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Cyfoeth Naturiol Cymru
Natural Resources Wales

Invasive Non-native Species Action Plan for Wales:

Japanese oyster drill and American oyster drill

(*Ocinebrellus inornatus and Urosalpinx cinerea*)

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APEM Ltd. And Natural Resources Wales

With thanks to Gabrielle Wyn

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Executive summary

- Invasive non-native species (INNS) are plants, animals or pathogens that do not naturally occur in an area but have been moved there, usually by human activities (either accidentally or deliberately) and cause significant environmental, social or economic impacts. The impacts of INNS include outcompeting native species for food and space, altering habitats, spreading disease and incurring direct and indirect costs for local and national economies.
- The movement (i.e. introduction and spread) of INNS is facilitated by human mediated routes and activities called "Pathways", for example shipping, recreational boating and aquaculture.
- Although reducing the impact of INNS is commonly approached through efforts to prevent introduction and spread at the pathway level, there are several INNS that have been prioritised by National Resource Wales.
- The overall aim of this Species Action Plan is to reduce the risk of the introduction and spread of the Japanese oyster drill, *Ocinebrellus inornatus* and American oyster drill, *Urosalpinx cinerea*, by putting forward actions that can be applied at national (Welsh), regional and local levels.
- This SAP provides an overview of the invasive Japanese and American oyster drills, their behaviour and life cycles, pathways of spread and impacts, as well as actions that could be implemented to address the spread of these species.
- The negative impacts of the oyster drills include predation on commercially important species and competition with other species. These issues may result in costly implications for aquaculture operations, as well as direct harm to the natural marine environment.
- The actions outlined within this SAP provide stakeholders of the Welsh marine environment a series of actions that could be implemented to prevent the introduction of these horizon species (i.e. species that are not yet recorded as present in an area) and respond quickly to possible incursions.
- Stakeholders are those that use, benefit from or are responsible for (e.g. managing, protecting or regulating) the marine environment. Here, this includes authorities (i.e. bodies with powers to introduce, amend and enforce regulations, legislation and policy), statutory bodies, national non-governmental stakeholders (e.g., recreational governing bodies, NGOs, associations and trusts), commercial operations, port authorities and harbourmasters, recreational users and individuals. See Key stakeholders for further examples.

- The SAP outlines seven components of biosecurity focus to be undertaken by stakeholders that address the American and Japanese oyster drills within Welsh marine areas.

    1. Understanding roles and legal responsibilities
    2. Information and guidance on the Japanese and American oyster drills
    3. Raising awareness
    4. Biosecurity processes and procedures
    5. Species management
    6. Monitoring and reporting
    7. Collaborative working

This plan is intended to be used in support of the associated Pathway Action Plans (PAPs) and Biosecurity Action Plans (BAPs).

Preface

Safeguarding Wales's marine environment and native biodiversity requires robust biosecurity measures to prevent the spread and impact of invasive non-native species (INNS). The guidance in this Species Action Plan provides information and guidance to support stakeholders with their biosecurity efforts in Welsh marine areas, where the Japanese and American oyster drills are considered a priority threat.

It is acknowledged that no single activity is solely responsible for the spread of INNS, and no single species should be targeted at the expense of wider holistic efforts. All users of the marine environment are encouraged to take the time to understand more about the Japanese and American oyster drills and how they can contribute to tackling them.

Stakeholders are encouraged to share this plan, the guidance within it, the actions that they choose to undertake and to raise awareness of biosecurity. Collective effort is ideal, but individual actions are equally vital. Proactive steps by stakeholders, even when taken independently, strengthen national INNS biosecurity and help to protect our marine environment — every action counts.

The significance of this issue is recognised by Natural Resources Wales, who commissioned, and will manage this plan under a wider framework of INNS biosecurity planning.

Background

What are Invasive Non-Native Species (INNS)?

Non-native species (NNS) are plants, animals or pathogens that do not naturally occur in an area but have been moved there, by human activities (either accidentally or deliberately). NNS are also sometimes referred to as “alien species”, “non-indigenous species” or “exotic species”. Most NNS do not cause issues within the area where they have been introduced. However, 10-12% cause significant environmental, social or economic impacts. These are known as Invasive Non-Native Species (INNS) and, in Wales, include the American slipper limpet, carpet sea squirt and Japanese wireweed, among many others. The impacts of INNS include threats to biodiversity, habitat alteration, fouling underwater structures (including

aquaculture equipment, navigational aids and piers) and the introduction of diseases. The impacts of INNS (in all environments including marine) are estimated to cost the British economy £4 billion per year, of which, £499 million per year is attributed to impacts in Wales (see the 2023 paper from Eschen).

Marine INNS are resilient and often capable of surviving harsh and variable conditions, making them particularly challenging to manage. Many species can endure high levels of drying, temperature fluctuations, and low nutrient availability, allowing them to persist in damp conditions for extended periods. For instance, mussels, barnacles and algae can remain viable (i.e., still able to live and/or reproduce) when attached to damp equipment, nets or boat hulls, even after days or weeks out of the water. The resilience enables them to travel long distances, hitchhiking on fishing gear, recreational boats, or clothing/equipment.

What are pathways?

The mechanisms and routes by which INNS are moved from one location to another by humans are termed "pathways". This movement of species by humans, accidentally or deliberately, allows INNS to overcome natural barriers that would otherwise prevent them from spreading between their native and non-native ranges, e.g., an ocean. For instance, Pacific oysters, native to Japan, would not be able to reach UK waters through natural spread, but when introduced into UK waters by human activity can survive and establish as the environmental conditions in the UK are compatible with their native range.

Animals can be moved as eggs and in their larval, juvenile and adult life stages. Seaweed can be moved as fragments or spores. Larvae can be planktonic (drift with currents, unable to propel themselves against water movement) or free-swimming (can actively move and maintain their position in the water column).

Pathways are broadly classified as two types:

1) Pathways of initial introduction: Those which transfer NNS to regions or locations that are geographically separate and isolated from their native range (referred to as "introduction(s)" in this document). An example of this would be the movement of transoceanic vessels.

2) Pathways of further spread: These facilitate the movement of NNS populations beyond their initial introduction point (referred to as "spread" in this document):

    a. Facilitating the short-range dispersal (i.e. spread from place of introduction to wider area) of an NNS population within a single habitat or location (e.g. paddle boarders spreading a seaweed within a bay), or

    b. Facilitating regional spread where some small barriers exist (e.g., the movement of recreational boats between two nearby but separate harbours).

The frequency and magnitude of pathways in the marine environment have been increasing since the 1800s with the beginning of rapid globalisation. A significant movement of marine INNS has been through the trans-oceanic voyages and shipping that has long supported growing global economies and international supply chains. For more information on other

pathways in the marine environment, please see the Welsh Pathway Action Plans. Links can be found on the Wild Seas Wales website

Vectors are the specific, discrete parts of a pathway that facilitate the movement of INNS from one location to another. For example, vectors within the aquaculture pathway could include the escape of a cultured INNS from the aquaculture site, INNS hitchhiking on the cultured species or INNS-fouled equipment that is brought to a site. For boating pathways, vectors could include INNS fouling the boat hull or INNS being taken up in water-retaining features (e.g., bilge or ballast tanks). The relationship between pathways and vectors in the marine environment is illustrated in Figure 1.

Natural spread of INNS e.g., larvae distributed along a coastline by tides and currents, may also occur following introductions. However, unlike the spread caused by human activities, natural spread is generally limited by the inherent barriers between locations. Natural spread is generally gradual and organic (i.e. slow outward spread from a point-source of introduction). Although natural spread is more challenging to manage, improved biosecurity procedures, particularly at high-risk/vulnerable sites, can reduce the risk of impact and improve the chances that introductions are detected early.

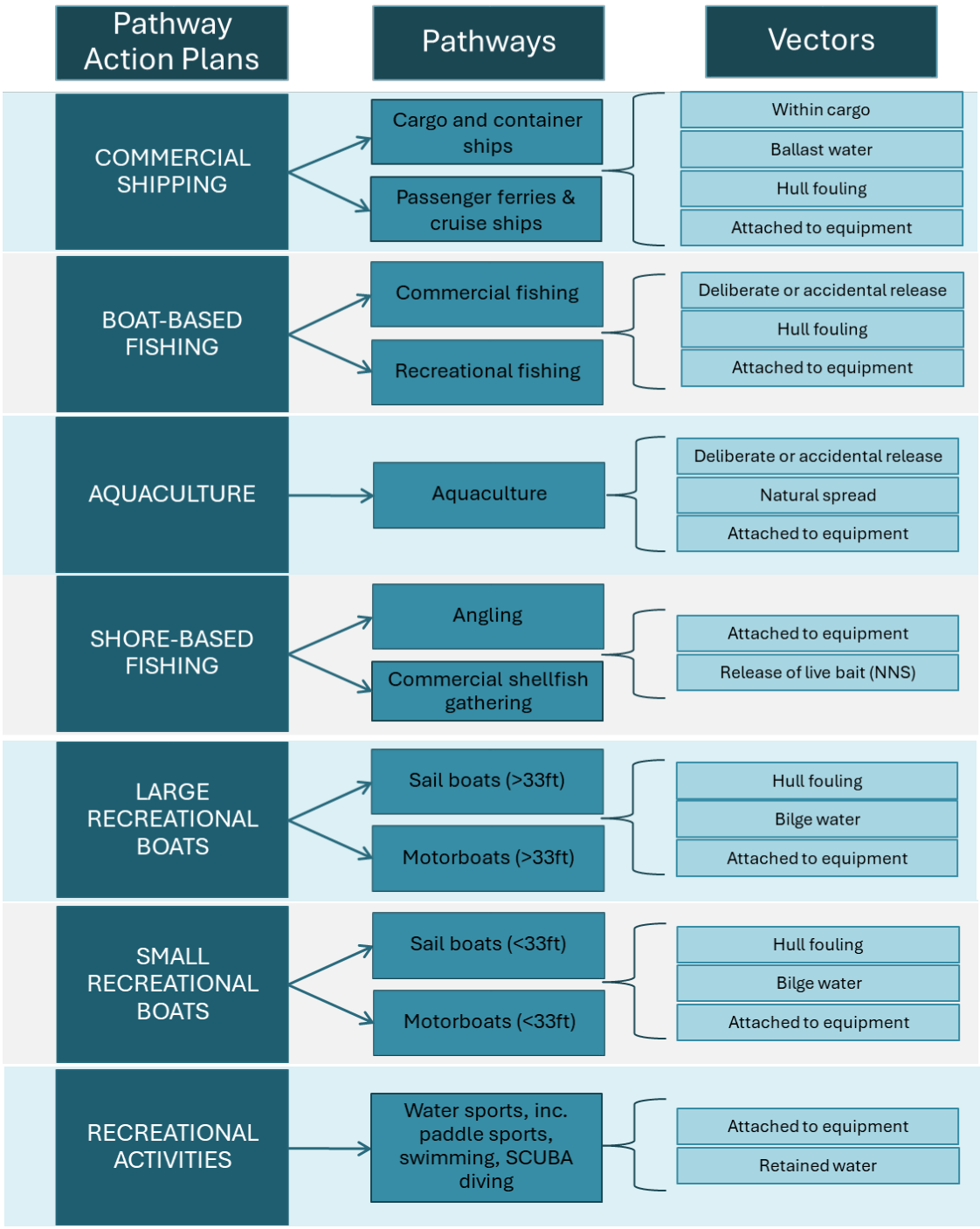

Figure 1. An overview of the Pathway Action Plans that have been developed for Wales, and the vectors associated with the pathways. Note that the list of vectors is not exhaustive.

