



Invasive Non-native Species Pathway Action Plan: Commercial Shipping in Wales



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APEM Ltd. and Natural Resources Wales

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Crynodeb gweithredol

- Mae [rhywogaethau estron goresgynol](#) yn rhywogaethau o blanhigion, anifeiliaid neu bathogenau nad ydynt i'w cael yn naturiol mewn ardal ond sydd wedi cael eu symud yno, gan weithgareddau dynol (naill ai'n ddamweiniol neu'n fwriadol) ac sy'n achosi effeithiau amgylcheddol, cymdeithasol neu economaidd sylweddol. Rhai o effeithiau rhywogaethau estron goresgynol yw eu bod yn cystadlu'n llwyddiannus â rhywogaethau brodorol am fwyd a gofod, eu bod yn newid cynefinoedd, lledaenu clefydau ac achosi costau uniongyrchol ac anuniongyrchol i economïau lleol a chenedlaethol.
- Mae symudiad (h.y. cyflwyno a lledaenu) rhywogaethau estron goresgynol yn cael ei hwyluso gan drywyddau a gweithgareddau dynol o'r enw "[Llwybrau](#)", er enghraifft, morgludo, defnyddio cychod hamdden a dyframaethu.
- Mae morgludiant yn cael ei gydnabod fel un o'r llwybrau arwyddocaol ble caiff rhywogaethau estron goresgynol eu cyflwyno a'u lledaenu, gyda photensial i weithgareddau morgludo symud anifeiliaid (ar ffurf wyau, larfâu, anifeiliaid ifanc ac oedolion) a gwymon (fel darnau neu sborau).
- Gall rhywogaethau estron goresgynol gael eu cyflwyno a'u lledaenu drwy gyfrwng biolygredd ar gyrff llongau, dŵr balast a gwaddod balast, llygredd mewn tanciau, organebau'n cael eu dal mewn mecanweithiau llongau ac o fewn cargo.
- Fel arfer ceisir mynd i'r afael â lleihau effaith rhywogaethau estron goresgynol drwy gyfrwng ymdrechion i atal eu lledaeniad ar lefel y 'llwybr'.
- Mae deddfwriaeth a pholisi yn ymwneud â chyflwyno a lledaenu rhywogaethau estron goresgynol yn bodoli yng Nghymru.
- Mae amcanion y Cynllun Gweithredu Llwybr (PAP) hwn fel a ganlyn:
 - Amlinellu'r risgiau bioddiogelwch o ran rhywogaethau estron goresgynol sy'n gysylltiedig â'r llwybr morgludo masnachol.
 - Nodi rhywogaethau estron goresgynol morol allweddol sy'n gysylltiedig â'r llwybr morgludo masnachol.
 - Darparu cyfres o [gamau gweithredu graddadwy](#) i randdeiliaid amgylchedd morol Cymru y gellid eu rhoi ar waith ble mae morgludo masnachol yn digwydd.
- Rhanddeiliaid yw'r rhai sy'n defnyddio, yn elwa o, neu sy'n gyfrifol am (e.e. rheoli, amddiffyn neu reoleiddio) yr amgylchedd morol. Yma, mae hyn yn cynnwys cyrff statudol ac awdurdodau perthnasol, awdurdodau harbwr a harbwrfeistri, busnesau morgludo masnachol a rheolwyr safleoedd, a'r rhai sy'n ymwneud â gweithrediadau morgludo masnachol ar gyfer y llongau a restrir isod.
- Y bwriad yw y bydd y PAP hwn yn berthnasol i forgludo masnachol ar draws holl ardaloedd morol Cymru, gan gynnwys, ond heb fod yn gyfyngedig i'r canlynol:
 - Llongau cargo a llongau cynwysyddion;
 - Llongau swmp a thanceri;
 - Llongau cludo teithwyr, fferïau ceir a llongau mordeithio; a
 - Llongau eraill a ddefnyddir at ddibenion masnachol gyda chapasiti storio dŵr balast.
- Mae'r PAP hwn yn amlinellu saith cydran ffocws bioddiogelwch ar gyfer y llwybr morgludiant o fewn ardaloedd morol Cymru:

