of fish and invertebrate detections but limited detection of emergent riparian plants (whose detection was expected) (Flitcroft et al., 2025). Also, the detection of a species through eDNA relies on the availability of sequence data for that species. Sequencing references library are improving all the time but the absence of sequence data still presents challenges for the widespread deployment of this method. Further, processing of eDNA samples is a specialist service and which incurs costs and is timely.

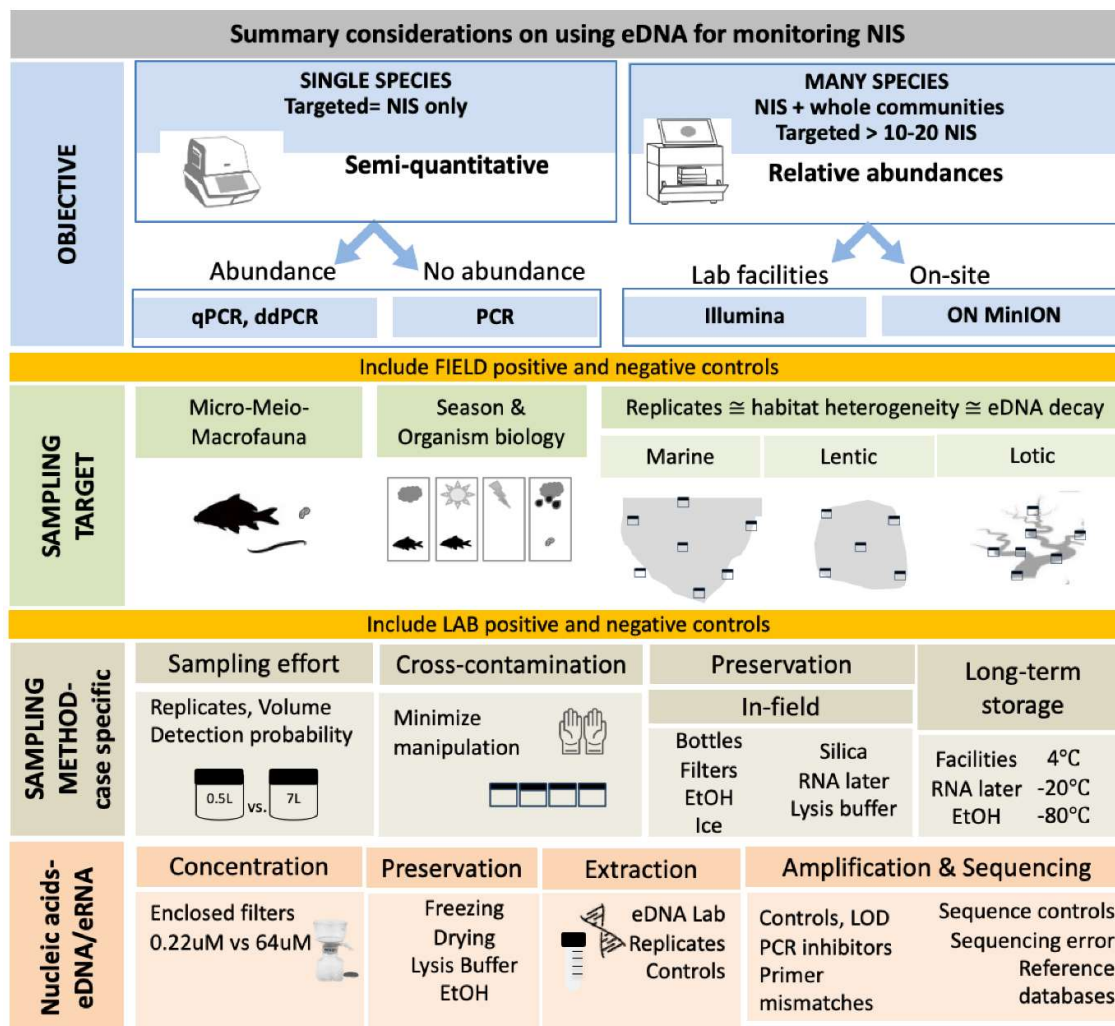


Figure 11. Summary of considerations for using eDNA for invasive species monitoring – identification of study objectives followed by biological and technical considerations (sampling target and methods). Taken from Fonseca et al., (2023). Note that NIS refers to non-indigenous species (synonymous with non-native species and alien species).