What is biosecurity?

Biosecurity measures are actions, procedures and behaviours put in place to reduce the risk of INNS introduction and spread within and outside of a given area. Biosecurity measures should be realistic, pragmatic and cost-effective. Preventing the introduction and spread of INNS is by far the most effective way to reduce the impact of INNS. Eradication and control of INNS is often not possible in the marine environment and any attempts are more costly, difficult, and time-consuming compared to preventing the arrival and establishment of INNS in the first place.

A biosecurity framework: what is the context for this Species Action Plan?

This Species Action Plan forms part of a biosecurity planning framework commissioned and endorsed by Natural Resources Wales. The driver behind the framework is the wider goal of improving the condition of and increasing biodiversity in protected marine sites. Within the marine environment, this goal includes reducing the introduction and spread of INNS. The Species Action Plans (SAPs) and the Pathway Action Plans (PAPs) produced for this framework are intended to provide a basis for biosecurity planning for all marine sites throughout Wales, as well as presenting standalone guidance for pathway management. Figure 2 shows the relationships between each of the action plans.

Pathway Action Plans (PAPs) describe the pathway and list possible actions that could be undertaken to address the risk of the introduction and spread of INNS via that pathway into or around Wales. Links to the other PAPs can be found on the Wild Seas Wales website.

Species Action Plans (SAPs) describe priority INNS and list possible actions that could be undertaken to address the introduction and spread of that species into or around Wales. Links to the SAPs can be found on the Wild Seas Wales website.

Biosecurity Action Plans (BAPs) are site-specific. BAPs can be scaled as appropriate but there are no barriers to producing a BAP for a whole region (i.e. as has been done for the Pembrokeshire Marine, Cardigan Bay, Menai Straits and Carmarthen Bay Special Areas of Conservation (SACs)) or for an individual port, harbour or aquaculture site. They will identify the pathways relevant for that site and the species at or near the site that are of concern. The actions listed in the PAPs and SAPs are relevant to all stakeholders (see Key stakeholders) and should be considered and incorporated into a site's BAP. Due to the wide breadth and scale of the different stakeholder groups, the scope of these actions is equally broad. It is therefore important that individual stakeholders review their activities and use of the site to decide which of the biosecurity actions are applicable and practicable.

Biosecurity To-Do-List trackers have been created to make it easier for stakeholders to log what actions they plan to carry out and track what progress is being made on each action. The need for using to-do-list trackers will be dependent on the scope and scale of the BAP. For example, the BAPs produced for the Welsh SACs cover such large areas that it is necessary to provide individual stakeholders with an additional support tool that makes it easier to log and

track their actions. The tracker also enables NRW, as the SAC BAP manager, to effectively oversee the implementation of biosecurity within each SAC, highlighting progress and pinpointing where further assistance or support may be needed. This approach is also intended to facilitate coordinated monitoring and collaborative efforts to share and enhance biosecurity practices between stakeholders. Biosecurity planning at smaller scales (e.g. an individual port or aquaculture facility) are unlikely to require a BAP and a to-do-list tracker in parallel. Stakeholders can decide which is the most appropriate method for facilitating their biosecurity efforts.

This framework has not been created with punitive or intentionally burdensome measures, and we encourage all stakeholders to consider the benefits of improved biosecurity to both the sustainability of their operations / activities.

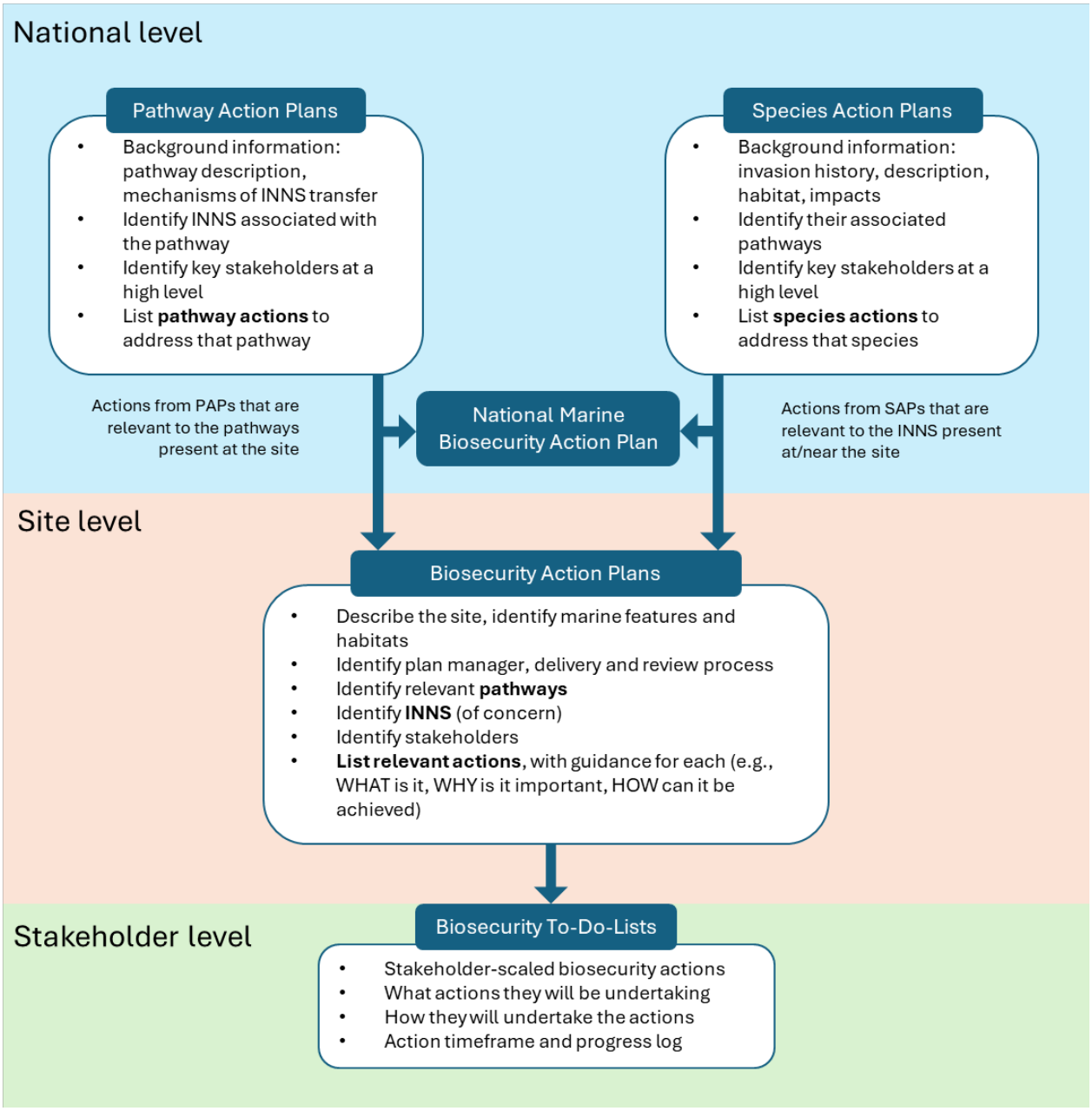

Figure 2. A flowchart showing the relationships between the Pathway Action Plans, Species Action Plans and the Biosecurity Action Plans created for the Natural Resources Wales Biosecurity Planning Project with APEM Ltd.

Scope, aims and objectives

Scope

This Species Action Plan (SAP) is intended to be applicable across all Welsh marine areas, presenting actions that can be undertaken by relevant parties (outlined below) to manage the introduction and / or spread of the Japanese and American oyster drills or sting winkles, *Ocinebrellus inornatus* and *Urosalpinx cinerea* (referred to as either Japanese or American oyster drills from here onwards). The actions outlined in this document are intended to complement those within the PAPs (available on the Wild Seas Wales website) in order to be more readily incorporated into BAPs, as described in the framework above. As such, there will be some overlap between the actions recommended in this SAP and the actions recommended in the PAPs. This document is aimed at:

- Individuals, organisations or groups undertaking activities in the marine environment.
- Regulators, governmental organisations and local authorities planning the implementation of policy, legislation or regulations.

The actions and guidance outlined in this document encompass several dimensions of INNS management for the Japanese and American oyster drills, including:

- Strategies for effective INNS biosecurity;
- Strategies to enable early detection and quick reaction to new records;
- Coordination of efforts, resource sharing and collaboration;
- Research, development and innovation; and
- National policy and regulatory frameworks

Aim

The overall aim of this SAP is to reduce the risk of the introduction and spread of the American and Japanese oyster drills by putting forward actions that can be applied at national (Welsh), regional and local levels. The goal is to use existing INNS and American and Japanese oyster drills specific awareness raising communications and biosecurity resources, wherever available, and adapt them to fit specific requirements. This approach aims to avoid any duplication or unnecessary additional effort. This will facilitate a consistent approach to biosecurity for this species across Wales.

Objectives:

- Increase public awareness of the American and Japanese oyster drills and the risks they pose.
- Put forward recommendations for actions that aim to reduce the further introduction and spread of the American and Japanese oyster drills into and around Wales and improve surveillance and reporting of new individuals.

- Outline possible control methods for the American and Japanese oyster drills that have previously been employed elsewhere.

Japanese and American oyster drills: Background

Table 1. A summary of the Japanese and American oyster drills (Ocinebrellus inornatus and Urosalpinx cinerea) background information.

Attribute	American oyster drill.	Japanese oyster drill.
Native range	East coast of the USA.	Northwest Pacific.
Appearance	Yellow, orange or grey shell up to 50mm. Usually 6-8 whorls (turns) twisted anticlockwise in relation to the top of the shell. Shell opening is oval. An orange-yellow plate closes the opening.	Beige, grey or yellow shell up to 60mm, often with irregular brown bands. Typically 5-6 whorls.
Substrate	Mud, shell (oyster beds) and gravel. Hard substrate required for egg laying.	Mud, shell (oyster beds) and gravel. Hard substrate required for egg laying.
Depth	Primarily found in the intertidal zone.	Primarily found in the intertidal zone.
Feeding method	Predatory.	Predatory.
Reproduction / Propagation	Sexual (cross-fertilisation).	Sexual (cross-fertilisation).
Predators	Likely predation by crabs, birds, lobsters and fish.	Likely predation by crabs, birds, lobsters and fish.
Pathways and vectors	Aquaculture, dredging and natural spread.	Aquaculture, dredging and natural spread.
Impacts	Competition, predation, ecosystem alteration, disease/ parasite transmission and socioeconomic.	Competition, predation, ecosystem alteration, disease/ parasite transmission and socioeconomic.

Where did they come from?

The American oyster drill

The American oyster drill (also known as the Atlantic oyster drill) is native to east coast of the USA.

Non-native range

The American oyster drill has been introduced to the Pacific coast of North America, initially reported in San Francisco Bay in 1890. This species has also been introduced into Europe. In particular, this species was reported in France between 1960 and 1969, though establishment did not occur there, and in the Oosterschelde Estuary in Netherlands in 2007, where it established a self-sustaining population. Recent records also indicate that the species was found for the first time in Portugal in 2021.