1. [Deall rolau a chyfrifoldebau cyfreithiol](#)
 2. [Hyrwyddo gwybodaeth ac arweiniad ar rywogaethau estron goresgynnol a boddlogelwch](#)
 3. [Codi ymwybyddiaeth](#)
 4. [Prosesau a gweithdrefnau boddlogelwch](#)
 5. [Cyfleusterau boddlogelwch](#)
 6. [Gwyliadwriaeth ac adrodd](#)
 7. [Gweithio ar y cyd](#)
- Y bwriad yw i'r cynllun hwn gael ei ddefnyddio i gefnogi'r [Cynlluniau Gweithredu Rhywogaethau \(SAP\)](#) a'r [Cynlluniau Gweithredu Boddlogelwch \(BAP\)](#) cysylltiedig.

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, 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. the introduction and spread) of INNS is facilitated by human mediated routes and activities called “[Pathways](#)”, for example, shipping, recreational boating and aquaculture.
- Shipping is recognised as a significant pathway for the introduction and spread of INNS, with potential for shipping activity to move both animals (as eggs and in their larval, juvenile and adult life stages) and seaweed (as fragments or spores).
- INNS can be introduced and spread via biofouling on the hulls of vessels, ballast water and ballast sediment, internal tank fouling, organisms being caught up in vessel mechanisms and within cargo.
- Reducing the impact of INNS is commonly approached through efforts to prevent their spread at the pathway level.
- Legislation and policy related to the introduction and spread of INNS exists, covering both general activities and activities specific to commercial shipping.
- The objectives of this Pathway Action Plan (PAP) are to:
 - Outline the INNS biosecurity risks associated with the commercial shipping pathway.
 - Identify key marine INNS associated with the commercial shipping pathway.
 - Provide stakeholders of the Welsh marine environment with a [series of scalable actions](#) that could be implemented where commercial shipping occurs.
- Stakeholders are those that use, benefit from or are responsible for (e.g. managing, protecting or regulating) the marine environment. Here, this includes relevant authorities and statutory bodies, harbour authorities and harbour masters, commercial shipping businesses and site managers, and those involved in commercial shipping operations of the vessels listed below.
- This PAP is intended to be applicable to commercial shipping across all Welsh marine areas, including, but not limited to:
 - Cargo ships and container ships;
 - Bulkers and tankers;
 - Passenger carriers, car ferries and cruise ships; and
 - Other vessels used for commercial purposes with ballast water storage capacity
- This PAP outlines seven components of biosecurity focus for the commercial shipping pathway within Welsh marine areas.
 1. [Understanding roles and legal responsibilities](#)
 2. [Information and guidance on INNS and biosecurity](#)
 3. [Raising awareness](#)
 4. [Biosecurity processes and procedures](#)

5. [Biosecurity facilities](#)
6. [Monitoring and reporting](#)
7. [Collaborative working](#)

- This PAP is intended to be used in support of the associated [Species Action Plans \(SAPs\)](#), 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 Pathway Action Plan outlines actions and guidance to support stakeholders with their biosecurity efforts, with the aim of making Welsh marine commercial shipping more sustainable.

It is acknowledged that no single activity is solely responsible for the spread of INNS and all users of the marine environment are encouraged to take the time to understand more about this threat and how they can contribute to tackling it.

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 boat hulls, 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 Eschen paper](#)).

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 (their reproductive structures). 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 to a wider area (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 other Welsh Pathway Action Plans. Links can be found on the [Wild Seas Wales website](#).

Vectors are the specific, discrete parts of a pathway (i.e. the means within a pathway) that facilitate the movement of INNS from one location to another. Vectors within the shipping pathway could include ballast water, ballast sediment and INNS fouling the vessel hull. 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.