In the context of invasive species reporting, the weighting of detection via eDNA (in the absence of physical detention) again detection of a physical form, needs consideration. The inclusion of eDNA detections in reporting is likely to result in a huge increase in the number of invasive species. This is something that is likely to generate increasing discussion at an international scale.

Sample analysis for the detection of invasive species via eDNA commercially available for a number of species. Zinto Labs (an Irish genomics solutions company), supported by Greenman Group and the National Biodiversity Data Centre, are currently developing and validating a molecular based early warning system for detecting invasive aquatic species in Irish waters using environmental DNA (eDNA). More specifically, this work is developing primers and eDNA protocols and pipelines for four

aquatic species: Chinese mitten crab (*Eriocheir sinensis*), coypu (*Myocastor coypus*), chub (*Squalius cephalus*), and blue crab (*Callinectes sapidus*).

Note that while distinct from eDNA monitoring, molecular methods are also implemented for the identification of species which are challenging to ID from taxonomic features.

Useful sources of information:

Mirimin L. (2021) 'Marine Invasive Species Ireland (MISI) Project eDNA TOOLKIT', Report prepared by the Galway-Mayo Institute of Technology (GMIT) as part of the Blue Growth & Marine Spatial Planning Scheme EMFF Operational Programme 2014-2020.

https://emff.marine.ie/sites/default/files/bluegrowth/PDFs/gmit_2022_-_edna_toolkit_-_marine_invasive_species_ireland_project.pdf

There are a number of papers which provide further insight into eDNA as a monitoring tool and the necessary considerations for its application to statutory monitoring, including:

Darling, J. A. (2019) 'How to learn to stop worrying and love environmental DNA monitoring', *Aquatic Ecosystem Health and Management*, 22(4), pp. 440-451. Available at:

<https://bioone.org/journals/aquatic-ecosystem-health-and-management/volume-22/issue-4/14634988.2019.1682912/How-to-learn-to-stop-worrying-and-love-environmental-DNA/10.1080/14634988.2019.1682912.short>

Fonseca, V. G., Davison, P. I., Creach, V., Stone, D., Bass, D., & Tidbury, H. J. (2023). The Application of eDNA for Monitoring Aquatic Non-Indigenous Species: Practical and Policy Considerations. *Diversity*, 15(5), 631. Available at: <https://www.mdpi.com/1424-2818/15/5/631>

3.2.17 Artificial Intelligence

Artificial Intelligence (AI) and machine learning (ML) are increasingly being integrated into invasive species monitoring and data processing to improve efficiency, accuracy, and scalability.

Advancements in this area should be evaluated regularly and incorporated into invasive species surveillance and monitoring where applicable. Some example applications are:

Species identification from imagery: AI-powered image recognition models can be used to rapidly detect and classify invasive species, processing large photos and video datasets from camera traps, drones, ROVs, and underwater imaging systems.

Behavioural insights: ML can be applied to the analysis of video footage to identify patterns in species behaviour, which can inform monitoring design and onward management strategies.

Data analysis: AI can be used as part of eDNA monitoring data analysis to accelerate sequence matching against reference libraries.

Data processing and QA: AI can improve the reliability of citizen science data by facilitating validation of public-submitted data (e.g., photos, location records), for example, by assessing image quality and species metadata completeness.

3.3 Summary and seasonal deployment guide

While the deployment of each method should be considered in the context of the target species specifically, there are some general principles which can followed with respect to the deployment seasonality. These are captured in Table 1 along with key information for each monitoring method.

Table 1. A summary of invasive species monitoring methods. This includes the reference to the most suitable environment and target species, key considerations, and the optimal timing for deployment. While cells denote generally unsuitable months, grey cells denote generally sub-optimal monitoring months and blue cells denote generally optimal months. This table can be cross referenced with priority species classifications in Chapter 1, to facilitate deployment of an appropriate method(s) for a given priority species.

Method	Environment	Primary Target Species group	Key considerations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rapid Assessment Surveys	M & FW	Sessile/fouling animals, attached plants	Relatively quick & low cost (surveyor time is key cost). Standardised & established method. Requires taxonomic ID expertise. Laboratory analysis may be required for ID of some species.												
Settlement panels	M & FW	Sessile/fouling animals, attached plants	Panels can be self-built to reduce costs. Deployment does not require expertise. Panel analysis requires taxonomic ID expertise. Laboratory analysis may be required for ID of some species. Placement location is important. Sensitive to extreme weather which can result in detachment & loss of panel.												
Trapping	All	Mobile/benthic (marine and freshwater), all terrestrial animals apart from subterranean invertebrates.	Relatively low cost and easy to implement. Bespoke approach tailored to target species required. Standardised and established trapping approaches for some species. Trapping of non-target organisms or predation within trap presents challenges. Licenses / certification may be required for trapping of some species / use of certain methods (e.g., mist nets).												