With respect to GB specifically, the American oyster drill was reported in Essex oyster beds in 1927, and then subsequently in estuaries of the rivers Colne, Blackwater, Crouch and Roach and in Kent: mouth of the River Swale. The species has also been reported in Devon (1998, 2017), Dorset (2010), Norfolk (2011) and Cornwall (2020) though it is uncertain whether these reports are misidentifications of the native oyster drill. The American oyster drill is a "horizon species" for Wales, meaning that while it is not currently recorded in Wales it is considered likely to be introduced and be able to establish there.

The Japanese oyster drill

The Japanese oyster drill is native to the Northwest Pacific.

Non-native range

The Japanese oyster drill has been introduced to the West Coast of the USA, where it was first recorded in 1924 in Samish Bay (Washington, USA) on newly transplanted Pacific oysters (*Magallana gigas*) from Japan, and subsequently in Canada. The first report of the Japanese oyster drill in Europe was in 1995 in France, where it was discovered in the Bay of Biscay where, according to molecular analyses, it was probably introduced with Pacific oyster imports from Washington (USA), and later from Japan. From there it spread northwards to other oyster culture areas in France. In 1999 this species was reported in Sagres, Portugal. Later, in the 2000s, the Japanese oyster drill was recorded in Jutland (Denmark) and the Oosterschelde estuary (Netherlands). In 2023 there was a confirmed record of Japanese oyster drill in Jersey, with an additional record being reported in 2024.

There are no records of the Japanese oyster drill in GB. However, it is considered a horizon species for GB (and Wales) and has been classified as an alert species by the GB Non-Native Species Secretariat (GB NNSS) – one of only two marine species to be classified as such.

What do they look like?

Oyster drills (also known as sting winkles) are marine gastropod molluscs, or predatory snails. Table 2 contains a comparison of some of the key characteristics of the native European oyster drill (*Ocenebra erinacea*), and the American and Japanese oyster drills. These characteristics can also be seen in Figure 3, Figure 4, Figure 5 and Figure 6.

The American oyster drill

The American oyster drill has a shell height up to 40 mm. The shell is typically yellowish, orange or grey with up to 8 turns or whorls. It has rounded vertical ribs (10-12 in the final turn) and numerous finer concentric spiral ridges (~15). The shell opening is oval with a short open canal at the base. An orange / yellow plate covers the opening when the animal withdraws. In comparison, the native oyster drill has a rougher narrower shell with uneven sculpturing. American oyster drill has yellowish, flat vase-like egg cases with more or less parallel sides.

The Japanese oyster drill

The Japanese oyster drill has a shell height up to 60 mm. The shell may be beige, greyish or yellow, often with irregular brown bands. Shell morphology can vary significantly, often making it difficult to distinguish from the native oyster drill. The shell has a flat upper projecting shelf with a deep suture between whorls extending to the spire apex. There may be four to eleven flared vertical ridges occurring irregularly on the whorls. Siphonal canal is open along its length. In comparison, the native oyster drill has eight to nine ridges which are generally not as raised. The Japanese oyster drill has white to yellow, bottle/crescent-shaped egg cases, which are 15-20mm.

Table 2. A comparison of key characteristics of the European, American and Japanese oyster drills.

Characteristic	European (native)	American (non-native)	Japanese (non-native)
Shell height	Up to 50mm	Up to 40mm	Up to 60mm
Shell colour	Shell yellowish or white in colour	Yellowish, orange or grey, sometimes with irregular brown marks	Beige, greyish or yellow, often with irregular brown bands.
Ridges	8-9	~15	4-11
Whorls	8	7-8	5-6

Characteristic	European (native)	American (non-native)	Japanese (non-native)
Siphonal canal	Closed siphonal canal (in adults)	Short and open with the groove bent towards the left.	Short, straight open siphonal canal.
Other notes	Angled shoulder.	Sharply pointed spire. Pronounced ridges and ribs. Broader, fatter shell than the European.	Large oval opening. Chalky texture shell
Egg cases	Triangular-shaped, whitish colour. 6-13mm high.	Yellowish, vase-shaped capsules.	Bright-yellow, bottle/crescent-shaped. 15-20mm high.

Figure 3. American oyster drill. Cricket Raspet (left) and Benny Albro (right) both via iNaturalist [CC BY].

Figure 4. Japanese oyster drill. Cricket Raspet, via iNaturalist [CC BY].

Figure 5. European oyster drill. Thomas Dreux, via iNaturalist [CC BY]

Figure 6. (A) American oyster drill eggs. Zihao Wang. (B) Japanese oyster drill eggs. Lou Wagstaffe. (C) European oyster drill eggs. Libby Keatley. All via iNaturalist, [CC BY].

Please note that the appearance of oyster drills, both native and non-native, varies between individuals. We have tried to capture general observed differences between the species in the above section but identification to species level is challenging and typically requires input from highly trained taxonomic experts.

What habitat do they live in?

Oyster drills generally occupy an area from the intertidal (the area between the high and low tide lines) down to about 6-10 m in depth; although, the American oyster drill has been observed at a depth of 37 m. Oyster drills are often associated with oysters, being one of their primary food sources, and are found in bays, estuaries and rocky areas. Substrates on which

they are commonly found include mud, shell and sometimes gravel. Hard substrates such as boulders are required for egg laying.

Oyster drills can generally tolerate both brackish and fully saline water, although the minimum salinity tolerance of the American oyster drill is documented to be slightly lower (12 practical salinity units (psu)) than for the Japanese oyster drill (23 psu). The maximum salinity and temperature tolerances of the American oyster drill have been reported as 30°C and 40 psu, respectively, and it can tolerate temperatures as low as -1°C. The maximum salinity and temperature tolerances of the Japanese oyster drill have been reported as 32°C and 35 psu, respectively, and it can tolerate temperatures as low as 0°C.

Behaviour and life cycle

Oyster drills feed by drilling holes in hard shelled organisms using a radula (hardened teeth). They can also secrete sulphuric acid to dissolve the shell. Through the hole, they then insert digestive enzymes to digest the prey and slowly consume it, often over a series of days. Oyster drills are not able to drill into thicker shells and so are limited to the thinner shells of smaller bivalves. It is also understood that the size of their prey tends to be roughly equal to their shell length. They feed on bivalves such as oysters, mussels, clams, and also on barnacles, although most research relating to feeding has focused on oysters.

Oyster drills have separate sexes. Fertilisation of oyster drill eggs takes place within the body of the female. The females lay eggs on a hard surface above the seabed. Eggs are laid within 25-100 capsules which can each contain >1,000 eggs, of which only about 10-15 are viable. The other eggs are a food source for the developing embryos. Eggs hatch after about 3-10 weeks, at which point, the newly hatched oyster drills are 1-2 mm long. Juveniles mature when they reach 25-30 mm in length, after about 1-2 years of growth. Individuals can survive for up to 14 years. Neither the American nor the Japanese oyster drill have a pelagic (i.e. free-swimming) larval phase, this limits their spread by natural means.

Under UK conditions, the American oyster drill lays eggs in May and June, and sometimes August and September. Eggs of the American oyster drill have an incubation period of 6-8 weeks and so they usually begin to hatch in early July. Reproduction of the American oyster drill requires temperatures of at least 12-15°C and a salinity of at least 20 psu. The temperature and salinity requirements for the Japanese oyster drill are less well documented but are likely to be similar. In the Japanese oyster drill's introduced range in Europe, mature adults congregate to breed in both spring and autumn.

Oyster drills often climb up hard surfaces (particularly during the spawning season and when they are juveniles) and will gather underneath objects such as oyster shells when the tide is out. It has also been noted that individuals turn to face the oncoming current (known as rheotaxis) which may prevent them being swept away by currents.

Do they have any predators?

Information on known predators is limited; however, crabs, birds, lobsters and fish are likely to predate on both American and Japanese oyster drill egg cases and during larval, juvenile

and small-sized adult life stages. Larger adults have thicker shells and a more cryptic appearance, so they are less vulnerable to predation.

What are their pathways and vectors?

Pathways are the mechanisms and routes by which INNS are moved from one geographic location to another, and vectors are the specific, discrete parts within a pathway that facilitate the movement of INNS from one location to another. The pathways and vectors for the Japanese and American oyster drills are described below.

Aquaculture

The oyster trade is a major introductory pathway of oyster drills. In the west coast of the USA, both the Japanese and American oyster drills were first reported in oyster beds. The American oyster drill was first recorded in England where oysters were unsuccessfully planted in the 19th Century.

The activities that oyster growers perform to encourage oysters, including planting 'cultch' (shells to promote settlement) and transplanting oysters to new grounds, may act as a pathway for spreading oyster drills.

The ongoing cultivation of commercial shellfish species continues to act as a pathway of secondary spread around the UK. Adults and juveniles can hitchhike on shells and equipment, like oyster frames, trestles and pots, and can be unintentionally transferred to new locations when these are moved during operations.

Dredging

Oyster drills may be transferred during dredging operations via the fouling communities on vessel hulls. Another potential vector is the dredged sediment itself; however, the potential of INNS to be transferred via dredged sediment has received limited research and as such the viability of this pathway is poorly understood. Estimations of survival rates are complicated by the fact that survival is probably dependent on a wide variety of factors including a species' characteristics, the dredging equipment and methods used, and the environmental conditions at the disposal site. Characteristics of oyster drills that could facilitate their survival include their relatively broad environmental tolerances and hard shell, protecting them from physical impact. However, oyster drill mortality may be caused by sediment burial which is likely to occur during sediment transfer and upon discharge at the disposal site. More research is needed to understand if the oyster drill can be spread via the transfer of dredged sediment.

For dredging operations to take place in Wales, a licence is required from NRW unless conditions for an exemption are met. As part of the licence application, a marine INNS Biosecurity Risk Assessment and Management Plan must be completed. The risk assessment requires consideration of the presence of INNS at both the source and receiving sites as well as the INNS at the locations previously visited by the dredging vessel. Management measures must be identified which would mitigate the risk of introducing or spreading INNS.

Additional pathways

Reintroduction and restoration projects that transplant organisms (e.g., native oysters) from one location to another risk spreading INNS, including oyster drills. However, biosecurity considerations are already being made for many of these projects, with protocols/handbooks published that outline necessary practical steps to prevent the spread of INNS. For example, the European Native Oyster Restoration Handbook contains a chapter on biosecurity, providing information on protocols that should be followed when translocating oysters, shell cultch and other substrates (see Chapter 4 of the handbook). An example of biosecurity protocols in practice can be found in the biosecurity plan for the Firth of Forth native oyster reintroduction trials. In addition to outlining cleaning/sterilisation procedures, it also states that a donor site would be rejected (i.e. not used in the project) if there were known to be American oyster drills present (see Annex 4 of the Forth Oysters Biosecurity Plan).

A note on natural spread

Although not a human-mediated pathway, natural spread by currents can facilitate the dispersal of a species beyond the initial site of introduction in its non-native environment. Natural dispersal is limited and slow due to the lack of a planktonic (i.e., free-floating) development stage. Adults are mobile but unlikely to disperse over distances greater than 1 km. Reported dispersal speeds for the American oyster drill include 50 m in 48 hours for one individual, and 200 m in a year and a half for a population. Movement on soft sediment (i.e., silt and mud) is particularly slow and often the oyster drill crawls along submerged in such sediment. Oyster drills may lay eggs on material that can float and be moved by wind or currents to new locations, for example driftwood and vegetation. Egg cases may also be dispersed directly on ocean currents, but it is uncertain whether, and for how long, they can remain viable if they become detached from substrate.