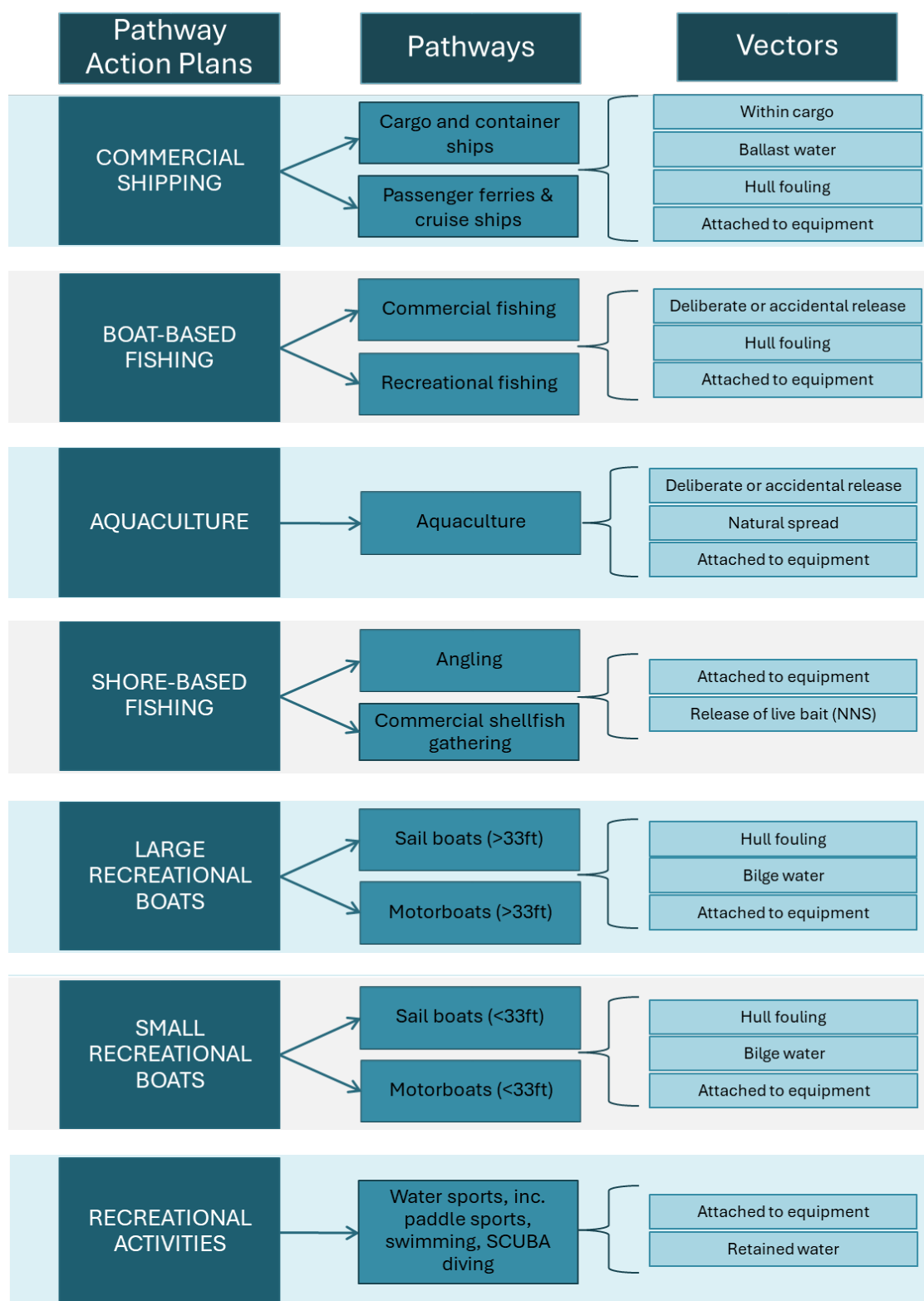


Figure 1. An overview of the Pathway Action Plans that have been developed for Wales, and the vectors associated with the pathways. Note that the list of vectors is not exhaustive.

What is biosecurity?

Biosecurity measures are actions, procedures and behaviours put in place to reduce the risk of INNS introduction and spread into, 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. This is especially true in the marine environment, where eradication is near impossible once INNS become established.

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

This Pathway 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 and can be scaled as appropriate. A BAP can be produced for a whole region (i.e. as has been done for the Pembrokeshire Marine, Cardigan Bay, Menai Strait and Conwy Bay and Carmarthen Bay and Estuaries 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. Individual site level BAPs were not developed as part of this project, however, the information within this PAP (and the other PAPs and SAPs) could be used to produce one.

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 harbour) 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 commercial shipping operators to consider the benefits of improved biosecurity to both the sustainability and profitability of the industry.