Method	Environment	Primary Target Species group	Key considerations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Imaging	All	All species	Can be as simple or sophisticated as required or capabilities/cost allows. Image quality affects data accuracy. Image analysis requires species ID expertise. Images from camera stations can be time consuming to processes.												
eDNA	All (through primarily deployed in the aquatic environment)	All species	Sample acquisition does not require specialist training. Sample contamination is a potential issue. Samples need to be stored in a way that reduces sample degradation - e.g., in freezer. The weighting of a DNA signal in the absence of physical sighting needs consideration for reporting Sample analysis is specialist and costly. Protocols are evolving all the time, limiting consistency and comparability. Many factors (e.g., temperature, salinity, pollutants) affect the longevity of DNA in the environment, thereby affecting the accuracy and comparability of results. Species shed DNA at different rates (and rates change seasonally).												
Walkover	T & FW	Terrestrial & FW plants	Quick and relatively low cost to undertake. Can target single or multiple invasive species. Expertise is required for accurate ID of species. Not suited for areas which are difficult to access Well suited to survey of riparian species.												

Method	Environment	Primary Target Species group	Key considerations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Zooplankton trawls	M & FW	Pelagic, including early life stages	Relatively simple and low cost to deploy. Very seasonally sensitive if deployed for the detection of early life stages. Mesh size needs to account for target organism size. Small mesh vulnerable to becoming blocked by non-target organisms / particles in the water body. Samples often require laboratory analysis.												
Sediment grabs (e.g., Ekman, Mini Hamon) & bottom dredges	M & FW	Benthic	Specialist equipment needed. Relatively straight forward to deploy, though some training on equipment use is needed. Sieving and sample processing can take some time Samples may require laboratory analysis.												
Kick sampling	M & FW	Benthic	Relatively straight forward to deploy. Relies on water current. Samples may require laboratory analysis.												
Sweep netting	M & FW	Benthic	Relatively straight forward to deploy. Can be deployed in still water. Samples may require laboratory analysis.												
Electrofishing	FW	Pelagic	Requires specialist equipment and training (costs associated with these). Better suited to small, shallow or fast flowing water bodies.												
Seine netting	FW	Pelagic	Relatively straight forward to deploy. Suited to larger water bodies with slower flow.												

Method	Environment	Primary Target Species group	Key considerations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fyke netting	FW	Pelagic	Relatively straight forward to deploy. Can be left over night to increase the probability of capturing target species.												
RoVs	M & FW	Mobile, sessile/fouling animals, anchored attached plants.	Specialist equipment needed. Specialist training needed. High capital cost and potentially high maintenance costs. Provides means to cover large areas quickly. Provides high quality real time imagery. Water quality and visibility affect quality of data produced.												
Drones	T	Terrestrial plants	Licenses and certification required. Specialist equipment needed. Specialist training needed. High capital cost and potentially high maintenance costs. Provides means to cover large areas quickly. Provides high quality real-time imagery. Can provide means to survey otherwise inaccessible landscapes. Disruption to sensitive habitats minimal.												
Wax blocks and tracking tunnels	T	Land-based animals	Straight forward to deploy. Facilitates survey of elusive mammals.												
Detection dogs	All (for marine, intertidal rather than offshore)	All	Relatively new so standardised protocols not well developed. Only possible for species for which dogs have been trained to detect. Requires highly trained dogs and handlers. Expensive relative to other techniques. Best for detection of rare or elusive species.												

Method	Environment	Primary Target Species group	Key considerations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bioacoustic monitoring	T (& FW)	Land-based animals	Relatively new so standardised protocols not well developed. Requires specialist equipment and trained personnel for data analysis. Potential for lots of data, including relating to target species and the ecosystem more generally.												