What are their impacts?

Environmental

Competition and ecosystem alteration

Both the American and Japanese oyster drills have the potential to compete for space and food with native predatory snails. Densities of 15,000-20,000 American oyster drills per hectare were reported in England in the 1950s making competition likely, although densities declined in the 1980s possibly due to exposure to tributylin (TBT), a biocide used in anti-fouling paints on boat hulls. Since the use of TBT is now banned, populations may increase in abundance, and the potential for competition may increase as a result. In estuaries in Essex and Kent (UK), the introduced American oyster drill largely replaced the native the European oyster drill. Although, this was probably due to the American oyster drill's better tolerance of low temperatures during several unusually severe winters. In France, there is evidence that the Japanese oyster drill competes with the native oyster drill – in 2000, 25-30 years after its first introduction the Japanese oyster drill has completely outnumbered the native oyster drill.

The predation of oysters and other bivalves consumed by oyster drills could reduce ecosystem services, since bivalves provide a habitat and food source for fish and invertebrates and help to improve water quality through filtration of the water column. Predation of oysters could also impede native oyster restoration initiatives.

Predation

Oyster drills commonly feed on oysters (and other bivalves) and barnacles. Their impact on oyster populations is particularly high due to their preference for feeding on smaller, and therefore younger, bivalves. The size of the prey selected is usually roughly equal to the shell length of the oyster drill. Evidence of predation is usually scarce, since, once shellfish have been drilled and die, they degrade and/or get washed away by currents.

Ocean acidification caused by climate change may increase the vulnerability of bivalve to predation by oyster drills, as it can make shells thinner and therefore more susceptible to drilling.

Transmission of disease or parasites

Parasites of the American oyster drill have been recorded, including the flatworm *Parorchis acanthus* (found in Massachusetts, USA, and in the River Blackwater in Essex, England) and the flatworm *Hoploplana inquilina* (found in Delaware Bay, USA). It is not known if these parasites cause oyster drill death, but they are likely to impede their development, reproduction and growth. Importantly, it is not known if the American or Japanese oyster drills are able to spread these parasites to the native oyster drill, resulting in negative impacts to this species.

Socio-economic

The predation of oysters by oyster drills can result in substantial financial losses for fisheries. In Essex (England) oyster spat losses of up to 75% due to predation by the American oyster drill have been recorded.

In France, the Japanese oyster drill is a pest of the introduced Pacific oyster which is cultivated commercially. While the Japanese oyster drill has a lower feeding rate than the European oyster drill in France, it has a higher reproductive output and a longer breeding season than the European oyster drill, and so the potential to consume more oysters.

Oyster drills in Wales: National context

Distribution of the oyster drills

There are currently no records of the American oyster drill in Wales but, considering nearby records in England and the presence of potential pathways (e.g., aquaculture), future spread

into Wales is likely. In England, the American oyster drill was first reported in the Crouch estuary, Essex, in 1927. It has since been reported from the Colne, Blackwater, and Roach estuaries in Essex and from the Kentish Flats near Whitstable. More recently, the American oyster drill has been recorded from the Dorset coast, south coast of Cornwall, the north and south coast of Devon and off the coast of Norfolk. The closest confirmed record to the Welsh marine area was made in 2017 near Ilfracombe, north Devon. An up-to-date map of American oyster drill records in the UK can be found on the NBN Atlas.

There are currently no records of the Japanese oyster drill in the UK. However, considering that it is present and established in France and the Netherlands (i.e. it is geographically close), there are viable pathways (e.g., import of oysters) in the UK (i.e. it has the potential to be introduced), and its ecology, prey and habitat preferences are similar to that of the American oyster drill (i.e. it would be able to survive and establish if introduced), introduction into the UK is likely. These risks have been assessed by the GB NNSS and are outlined below. It has been classified as an "alert species" by the GB NNSS.

MPA features at risk from the American oyster drill

The potential impact of the American oyster drill to MPA habitat features in Wales was assessed in a 2020 NRW report and then mapped (see Figure 7) in the NRW evidence report "Marine Protected Areas: Features at risk from marine invasive non-native species" (pending publication). The mapping shows that the risk to habitats from the American oyster drill varies across Welsh waters. The main ecological concerns regard predation of oysters and mussels, with intertidal and shallow subtidal bivalve reefs potentially impacted. For habitats where mussels and oysters are not predated or are predated at low rates due to the size of mature individuals, consumption of juveniles preventing natural recruitment may over time result in a loss of reefs.

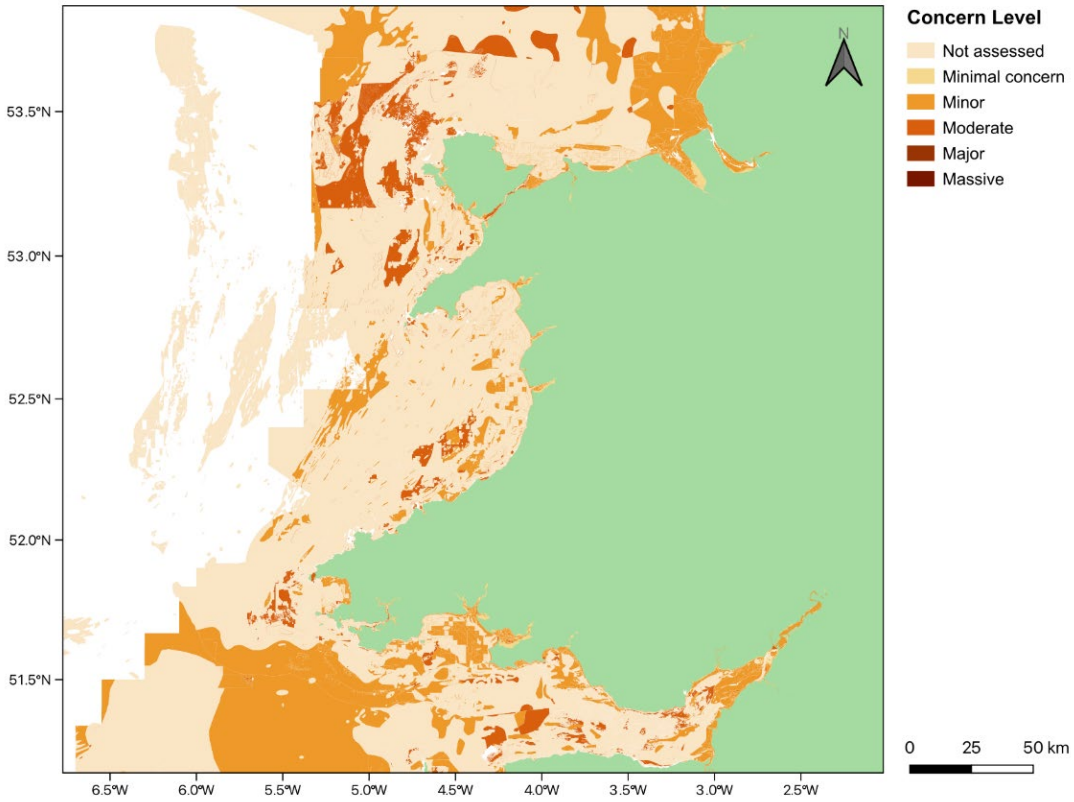

Figure 7. Habitat risk (concern level) from the American oyster drill, Urosalpinx cinerea, based on the assessment carried out in the NRW evidence report: 'Assessing the impact of key Marine Invasive Non-Native Species on Welsh MPA habitat features, fisheries and aquaculture'.

MPA features at risk from the Japanese oyster drill

The potential impact of the Japanese oyster drill to MPA habitat features in Wales was assessed in a 2020 NRW report and then mapped (see Figure 8) in the NRW evidence report "Marine Protected Areas: Features at risk from marine invasive non-native species" (pending publication). The mapping shows that the risk to habitats from the Japanese oyster drill varies across Welsh waters. The main ecological and economic impacts are due to predation of oysters, and particularly young 'seed oysters' (from papers by Buhle (2009) and Lützen (2012)). Buhle found that per capita effects of invasive drills on native oysters (*O. lurida*) varied nonlinearly with native oyster density and with the density of nonnative alternative prey. Mytilus edulis are an alternative prey (Lützen). Predation on bivalve species, including consuming commercially and environmentally important biotopes and reef building species will impact all habitats characterised by these species with particular effects on bivalve reefs. Where mussels and oysters are not predated or are predated at low rates due to the size of mature individuals, consumption of juveniles preventing natural recruitment may over time

result in a loss of reefs. Impacts are assessed as ‘Moderate’ at low confidence with the potential for more severe impacts in the longer-term.

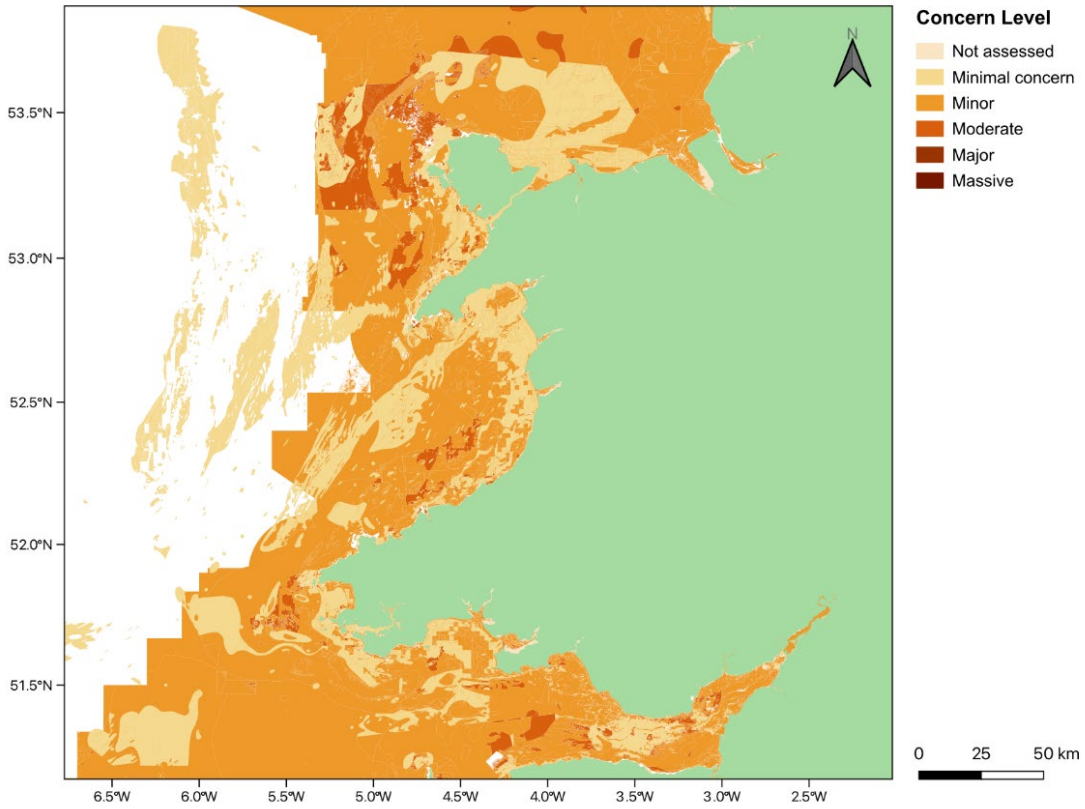

Figure 8. Habitat risk (concern level) from the Japanese oyster drill, Ocinebrellus inornatus, based on the assessment carried out in the NRW evidence report: ‘Assessing the impact of key Marine Invasive Non-Native Species on Welsh MPA habitat features, fisheries and aquaculture’.