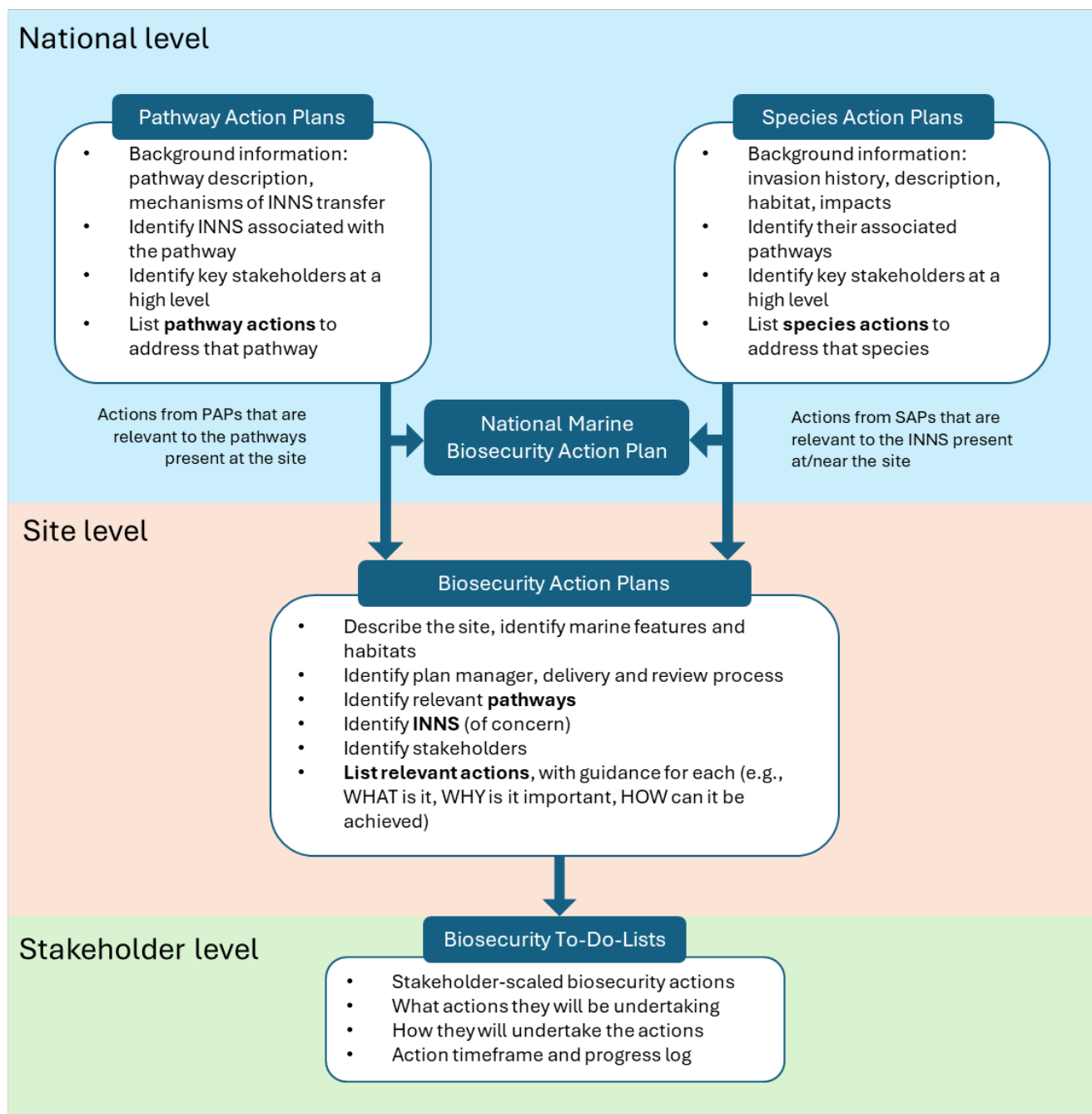


Figure 2. A flowchart showing the relationships between the Pathway Action Plans, Species Action Plans and the Biosecurity Action Plans created for the Natural Resources Wales Biosecurity Planning Project with APEM Ltd.

Scope, aims and objectives

Scope

This Pathway Action Plan (PAP) is intended to be applicable to commercial shipping across all Welsh marine areas. Here, commercial shipping operations include, but are not limited to the use of:

- Cargo ships and container ships
- Bulkers and tankers
- Passenger carriers, car ferries and cruise ships
- Other vessels used for commercial purposes with ballast or hopper water storage capacity.