4 References

- Abrahams, C., Ashington, B., Baker, E., ..., & Metcalf, O. (2022). Good practice guidelines for long-term ecoacoustic monitoring in the UK. UK Acoustics Network.
- Arenas, F., Bishop, J. D. D., Carlton, J. T., Dyrinda, P. J., Farnham, W. F., Gonzalez, D. J.,...Wood, C. A. (2006). Alien species and other notable records from a rapid assessment survey of marinas on the south coast of England. *Journal of the Marine Biological Association of the United Kingdom*, 86(6). <https://doi.org/10.1017/S0025315406014354>
- Bennett, E., Jamieson, L. T., Florent, S. N., Gill, N., Hauser, C., & Cristescu, R. (2022). Detection dogs provide a powerful method for conservation surveys. *Austral Ecology*, 47(4). <https://doi.org/10.1111/aec.13162>
- Bishop, J. D. D., Wood, C. A., L  v  que, L., Yunn  e, A. L. E., & Viard, F. (2015). Repeated rapid assessment surveys reveal contrasting trends in occupancy of marinas by non indigenous species on opposite sides of the western English Channel. *Marine Pollution Bulletin*, 95(2). <https://doi.org/10.1016/j.marpolbul.2014.11.043>
- Cook, E. J., Beveridge, C., Twigg, G., & Macleod, A. (2015). Assessing the effectiveness of early warning systems for the detection of marine invasive non-native species in Scottish waters. Scottish Natural Heritage Commissioned Report No. 874.
- Darling, J. A. (2019). How to learn to stop worrying and love environmental DNA monitoring. *Aquatic Ecosystem Health and Management*, 22(4), 440-451. <https://doi.org/10.1080/14634988.2019.1682912>
- Flitcroft, R. L., Penaluna, B. E., Hauck, L. L., Munyon, J. W., Capurso, J. M., Flitcroft, R. L.,...Capurso, J. M. (2025). Multi-species eDNA as a screening tool to facilitate early detection and eradication of aquatic invasive species in large water bodies. *Scientific Reports* 2025 15:1, 15(1). <https://doi.org/10.1038/s41598-025-19083-7>
- Fonseca, V. G., Davison, P. I., Creach, V., Stone, D., Bass, D., & Tidbury, H. J. (2023). The Application of eDNA for Monitoring Aquatic Non-Indigenous Species: Practical and Policy Considerations. *Diversity*, 15(5), 631-631. <https://doi.org/10.3390/D15050631/S1>
- HELCOM. (2019). Guidelines for non-indigenous species monitoring by extended Rapid Assessment Survey (eRAS).
- HELCOM. (2021). Guidelines for the monitoring of marinas.
- Lamb, P. D., Fonseca, V. G., Maxwell, D. L., & Nnanatu, C. C. (2022). Systematic review and meta-analysis: Water type and temperature affect environmental DNA decay. *Molecular Ecology Resources*, 22(7), 2494-2505. <https://doi.org/10.1111/1755-0998.13627>
- Minchin, D. M., & Nunn, J. D. (2013). Rapid assessment of marinas for invasive alien species in Northern Ireland. Northern Ireland Environment Agency Research and Development Series No. 13/06.
- Newson, S. E., Else, R., Crymble, J., Gilbert, G., Tosh, D., & Booth Jones, K. (2023). Bioacoustics as a novel approach for detecting the presence of Brown Rats on seabird islands. BTO Research Report 755 BTO, Thetford. BTO Research Report 755 BTO, Thetford.
- Newson, S. E., & Pearce, H. (2022). The potential for acoustics as a conservation tool for monitoring small terrestrial mammals. JNCC Report No. 708. JNCC, Peterborough, ISSN 0963-8091.

- O'Shaughnessy, K. A., Lyons, D., Ashelby, C. W., Counihan, R., Pears, S., Taylor, E.,...Stebbing, P. D. (2023). Rapid assessment of marine non-native species in Irish marinas. *Management of Biological Invasions*, 14(2), 245-267.
- Silva, T. A. M., Beraud, C. P. C., Lamb, P. D., Rostant, W., & Tidbury, H. J. (2025). Frontiers | Modelling the spatial bound of an eDNA signal in the marine environment – the effect of local conditions. *Frontiers in Marine Science*, 12. <https://doi.org/10.3389/fmars.2025.1613001>
- Thompson, M. M., Moon, K., Woods, A., Rowley, J. J. L., Poore, A. G. B., Kingsford, R. T., & Callaghan, C. T. (2023). Citizen science participant motivations and behaviour: Implications for biodiversity data coverage. *Biological Conservation*, 282. <https://doi.org/10.1016/j.biocon.2023.110079>
- 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.