INNS and the law

The following points provide a brief summary of relevant legislation (at time of writing):

- The Wildlife and Countryside Act 1981 makes it an offence to release or allow to escape into the wild any plant or animal which is not ordinarily resident in Great Britain (i.e. non-native) and is not a regular visitor to Great Britain in a wild state (i.e. migratory). Additionally, the American oyster drill is listed under Schedule 9 of the Wildlife and Countryside Act 1981 (WCA), for which the release of a listed species, even though they are already established in the UK, is also an offence.
- The Marine Strategy Regulations 2010 transpose into domestic law the EU Marine Strategy Framework Directive. The Directive aims to reduce human impacts on the marine environment, including INNS. The programme of measures is intended to reduce the introduction and spread of INNS. INNS pathway management helps to deliver the 2010 Regulations. Specific species, such as oyster drills, are not mentioned within the Regulations, but measures should be appropriate to their management.
- The Water Environment Regulations 2017 transpose into domestic law the EU Water Framework Directive. The Directive establishes a framework for national measures to achieve or maintain a good ecological status, including transitional and coastal waters. While oyster drills (or INNS at all) are not specifically mentioned within the 2017 Regulations they could affect the ecological status of waterbodies. Pathway management is a key aspect of managing the potential spread of INNS.
- Pathway management and the development of pathway action plans are specifically mentioned under the EU Regulation (1143/2014) on the prevention and management of the introduction and spread of invasive alien species. This regulation was retained in domestic law under the European Union (withdrawal) Act 2018 as the Invasive Alien Species (Enforcement and Permitting) Order 2019.

There are pathway-specific regulations that would relate to the movement of this species. Please see the relevant PAPs on the Wild Seas Wales website for more information.

Under the legislation and policy summarised above, the American and Japanese oyster drills have been assessed for the risks and impacts they pose to UK marine ecosystems and the associated economy. The outcomes of these assessments are listed in Table 3 and Table 4 below. The GB Non-native Species Secretariat (GB NNSS) commission and approve risk assessments of NNS to determine the risk of them entering, establishing, spreading and causing impacts in GB. These risk assessments support the Invasive Non-native Species Regulations and the wider GB legislative framework. Additionally, the Welsh Government's Marine INNS Priority Monitoring and Surveillance List for Wales summarises the INNS that are referred to directly in relevant legislation and/or their supporting documents. The list identifies INNS present in Wales and those that are horizon species. The document also includes an assessment of the risk posed by INNS in Wales (in terms of invasiveness, spread and impact), which draws upon risk assessments developed by the GBNNSS. Additionally, as previously described, the Japanese oyster drill is a GB Alert Species.

Table 3. Species impact and risk assessments for the American oyster drill.

Assessment	Legislative driver	American oyster drill assessment outcome
INNS prioritisation (according to invasiveness, impact and spread)	Marine Strategy Regulations 2010	UK Priority Species
WFD UK Technical Advisory Group classification of aquatic alien species (according to their impact level)	The Water Environment Regulations 2017	High Impact
GB NNSS risk assessment	The Invasive Non-Native Species Regulations 2019. Wider GB legislative framework.	Medium Risk Entry Risk = Very Likely Establishment Risk = Very likely Spread = Slow Impacts = Moderate
Marine Invasive Non-native Species Priority Monitoring and Surveillance List for Wales	Marine Strategy Regulations 2010	High Risk (surveillance list)

Table 4. Species impact and risk assessments for the Japanese oyster drill.

Assessment	Legislative driver	Japanese oyster drill assessment outcome
INNS prioritisation (according to invasiveness, impact and spread)	Marine Strategy Regulations 2010	UK Priority Species
GB NNSS risk assessment	The Invasive Non-Native Species Regulations 2019. Wider GB legislative framework.	Medium Risk Entry Risk = Mod. Likely Establishment Risk = Very likely Spread = Slow Impacts = Moderate
Marine Invasive Non-native Species Priority Monitoring and Surveillance List for Wales	Marine Strategy Regulations 2010	High Risk (surveillance list)

Challenges to control and eradication of oyster drills

1. Identification of the American and Japanese oyster drills can be extremely difficult. It can be time consuming and requires expert knowledge, which can result in delays to any form of rapid response.
2. Both oyster drills like to hide in crevices or under rocks, making detection incredibly difficult.
3. Eradication of an INNS in the marine environment is extremely difficult. It is more feasible to focus efforts on preventing the introduction of INNS (including oyster drills) to new locations, as much as is possible.
4. In the marine environment, control strategies that are undertaken to reduce the density of an INNS population can be both expensive and indiscriminately destructive, risking impacts to non-target species. Cost-benefit analyses must be undertaken in addition to considering the local ecosystem and minimising any impacts to protected species or sites. Habitat Regulations Assessments (HRAs) may be required for control strategies within European Marine Protected Areas.
5. Feasibility studies should be undertaken for potential control and eradication programs to assess the efficacy and impacts of different methodologies (see Table 6) and cases of control from elsewhere in the world.
6. More information is required on the conditions (physical, chemical and biological) that influence survival.
7. There are limitations and challenges for the enforcement, regulation and monitoring of national legislation and adherence to requirements.

Biosecurity to manage the oyster drills

The following sections present recommendations for actions that, if undertaken, will improve biosecurity in Welsh marine areas and, ultimately, reduce the risks posed to the environment and economy from the introduction and establishment of American and Japanese oyster drills.

Who are the key stakeholders?

Within the context of this SAP, a stakeholder is anyone who uses, benefits from or is responsible for (e.g., managing, protecting or regulating) the marine environment. Biosecurity to address the risk of the introduction of oyster drills requires engagement and action at national, regional and local scales by stakeholders including, but not limited to individuals, businesses, marina and harbour managers, statutory bodies, authorities (i.e., bodies with powers to introduce, amend and enforce regulations, legislation and policy).

For the successful implementation of the actions recommended in this SAP and across the biosecurity framework, stakeholders must work together to engage, support and secure resources where needed.

Examples of authorities and stakeholders are included below.

Authorities

- Government departments, organisations and agencies (e.g., Welsh Government)
- Regulatory bodies (e.g., Natural Resources Wales)
- The Fish Health Inspectorate
- County councils and local authorities
- National Park Authorities

National stakeholders

- Non-regulatory government bodies (e.g., Cefas)
- Management bodies for protected sites (e.g., National Trust)
- Environmental charities and Non-Governmental Organisations (NGOs) (e.g., the Marine Biological Society and Wildlife Trusts)
- Commercial operations governing bodies, organisations and groups (e.g., Aquaculture Wales, British Marine)
- Major landowners (e.g., the Crown Estate)
- Commercial fishing associations (e.g., Welsh Fisherman's Association, WFA-CPC)

Local stakeholders

- Regional fishery associations (e.g., Menai Strait Fishery Order Management Association)
- Local environmental groups
- Aquaculture site owners, managers and operatives
- Port authorities and commercial shipping operators (including dredge operators);
- Marina managers and harbourmasters
- Commercial boat businesses and operations (including shipping and dredging)
- Commercial fishers (including shellfish harvesters)

Recommended strategic actions for authorities

Table 5 contains a list of possible strategic actions which could be taken by national authorities. Achievement of these actions support a solid statutory basis for robust management of all INNS in Wales. However, it is acknowledged that any statutory changes require extensive and time-consuming legislative assessments and consultation which is at odds with the urgency required for pathway and INNS management at present. It is therefore recommended that these strategic actions act as long-term goals for authorities and that priority is placed on actions that can be undertaken and achieved on shorter timescales by all stakeholders (see Recommended actions for stakeholders).

Table 5. Recommended strategic actions for authorities to address the introduction and spread of marine INNS via all pathways in Wales. The ID letters SS (Species Strategic) denote that the actions are aimed at addressing the management of species, differing from the ID letters PS (Pathway Strategic) in the Pathway Action Plans (PAPs) that are aimed at addressing the management of pathways.

ID	Strategic action	Purpose
SS-1	**Develop a national (Welsh) position statement for key marine INNS**	The statement (and its guidance) should • Set out the position of the Welsh Government on pathway management and lay out a national approach for addressing key marine INNS. • Provide a clear objective for all marine stakeholders, supported through guidance and assistance where available. Top-down direction is a critical need for the facilitation of national, regional and local biosecurity planning. • Make it clear that improved biosecurity is the priority; however, also include goals in relation to surveillance and monitoring, early detection, rapid response and management. • Aim to clearly state what is expected of all stakeholders and provide realistic, measurable and agreed targets. The position should conceptually align with other GB strategies and existing regulation to ensure a consistent approach to INNS management throughout the British Isles. However, it must be grounded within a realistic Welsh focus, taking current limitations into account. To achieve the best outcomes, stakeholders should be consulted in policymaking, and policymakers should support the integration of industry expertise and experience into INNS management strategies.

ID	Strategic action	Purpose
SS-2	**Review existing legislation**	A review should be undertaken of current legislation relating to key INNS (and their pathways) to identify legislative gaps and highlight opportunities to strengthen INNS and biosecurity legislation. The review should identify primary legislation under which INNS management can be enforced (e.g., Wildlife and Countryside Act, 1981). The outcomes of this review could provide evidence, justification, and legislative support for national position statements or introducing / amending legislation relating to key INNS and their pathways in Wales.
SS-3	**Review and prioritise resource allocation in support of policy and legislation related to INNS**	Enforcement / enactment of existing and new policy and legislation should be considered. Resources, roles and responsibilities should be agreed and assigned to ensure that prioritised policy and legislation is being effectively enacted (e.g., provisions for enforcement officers to carry out inspections). Incentives for following legislation could be outlined in biosecurity-related award schemes or accreditations, which should be investigated, created and/or developed and endorsed by the Welsh Government or Natural Resources Wales. Penalties for offences could include fines or suspension of relevant licences as per The Invasive Alien Species Order 2019. Importantly, legislative policy needs to be clearly communicated to stakeholders.
SS-4	**Identify and prioritise high risk areas/locations for marine INNS introductions and impacts**	Species and pathway risk assessments are a valuable tool for identifying and prioritising high-risk locations and more effectively allocating resources. Data gathered from previous reports (e.g., NRW Report 459 and NRW evidence report "Marine Protected Areas: Features at risk from marine invasive non-native species" (pending publication) and information from the SAPs and PAPs in the biosecurity framework should be used to inform strategies for species and pathway management and surveillance. It is recognised that data used to inform pathway risk assessments is currently limited and further data collection is required.

ID	Strategic action	Purpose
SS-5	**Develop a national plan for monitoring marine INNS**	A national plan should develop a standardised approach to monitoring marine INNS and their pathways and implementing inspection programs in high-risk locations (see SS-4). The procedures within this plan should be applicable and practical at local, regional and national levels with provisions included for necessary resources or support required to undertake actions. The plan could be developed in consultation with stakeholder from all levels. A cost-benefit analysis could also be undertaken to ensure that the implementation of inspections will not damage Welsh businesses.
SS-6	**Continue to develop contingency plans for key marine INNS**	Contingency plans put forward protocols for situations when a new record of an INNS is made in an area it has not been previously recorded. This can include INNS that are new to Wales and INNS that are found in some regions of Wales but not others. The protocol typically involves contacting relevant authorities and taxonomic experts for positive identification, as well as putting in place rapid actions to contain the spread of the newly recorded INNS. General contingency plans for marine INNS have been developed for England by the GB NNSS and a general INNS contingency plan for Wales is in draft (at time of writing, June.2025).
SS-7	**National level curriculum**	Lobby the Department for Education to include information on INNS and biosecurity in the national curriculum. Advice should be provided for the development of appropriate materials.