Note that commercial fishing vessels are covered under a [separate PAP which can be found on the Wild Seas Wales website](#).

This document, and the biosecurity measures outlined within it, are intended to be applicable to commercial shipping operators, commercial shipping authorities, port authorities, regulators and relevant wider stakeholder groups. Please see [Key stakeholders](#) for more information. The actions encompass several dimensions of INNS management for the pathway 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
- National policy and regulatory frameworks

Aim

The overall aim of this PAP is to reduce the risk of the introduction and spread of marine INNS via commercial shipping.

This document aims to complement the existing national approach to biosecurity ([for further information legislation](#)), providing commercial shipping-specific information to aid a pathway-based approach to biosecurity. It also seeks to put forward actions that can be applied at national (Welsh), regional and local levels. The goal is to use existing communications and 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 pathway across Wales.

Objectives

- Outline the biosecurity risks associated with commercial shipping.
- Identify marine INNS associated with the commercial shipping pathway.

- Provide a list of clear and practical biosecurity actions to address the pathway. These can subsequently be appropriately scaled and applied to a specific site and its stakeholders.

The commercial shipping pathway

Commercial shipping is important for maintaining the movement of goods and supporting international trade, with over 80% of global trade (by volume) carried by sea (according to [UN Trade and Development](#)). In Wales, commercial shipping is important for the import of liquid bulk, dry bulk and general cargo, in particular, fuel imports through the Port of Milford Haven. Freight statistics can be found on the UK Department for Transport [Maritime statistics: interactive dashboard](#) and outcomes from a Welsh pathway mapping project can be found in [Useful resources](#).

In the marine environment, commercial shipping is recognised as a significant pathway for INNS introduction and spread on a global, regional and local scale. This is attributed to the movement of animals (as eggs and in their larval, juvenile and adult life stages) or seaweed (as fragments or spores) being transferred by vessels. As a result, the ports and harbours that host commercial shipping operations are generally known to be hotspots for marine INNS.

There are multiple vectors associated with the commercial shipping pathway. These include:

- biofouling on the hulls of vessels and hard to reach areas;
- ballast water and ballast sediment;
- internal tank biofouling;
- organisms caught up in vessel mechanisms (e.g., propellers, anchors, anchor chains); and
- cargo (more often associated with the transfer of terrestrial INNS, so not covered here).

Biofouling

Biofouling (or biological fouling) is the accumulation of marine organisms (plants, animals, bacteria and their detritus), including INNS, on underwater surfaces. This includes all surfaces and hard to reach areas and crevices that are in contact with the water. Common hard to reach areas that risk harbouring INNS, as seen in Figure 3 include sea chests and sea chest gratings, intake and outflow pipe openings, and the rudder and rudder shaft/recess. In the marine environment, common biofouling organisms include sea squirts, barnacles and sponges.

The first stage of fouling is the formation of a biofilm on the surface which is a thin layer of microalgae, bacteria and small particles. The presence of this biofilm facilitates the further colonisation of the surface by other marine organisms. It is important to note that the species found on a hull (or other underwater surfaces) are not necessarily INNS, but

there are many INNS known to accumulate as biofouling or live among biofouling organisms.

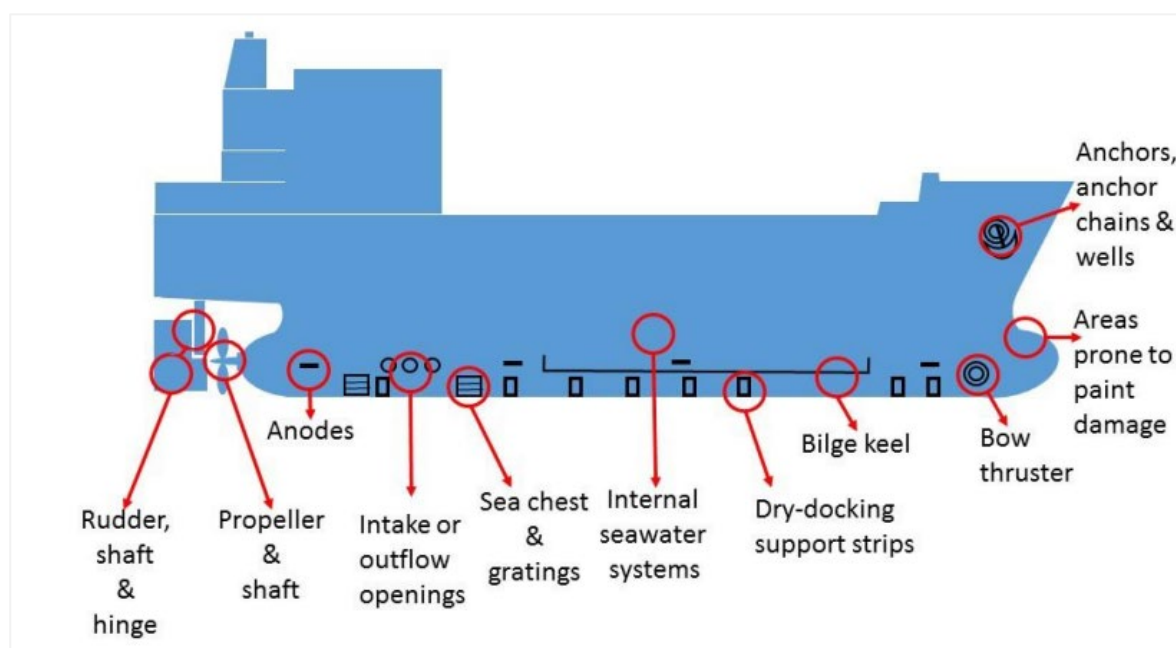


Figure 3. Hard to reach areas where biofouling can accumulate. Source: Ministry for Primary Industries and licensed by MPI for re-use under the Creative Commons Attribution 4.0 International licence.

Biofouling can especially accumulate if a vessel remains static in the water for a prolonged period of time, for example, moored at a port or harbour for weeks to months. If the vessel is then moved or travels to a different location without first being cleaned, the species that have accumulated on the vessel can then spread to this new location. Even vessels with antifouling paints or coatings are at risk of INNS colonisation if left stationary for long periods of time. This is because some INNS (e.g., the red ripple bryozoan, *Watersipora subatra*) are resistant to the toxic effects of antifouling coatings. Figure 3 shows the areas on a vessel where INNS can accumulate.

If the boat is cleaned in the water (for boats with more than just a biofilm/slime layer) or is lifted and cleaned but the debris is washed back into the water, there is a risk that the organisms in that biofouling community, including any INNS, may survive and be able to establish in that area.

The level of hull fouling can be graded/ranked based on the amount and coverage of the fouling visible. Table 1 shows information from a 2006 paper that outlines a ranking system for hull fouling which can be used for reference when undertaking inspections of vessels. Similar hull fouling ranking has been employed in other biosecurity inspection programs.

Table 1. Hull fouling ranking from Ashton, G.V., Boos, K., Shucksmith, R. and Cook, E.J., 2006. Risk assessment of hull fouling as a vector for marine non-natives in Scotland. Aquatic Invasions, 1(4), pp.214-218. *biofilm: thin layer of bacteria, microalgae, detritus and other particulates.

Rank	Description	Visual estimate of biofouling cover
0	No visible fouling. Hull entire clean, no biofilm* on visible submerged parts of the hull.	Nil
1	Slime fouling only. Submerged hull areas partially or entirely covered in biofilm, but absence of any plants or animals.	Nil
2	Light fouling. Hull covered in biofilm and 1-2 very small patches of one type of plant or animal.	1-5% of visible submerged surfaces
3	Considerable fouling. Presence of biofilm, and fouling still patchy, but clearly visible and comprised of either one or more types of plant and/or animal.	6-15% of visible submerged surfaces
4	Extensive fouling. Presence of biofilm and abundant fouling assemblages consisting of more than one type of plant or animal.	16-40% of visible submerged surfaces.
5	Very heavy fouling. Many different types of plant and/or animal covering most of visible hull surfaces.	41-100% of visible submerged surface

Sea chests and other hard to reach areas are less easily managed with respect to biofouling due to their size, design and location. Antifouling coatings are most effective on flat surfaces that are exposed to water movement (i.e., while underway). The recessed nature of these areas means that the variable flow conditions experienced are often not sufficient to remove fouling organisms. Fouling organisms might also settle and accumulate on any surfaces without antifouling coating/paint (e.g., dry-docking support strips) and areas where the paint or coating has been damaged.