ID	Strategic action	Purpose
SS-8	**Improve collaboration and links between stakeholders and authorities**	Invite stakeholders to participate in existing platforms and/or forums for ongoing communication, collaboration, and knowledge exchange, such as the British Ecological Society Invasion Science Special Interest Group (BES IS SIG). Platforms like this serve as a hub where researchers, policymakers, government agencies, industry representatives, and wider stakeholders come together to share expertise, data, and resources related to INNS management. Key features should include: 1. Regular meetings and workshops; 2. Agreements for data sharing and data integration; 3. Collaborative research, leveraging the expertise and experience of the industry; 4. Capacity building; and 5. Research and monitoring priorities communicated between stakeholders. Promote the Natural Resources Wales list of high priority evidence needs and research ideas page: Natural Resources Wales / Marine and coastal evidence priorities.
S S-9	**Improve national data flow**	Data flow is fragmented, data administration slow, and existing mechanisms for priority species reports reaching authorities are inconsistent, which may delay management response. Different recording schemes have variable verification and data upload timescales as well as variable data restrictions and some records are lost in the data flow process. Authorities should work with partners including The UK Centre For Ecology & Hydrology, The Marine Biological Association, The National Biodiversity Network and Local Environmental Records Centres to ensure records arrive at the appropriate destination in a timely manner and are accessible to all. This may include continuing work with Defra on their 'improving marine NIS data access and flow efficiency' project.

Recommended actions for all stakeholders

The sections below outline seven components of biosecurity focus for the Japanese and American oyster drills within Welsh marine areas. Stakeholder-specific guidance, including example actions for each, is provided to support the development of tailored actions. Stakeholders are encouraged to define their own biosecurity actions, appropriately scaled and proportional to their activities, using the guidance provided.

The components in this SAP are designed to complement those outlined in the PAPs and other SAPs. They can serve as a foundation for creating a new biosecurity plan or modifying and enhancing existing procedures. Following stakeholder engagement, high-level 'priority issues' have been identified for each component. These are intended to inform the initial context for developing tailored action for each component rather than represent specific objectives. Biosecurity implementation is an ongoing process. The components aim to support and sustain stakeholder-level actions over time.

A pathway-based approach to biosecurity is more robust and appropriate than a species-based approach as addressing a pathway will address all the species that might be moved via that pathway. However, species-specifics can still be considered and integrated into a BAP (or used in support actions from a PAP) for an area/site where the Japanese and American oyster drills have been identified as a high-priority species, either for its management or for the prevention of its introduction or spread.

These components are:

1. Understanding roles and legal responsibilities
2. Information, guidance and research on the Japanese and American oyster drills
3. Raising awareness
4. Biosecurity processes and procedures
5. Species management
6. Monitoring and reporting
7. Collaborative working

1. Understanding roles and legal responsibilities

To ensure that all stakeholders are aware of the relevant and current INNS legislation and national policy that relate to INNS.

PRIORITY ISSUE: There is a lack of clarity within stakeholder groups (for all pathways) the legal requirements for INNS management. Stakeholders require more guidance on how their activities intersect with INNS legislation, and what is required under current policy (if anything) to achieve compliance (i.e. voluntary vs. mandatory actions).

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	Authorities should produce a policy position or statement (see actions S1 to S4), relevant to existing or new INNS-focused legislation and regulation. This policy(s) should provide stakeholders with an improved understanding of how INNS legislation or regulation affects them. This needs to be communicated via an appropriate information cascade to include all relevant stakeholders. If legislation or regulation exists, but enforcement policy is undefined, it is recommended that stakeholders are still offered advice on this matter.	• Consult with relevant stakeholders on the implementation and feasibility of INNS focused policy. • Collaborate with industries to develop appropriate and achievable policy, without undue impact to Welsh blue growth and operators. • Ensure consistency with wider legislation and regulation (i.e. biosecurity with regards to animal health). • Establish a policy(s) for relevant regulation(s) and release a statement to provide stakeholders with a clear definition of what is expected under the legislation.

Responsible stakeholder	Guidance for Development of Actions	Example actions
National & local stakeholders	Official statements (as above) should be summarised and shared between relevant stakeholders, using plain, accessible language. Information could be included in newsletters or other communications to relevant stakeholders (e.g., updates from fishing or aquaculture associations) so that all stakeholders are aware of any legal responsibilities with regards to INNS. In cases where an authority-produced statement is unavailable, national and local stakeholders are encouraged to independently review the relevant regulation and provide advice to their members as appropriate.	• Issue a press-release that summarises current national policy, highlighting the requirements for compliance with the legislation or regulation • Include an overview of key INNS legislation and policy in e.g., public communications, employee information and other announcements.

2. Information, guidance and research on the oyster drills

To ensure that information and guidance on the Japanese and American oyster drills and relevant biosecurity within Welsh marine areas are consistent, high-quality and appropriate for all stakeholders and sectors.

PRIORITY ISSUE: Information resources for INNS and biosecurity awareness are abundant but can be fragmented, making it difficult for stakeholders to navigate and identify the most relevant and appropriate information, especially without a prior understanding of biosecurity.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	To improve INNS biosecurity in Welsh marine areas, authorities should consider creating/aligning a national-level marine INNS and biosecurity awareness raising campaign. This should provide common resources and consistent messaging for all marine stakeholders. Key highlights of the campaign could include: • A centralised location for biosecurity and INNS awareness-raising materials. While there is considerable existing material available for this action, ensuring a common repository and "endorsement" of primary materials will help stakeholders maintain consistency. A defined list of priority INNS of concern. • Publication of INNS alerts when a population is newly established or spreading. • Clear points of contact for stakeholders seeking support and advice. Factsheets should be created to raise awareness of the oyster drills among key stakeholders. The factsheets should contain information on the impacts the species causes and what actions can be / are being undertaken to minimise it's further spread. Existing species factsheets from the GB NNSS (American oyster drill, Japanese oyster drill) could be used as a basis for any Wales-specific resources. Factsheets should be developed in co-ordination with sector representatives to ensure that the information is relevant and outlines best practice. Language and writing style should be considered for different stakeholder groups / audiences – it is critical that information is presented appropriately and accessibly.	• Develop and update sector-specific factsheets on the Japanese and American oyster drills. • Produce training resources on the Japanese and American oyster drills that can be provided to other stakeholders. • Print (and disseminate) ID guides (such as the Welsh and English ID guide booklets produced by NRW) to as many relevant stakeholders as possible (e.g., local groups, aquaculture operations). (see useful resource). • Keep ID guides up to date, accounting for new and horizon INNS.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities continued	The fact sheets should be disseminated to key stakeholders in all parts of Wales, particularly to those undertaking any monitoring work. They should be made available on-line and in printed format to ensure consistency of messaging. A simple identification guide could also be included with instructions on how sightings (or suspected sightings) of the species should be reported. Species distribution maps for the where Japanese and American oyster drills are present may provide insight into where they may be at risk of spreading to. Pathway analyses and risk assessments should be carried out to identify hot spots (see recent, related work above). This, in turn, will allow for effective prioritisation of resources for biosecurity and surveillance.	• Map the distribution of Japanese and American oyster drills and carry out pathway analyses to facilitate resource prioritisation.
All Stakeholders	It is critical that authorities, as well as local and national stakeholders, take a holistic approach by integrating and co-ordinating their biosecurity activities. By doing so, they can ensure a cohesive and unified effort that builds on and enhances existing measures, maximising the effectiveness of INNS management across all marine pathways and action plans. All stakeholders should ensure that resources are appropriate for their sector, reviewing national guidance and tailoring outputs to reflect relevant operations and risk factors. Authorities could consider leading a consultation with other stakeholders on the production/review of these guidance documents. A simple presentation (e.g., PowerPoint slide pack) should be prepared and made openly available for all to use. The slide pack should contain a summary of key points on Japanese and American oyster drills identification, how it's introduced and spread, the impacts it has, and how it should be reported. A simple script or recording should be included in the notes section to aid presenters. Use should also be made of the Japanese	• Refine existing biosecurity guidance to increase relevance for different sectors. • Provide identification training aids for the oyster drills. • Undertake research to fill knowledge gaps in understanding of Japanese and American oyster drill risk factors.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All Stakeholders continued	and American oyster drill specimens that are included in the INNS kit from the National Museum of Wales, detailed in Useful Resources. Research councils (e.g. NERC, BBSRC) could be influenced to highlight oyster drill evidence gaps as a priority. Investigations should be undertaken in collaboration with universities and researchers to provide scientific robustness. These evidence needs should be noted in NRWs marine evidence needs process and flagged as potential collaborative university student projects.	See actions above.

3. Raising awareness

To facilitate and encourage the active sharing of information and guidance on the Japanese and American oyster drills among all stakeholders within Welsh marine areas.

PRIORITY ISSUE: Some stakeholders operating within Welsh marine areas are not aware of INNS (including the Japanese and American oyster drills) and their impacts, or what biosecurity is. All stakeholders would benefit from more exposure to INNS awareness raising activities. All stakeholders could also facilitate the spread of information and awareness raising about INNS and biosecurity.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	Authorities should ideally be a primary source for INNS and biosecurity information in Wales. Messaging should ensure that stakeholders are aware of critical information, such as updates to policies or species records/alerts.	• Issue regular updates/social media posts offering INNS and biosecurity advice. • Continue to engage with stakeholders • Include links or QR codes to online resources (including ID guides and factsheets) with communications. Where appropriate, stock / disseminate paper copies of resources.
All stakeholders	It should be noted that raising awareness actions are expected to overlap significantly across all marine PAPs, SAPs and BAPs. Therefore, it is critical that authorities, along with local and national stakeholders take a holistic approach by integrating/coordinating their biosecurity activities. By doing so, they can ensure a cohesive and unified effort that builds on and enhances existing measures, maximising the effectiveness of INNS management across all marine pathways and action plans. All stakeholders can play a role in raising awareness of INNS and biosecurity by promoting and disseminating existing information	• Engage in any national awareness raising campaigns such as Invasive Species Week. Use approved or provided biosecurity resources in communications and training. A marine INNS workshop kit comprised of preserved specimens and information sheets can be borrowed from Amgueddfa Cymru (see Useful resources).

Responsible stakeholder	Guidance for Development of Actions	Example actions
All Stakeholders continued	regarding INNS and key biosecurity messages. This could be achieved both digitally and in print. There is no requirement for burdensome changes to current activities, but consideration of INNS within outwards facing communications or marketing can benefit the sustainability of all activities within Welsh marine areas. The useful resources within this SAP include links to existing high-quality information sources which can be used as the basis for awareness raising. However, it is hoped that as national awareness increases, stakeholders will expand their knowledge and activities in this area, eventually producing their own tailored resources (where they have not already done so), further amplifying awareness and engagement. Developing awareness raising materials that highlight the economic and environmental risks of the Japanese and American oyster drills (based on the information provided in this SAP and the useful links) can provide targeted warnings for sector where the Japanese and American oyster drills would pose a significant problem (e.g., in shellfish areas); although, it is recommended that targeted awareness raising of individual species is created and disseminated in parallel with general INNS awareness raising. Biosecurity signage is known to be successful in raising awareness. Where appropriate (e.g., onshore aquaculture facilities, staging areas, launches etc.) signage can be installed in visible (to employees or the public) areas. Information contained within signage can range from general actions and national guidance to site specific biosecurity protocols, depending on the intended audience. Landowner permission should be considered (if applicable or required).	• Become familiar with the existing Japanese and American oyster drill guidance and resources. • Share information resources with other stakeholders as widely as possible. • Provide ad hoc information/facts on the oyster drills and INNS in general to staff, colleagues, members of the public etc. • Add in a link to biosecurity information on the GB NNSS website in staff updates. • Put up ID posters of the Japanese and American oyster drills on notice boards or at the site office with a QR code to the iRecord web browser and/or to more information. Install Check Clean Dry signs at equipment stores. • Integrate oyster drill information into education activities with schools or school-age groups (e.g., rockpooling trips)

Responsible stakeholder	Guidance for Development of Actions	Example actions
All Stakeholders continued	It is important to educate and enthuse younger generations on issues relating to INNS and biosecurity. Engagement with local schools or school groups to explore the most suitable way in which the topic of INNS and biosecurity can be incorporated into national education. Materials and resources produced as part of component 2 should be shared with educators. Marine INNS and biosecurity could be integrated in the Ocean Literacy Strategy for Wales 2025 project "Y Môr a Ni". This strategy should be promoted.	See actions above.

4. Biosecurity processes and procedures

To improve INNS biosecurity procedures, especially those which reduce the risk of introducing and spreading the Japanese and American oyster drills, being undertaken by stakeholders, ensuring consistency and efficacy.

PRIORITY ISSUE: Biosecurity may not be routinely undertaken by stakeholders and there is a perceived lack of appropriate guidance.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	A pathway-based approach to biosecurity, rather than a species-based approach, is often taken preferentially as it means that all species associated with that pathway can be managed at the same time. This can improve efficiencies in cost, time and effort. In this way, all stakeholders operating within the Welsh marine environment are encouraged to implement or enhance biosecurity procedures. However, biosecurity could also be prioritised in areas where the oyster drills are present. At the most basic, INNS biosecurity can be achieved simply through 'Check Clean Dry' procedures (see GB NNSS information). Codes for good practice in aquaculture have already been developed, e.g., the Code of Good Practice for mussel seed movements from the Menai Strait Fishery Order Management Association (MSFOMA) and the Best Practice Guidelines for Pacific Oyster Producers. There is a 2005 ICES Code of Practice for the introduction and transfer of marine organisms that should be followed. Additionally, guidance for the biosecure movement of oysters for native restoration programmes has been jointly developed by the Environment Agency and the Native Oyster Network. Best practice for marine sectors has been created as part of the RAPID LIFE project. Reviews and updates should be carried out with a process of consultation with aquaculture operators to ensure that codes of good	• Authorities could define and provide support to national and local stakeholders for the implementation of improved biosecurity. • Adhere to requirements for the movement of marine organisms. • Review and update existing codes of good practice (e.g., for aquaculture) • Develop codes of good practice for all activities/operations in the Welsh marine environment. • Consult and collaborate with all sectors to ensure best practice is encouraged and enabled. The onus should be placed on pragmatic changes to procedures which do not negatively impact Welsh blue growth or individual operators.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	practice appropriately reflect practical and operational conditions as well as implementing improvements to biosecurity. Continuous improvement should also be a priority. Updates do not need to be onerous or burdensome. Enhancements can leverage existing best practices, integrate example biosecurity actions (see Table 6), or adopt innovative approaches tailored by operators themselves. <u>Appointment of Biosecurity Managers or Champions</u> For operations of varying scales, Appointing a biosecurity manager or champion can be beneficial for the different sectors that are relevant to most pathways, keeping in mind the operational scale. This individual, equipped with relevant knowledge and a defined responsibility for biosecurity, can oversee and ensure that biosecurity actions are conducted appropriately and effectively for their site, business, or organisation. <u>Research and develop INNS management measures</u> Invest and participate in the development and testing of new methods and technologies to manage INNS. For example, working with a research body / professional.	• Regularly review emerging methods and technologies that offer INNS risk reduction. • Appoint a biosecurity manager or champion to act as a central point of contact for INNS related queries. • Consider collaborating with researchers to advance INNS management technologies. • Ensure innovative approaches and updated best practice is shared within the industry

5. Species management

To effectively prevent the introduction of or respond rapidly to a suspected sighting of Japanese and American oyster drills.

PRIORITY ISSUE: Coordination of prevention efforts and guidance for stakeholders could be improved, developed and shared among stakeholders.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	Coordination and guidance for stakeholders must be improved to ensure best practices are followed in all management efforts. For example, clear guidance should be provided on how biosecurity best practice and codes of conduct relevant to introduction pathways (e.g., the movement of aquaculture stock). Guidance on how to monitor and assess efficacy of procedures should also be considered. Funding sources for further research should be considered and shared, with research councils like NERC and BBSRC prioritising invasive species management. Collaborative projects with universities will ensure scientific robustness, and NRW's marine evidence needs process should highlight invasive species as a research priority. University student projects should be encouraged to address knowledge gaps. Regular reviews should assess progress, refine strategies, and integrate new research findings. A structured and collaborative approach will help mitigate the introduction risks of Japanese and American oyster drills, protecting marine biodiversity and economic interests.	• Conduct investigations into novel control methods and the efficacy of current methods for oyster drills • If possible, develop control plans for future rapid responses.

6. Monitoring and reporting

To establish facilitate the early detection of new introductions.

To ensure that Japanese and American oyster drill sightings are reported to an appropriate platform and records are included in national databases.

To ensure that up to date species distribution data is available to facilitate rapid responses to new oyster drill introductions or spread events.

PRIORITY ISSUE: INNS monitoring and surveillance are insufficient in certain regions, with stakeholders often unaware of what to report or where to report sightings. Additionally, data flow is fragmented, data administration slow, and existing mechanisms for priority species reports reaching authorities are inconsistent, which may delay management response.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	Monitoring of high-risk locations where the species is likely to be introduced will be essential in triggering a rapid response processes. Ideally monitoring should be of a consistent effort and persistent at a regional level for comparability between years. It is suggested that monitoring at locations considered as high risk should be funded to ensure quality and consistency. Citizen scientists, including individuals, NGOs, charities and local action groups should be engaged with and encouraged to report sightings of the Japanese and American oyster drills. As the oyster drills can be difficult to definitively identify, a robust monitoring strategy should include the training of more ID specialists. The NRW INNS identification guide (links in Useful resources) is clear and concise and includes information on how to report marine INNS. This guide should be disseminated and maintained to facilitate effective reporting.	• Promote and encourage the use of INNS reporting / recording platforms. • Check Welsh INNS biosecurity communications for opportunities to collaborate on monitoring efforts. • Consider proactive INNS monitoring through citizen science programmes. • Borrow the marine INNS workshop kit to run training in identification. The kit is comprised of preserved specimens and information sheets and can be borrowed from Amgueddfa Cymru (see Useful resources).

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	However, surveillance and reporting should still generally target all INNS and be coordinated at a national level rather than focusing on individual species. Although, providing awareness materials and supplementary oyster drill identification guides at high-risk locations, or in reference to high-risk operations, can support prioritised monitoring efforts. Although this component aims to increase the INNS monitoring and surveillance effort by stakeholders, it should be noted that INNS monitoring is multi-faceted and there is an expectation that authorities and local and national stakeholders should take an integrated approach to monitoring. By doing so, they can ensure a cohesive and unified effort that builds on and enhances existing programmes, maximising the effectiveness of monitoring across all marine pathways and action plans. Stakeholders who own or manage assets (e.g. aquaculture operators, local authorities etc.) should consider implementing regular monitoring for INNS/priority species. Monitoring can either be undertaken and reported by stakeholders individually or could be through a collaborative effort with other stakeholders, for example those in academia. It is best to use standard procedures for monitoring high-risk INNS. Procedures may be directed from a new national approach or from existing monitoring. The best approach to monitoring for current and horizon INNS is to employ multiple methods in tandem to achieve maximum coverage of habitat and species detection. Some of the monitoring methods that could be employed include: • Rapid Assessment Surveys (optimal for detecting fouling organisms but not for planktonic or soft bottom habitat species);	• Promote opportunities for integrated or collaborative INNS monitoring efforts. • Conduct regular monitoring for the oyster drills

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	• Environmental DNA (eDNA) (used to ascertain which species are present at a site using the genetic material that can be obtained from an environmental sample such as water). Stakeholders can contact NRW for guidance on monitoring INNS at their site at: invasive.non.native@naturalresourceswales.gov.uk Confirmed or suspected INNS should be reported. This improves INNS distribution knowledge and the ability to reduce the spread. Information on how and where to report sightings should be included in all biosecurity materials and resources. NRW recommend that INNS sightings should be reported to: • iRecord online [www.irecord.org.uk/]; and • iRecord App [available on Google Play]. Potential INNS sightings can also be reported directly to NRW at: invasive.non.native@naturalresourceswales.gov.uk Reporters should take photos and make a note of the sighting location (ideally GPS coordinates). If possible, they should take notes about the surroundings (e.g., substrate type, other species in the area, tidal height). The reporting platform should be mentioned / linked on educational materials, at workshops and in social media engagements (see Component 2).	See actions above.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	It has been recognised that the reporting of INNS sightings is not as efficient as it could be. Authorities should therefore engage with local groups, citizen science surveying groups (e.g., Seasearch), Local Environmental Records Centres (LERCs) and non-governmental organisations (NGOs) (e.g., Wildlife Trusts) to set up or improve data sharing links and ensure that sightings of high-risk species or new incursions of horizon species are passed to the relevant authority and acted on in a timely manner. This could involve establishing a list of National alert species and disseminating this list to all relevant parties (e.g., LERCs and NGOs). A critical analysis of the dataflow for national INNS records should be considered, with the primary aim to improve the consistency, accuracy and timeliness of reports. Making use of existing reporting channels used by operatives in key sectors is also encouraged. For example, the reporting of INNS, including oyster drills, could be facilitated on the commercial fishing reporting "Catch Recording App" to make it easier for fishers to log sightings. It is important to also have records of negative results so that a clear understanding of absence of the species as well as monitoring effort can be gathered. Records should be accurate, accessible, and up-to-date and be maintained regularly. Any records obtained from locations where the species has not previously been recorded should be verified and acted on rapidly, as prioritised nationally. While the method by which information is gathered will depend on reporting processes, it may be beneficial for authorities and key stakeholders to maintain a shared species-specific database/dataset containing, as a minimum, the NGR (or latitude and longitude), date and nature of the record.	• Undertake a critical analysis of the data-flow for national INNS reports. • Ensure that priority INNS reports are flagged with relevant stakeholders (e.g. iRecord species alert notifications).

7. Collaborative working

To improve the collaboration between all stakeholders within Welsh marine areas and foster open communication, build trust, and align on shared goals to drive effective outcomes. To cooperate in decision-making, share resources, and leverage the experience and knowledge of stakeholders to address challenges and achieve success together.

PRIORITY ISSUE 1 : Stakeholders remain uncertain about advancing biosecurity implementation without clear guidance and support from regulators and authorities. Top-down leadership and inter-stakeholder collaboration are crucial. Mechanisms for sharing information, practical advice, and bespoke guidance tailored to both national and local stakeholder needs must be developed and prioritised.

PRIORITY ISSUE 2: Opportunities for coordinated and collaborative working can be missed due to limitations in communication, leading to duplicated effort and gaps.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	All stakeholders should work to strengthen communication and collaboration mechanisms, ensuring that practical improvements, best practices and the expert knowledge of stakeholders are effectively shared and considered within national or regional biosecurity implementation. Open communication channels will facilitate the flow of information from authorities to stakeholders within key sectors (i.e., those whose operations may act as pathways of introduction and spread). Open channels will also facilitate the sharing of information from stakeholders to authorities. For example, Japanese and American oyster drill sightings in new areas.	• Engage in the biosecurity framework for Welsh marine areas in some capacity. • Consider mechanisms for collaboration and integration with other stakeholders and projects.
Authorities	Authorities could consider taking a leadership/coordinating role in this process by setting clear frameworks, facilitating dialogue, and ensuring that all voices are heard. Impartial guidance is critical in driving coordinated efforts, updates to national policy, maintaining transparency, and promoting a proportional approach.	• Ongoing stakeholder engagement to keep INNS at the forefront of stakeholders' activities and awareness. • Establish/task an existing working group with coordinating collaborative working.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities continued	Authorities should ensure close working and collaboration with relevant authorities (and other stakeholders) in England (e.g., the Environment Agency) and Europe.	• Engage and coordinate with stakeholders to monitor progress and assess future support needs

Control and management methods

Table 6 contains a list of control methods for the oyster drills that have been used elsewhere and identified from available literature. These methods may be employed to prevent the spread and reduce the abundance of INNS populations. **Inclusion in this table is by no means an endorsement of any of these methods as some methods listed below could have detrimental effects on the surrounding environment and wildlife. Any control action that is taken for the Japanese and American oyster drills should be done so following the direction, advice and approval from the relevant authorities.** There may be limitations to the application of any of these methods if being undertaken in a protected site (e.g., SSSI, SAC or MCZ) and appropriate disposal of Japanese and American oyster drill material and treatment waste should always be considered. Marine licenses and Habitat Regulations Assessments may also be required to undertake any of the following control methods.

Table 6. A list of control methods for oyster drills that have been utilised elsewhere and are reported in scientific literature. The references used can be found in the control and management table's references section of the bibliography.

ID	Action	Information
C-UC/OI-1	**Hand picking**	A process by which oyster drills are picked from the seabed or shellfish by hand. Control in localised areas can be relatively effective due to the lack of a free-swimming stage in the life cycle of oyster drills which limits it long-range spread, and its slow dispersal rate. Hand-pick oyster drills and their egg cases from shellfish in the intertidal. Focus the search on juvenile shellfish that are susceptible to being predated on and look under shells and objects where oyster drills may be sheltering. Hand-picking will only be effective if carried out on a regular basis. Bear in mind that shellfish could be damaged or pushed into the seabed due to trampling. Be particularly vigilant during the spawning season of the oyster drill when it can accumulate in large numbers and lays eggs (May and June). Picking eggs before they hatch (usually from July onwards) is important, since each cluster of eggs can produce hundreds of juvenile oyster drills. Thoroughly dry the eggs for 3-4 days to kill them and/or dispose of them on land. Adults are likely to be relatively resistant to desiccation due to their shell. Do not put eggs or adults back into the water.

ID	Action	Information
C- UC/OI -2	**Separate oyster drills from oysters using forks**	This process involves using forks to shake oyster drills from oysters on the deck of boats. Oysters can be thrown overboard with forks instead of shovel so that oyster drills pass through the tines onto the deck to be destroyed later.
C- UC/OI -3	**Separate oyster drills from oysters using deck screens**	This process involves using a mesh to separate oyster drills from oysters. Shovel infested oysters against a 25 mm mesh screen of double weight chicken wire, or against a horizontal perforated iron plate – oyster drills fall through the perforations. Exposure to air loosens the drills from the oysters making them easier to separate. Deck screens can be placed under the dredger roller, about 10 cm above the deck, so that in the process of culling or forking oyster drills fall through the screen and can be destroyed later. This method is reported as being more efficient than forking but less efficient than trapping.
C- UC/OI -4	**Raking oyster ground**	A process by which oyster drills can be gathered on oyster laying ground for disposal before oysters are planted. Rake the ground using a hand rake to collect oyster drills. Remove debris to maximise the surface area that can be raked and to reduce refuges for the oyster drills. Do this before seed oysters are planted on the ground.

ID	Action	Information
C- UC/OI -5	**Traps**	This involves the use of traps to collect oyster drills. Traps take advantage of the oyster drills' habit of gathering under objects and congregating on objects raised above the seabed. There are different trap designs which include: small concrete pillars, wire bags filled with shells, bunches of large shells and tin cans wired together. These are laid out in water attached to lines and buoys and fished every few days before traps are moved to new locations. Alternatively, half sections of drainpipes can be laid on the beach at low water of spring tides to attract oyster drills. Drills climb into the traps, particularly during the spawning season. 'Drill box traps' consist of a galvanised iron box into which oyster drills enter at the ends through special openings covered with hinged metal strips which swing inward only and prevent the escape of the drills. Seed oyster bait is placed in the centre of the box in a small screened contained. The trap can be left on the seabed for a month or more, although its efficiency is uncertain, and biofouling could reduce the functioning of the hinged doors. Trapping will be most effective during the breeding and egg laying period, from April to October. Regularly move traps to new areas.
C- UC/OI -6	**Osmotic stress**	A process which uses osmotic stress (detrimental hydration or dehydration of body cells due to salinity changes) to cause mortality. Place oyster drill-infested dredged oysters in large floats anchored for about 10 days in brackish water. This kills the oyster drills but not the oysters. Transplant oyster drill infested oysters to grounds overlain by relatively fresh water. Flood diked oyster beds with freshwater to kill unhatched oyster drills.

ID	Action	Information
C- UC/OI -7	**Sharply pointed objects**	The structural supports of equipment that raise shellfish off the seabed for cultivation (e.g., trestles) could be lined by a surface with sharp points. Use of the chestnut burr prevented oyster drill individuals from climbing since their soft foot could not move across such a surface.
C- UC/OI -8	**Bottom-towed dredging**	A process by which oyster drills are collected using a dredge that is towed on the seabed. Oyster drills and their eggs may be dredged alongside cultivated oysters and so can be hand-picked when the oyster haul is brought aboard. Smaller oyster drills will slip through the dredge mesh, so use as fine a mesh as practically possible. A dredge chain bag would let most oyster drills pass through. The dredge may be dragged through the water to wash (dock) it several times to rinse out mud, however this can result in the loss of the majority, if not all, oyster drills. Instead, docking of the dredge should be omitted and contents should be washed into a container using buckets before hand picking oyster drills. Dredging using a specialised perforated pan (a 'drill dredge') allows oysters to pass through but oyster drills to be obtained, although this may not work well in sediments with large amounts of clay that could clog the pan. Additionally, it can cause damage to oyster shells and so would be best used for bed preparation before subsequent planting, after harvesting. If oysters are to be returned to the water after dredging this could remove much of their new growth and so prolong the time required to market the crop and subjecting the oysters by more attack from the oyster drills. The optimum time for dredging for oyster drills is in the spring. In the winter, a large proportion of the oyster drills may be buried in the seabed and those buried in small depressions would be missed by the dredge.

ID	Action	Information
C- UC/OI -9	**Biocontrol**	A process by which oyster drill predator densities are increased to cause mortality. This method may be difficult to implement as oyster drills do not have many predators. Crabs predate on oyster drills but usually prefer juveniles and may predate on shellfish (in addition to the oyster drill). It is not known if parasites cause significant mortality, but they probably impede development and growth.
C- UC/OI -10	**General practice for oyster farms**	Avoid stock transfers from areas known to have American or Japanese oyster drills. Follow guidance on stock transfers (e.g., ICES Code of Practice) and thoroughly check all new stock before laying (on beds or in trestles). Where possible, avoid laying new shellfish seed (juveniles) on cultivation beds or in trestles during the spawning season of oyster drills (May and June), especially if oyster drills are known to be in the area. Cultivate older (larger) shellfish that are less susceptible to predation. Remove unused hard objects and shells from the grounds as oyster drills may accumulate underneath them. Dry this material onshore, well away from the shoreline where sting winkles could migrate back into the sea. Line the edges of oyster beds or areas of oyster trestles with traps, and bare ground consisting of fine sediment, to act as barriers to oyster drill migration. Grow oysters on trestles (raised above the seabed).

Useful resources

- GB NNSS American oyster drill risk assessment
- GB NNSS American oyster drill Information Portal
- CABI Compendium American oyster drill information page
- Global Invasive Species Database American oyster drill fact sheet
- GB NNSS Japanese oyster drill risk assessment
- GB NNSS Japanese oyster drill Information Portal
- CEFAS Japanese oyster advice note
- Global Invasive Species Database Japanese oyster drill fact sheet
- European Native Oyster Restoration Handbook (see Chapter 4)
- Menai Strait Fishery Order Management Association (MSFOMA) Code of Good Practice
- Irish Best Practice Guidelines for Pacific Oyster Producers
- ICES Code of Practice on the Introductions and Transfers of Marine Organisms 2005
- Natural Resources Wales report on the impacts of marine INNS on MPA features
- Welsh marine INNS priority list
- Natural Resources Wales marine INNS guide in Welsh
- Natural Resources Wales marine INNS guide in English

- Links to Pathway Action Plans (PAPs) and other Species Action Plans (SAPs):

  Links to the action plans listed below can be found on the Wild Seas Wales website:

  - Chinese mitten crab, *Eriocheir sinensis* SAP
  - American slipper limpet, *Crepidula fornicata* SAP
  - Trumpet tubeworm, *Ficopomatus enigmaticus* Species Action Plan
  - American oyster drill, *Urosalpinx cinerea*, & Japanese oyster drill, *Ocinebrellus inornatus* SAP
  - Recreational Boating (large boats) PAP
  - Recreational Boating (small boats) PAP

- Recreational Activities PAP
- Commercial Shipping PAP
- Aquaculture PAP
- On-shore Fishing PAP
- Boat-based Fishing PAP

- **Marine Invasive Non-Native Species (INNS) Kit for Wales**

This kit was created with funding from European Maritime and Fisheries Fund and with support from NRW, Aberystwyth University and Wales Wildlife Trust. It is loosely based on the MBA's (Marine Biological Association, Plymouth) kit that was borrowed for an INNS workshop by the stakeholders in October 2022 and it was agreed that a kit for Wales would be useful. This kit can be borrowed as a whole or divided up into major groups and one part loaned out.

The kit consists of the following major groups:

- Algae (Seaweeds)
- Molluscs
- Sea Squirts
- Bryozoans
- Crustaceans
- Other (Polychaetes, and anemone)

The kit may be borrowed by anyone who is running a supervised workshop for adults and it is an excellent way to train recorders who are looking out for Invasive Non-Native Species. It is free to borrow, but courier or transport costs, must be paid for.

It includes specimens, images, distribution data and species information that are included with each group of the kit. Images of the kit are included in the following pages along with approximate dimensions of it as a whole and divided into its separate subject groups.

To borrow the kit or any aspect of the kit please contact Anna Holmes (anna.holmes@museumwales.ac.uk).

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