Ballast water and sediment

Ballast water is taken up and stored in ballast tanks onboard vessels to stabilise them while underway. Until recently this water was released, without restrictions, at the destination port along with any organisms or propagules (eggs or fragments) that had been taken up at the source port. As per the Ballast Water Management Convention (BWMC, see [Legislation](#)), which came into effect in 2022, ballast water from applicable vessels must either be exchanged in designated areas offshore (or at least 200 nautical miles from the nearest land and in water at least 200m deep) or treated to remove or kill any organisms that may be present. Ship-board treatment methods include mechanical means (e.g., filtration or cyclonic separation), UV application, high-energy treatment (e.g., using microwaves, ultrasound or heat) and chemical application (e.g., adding

biocides, chlorination or deoxygenation). Treatment systems often combine multiple methods to increase efficacy. Ballast water can also be managed port-side where it is removed, treated in port-side facilities and either returned to the vessel or released into the sea.

When ballast water is brought onboard, any sediments that are suspended in the water are taken up as well. These mainly consist of clay, silt and sand. Once in the ballast tanks, these sediments settle on to the tank bottom. Although conditions may not be favourable for the survival of many species (due to darkness and changes in water temperature) the sediment may provide a habitat for some of the organisms that survive the ballasting process. Surveys have reported the presence of a variety of organisms in different life stages (e.g., the resting, cyst stage for phytoplankton which can survive in sediments for several months or years) within the sediment. During ballast water exchange (or treatment) and de-ballasting, only a part of the sediment will be discharged and so the sediment layer can accumulate over the time that the vessel is operational. The removal and proper disposal of ballast sediment is therefore also included in the BWMC and provisions must be made for facilities at receiving ports.

Under the guidelines of the BWMC and the associated domestic legislation, there are conditions that must be met for ballast water to be released in the destination port. If the ballast water has been exchanged, 95% of the tank volume must have been replaced, or three times the tank volume must have been pumped through the tank. If the ballast water has been treated, there are maximum numbers of large ($>50\mu\text{m}$) and small ($10\mu\text{m}$ to $50\mu\text{m}$) viable organisms permitted and maximum units of *Vibrio cholera*, *E. coli* and intestinal *Enterococci* permitted. These standards are also applied to any ballast sediments that are released.

Internal fouling and equipment

Internal tanks and pipes which may not typically be treated with any antifouling paint or coating, can be fouled by organisms that are able to grow in these relatively inhospitable conditions (e.g., dark and with variable temperatures). These organisms may then produce propagules (eggs or fragments) that may be released during vessel operations.

Equipment that is periodically used in the water (e.g., chains, anchors, fenders, ropes, warp and tenders/sea vessels) can also act as potential locations for INNS to stowaway. For example, seaweed mats may become entangled in the anchor chain while the vessel is waiting to enter the port. Equipment that is brought aboard and left damp on the deck or stowed away in anchor lockers can provide a surface on which INNS can survive and then be subsequently spread to a new area when the equipment is used again.

How do INNS impact commercial shipping?

INNS can have a range of negative impacts to local ecosystems, from smothering native species to altering habitats. Although commercial shipping stakeholders should implement procedures which protect the marine environment from the negative impacts from INNS, operators should also be concerned about INNS disrupting the efficient functioning of their vessel(s). The impacts of INNS on commercial shipping may be extensive and varied and include the following:

- **Increased drag and reduced efficiency:** INNS can attach to hard substrate in high densities, impacting normal usage. On vessel hulls, high densities of biofouling can result in increased drag when underway, incurring higher fuel needs and costs for cleaning. The international maritime organisation estimates that biofouling can increase fuel use by up to 40%, representing a considerable increase to an operator's carbon footprint and costs. Biofouling management is, therefore, recognised as an effective tool to enhance energy efficiency and reduce emissions.
- **Damage to vessels:** Some INNS, like the trumpet tubeworm (*Ficopomatus enigmaticus*), can cement themselves to hulls and submerged metal vessel parts (e.g., propellers), requiring time-consuming and costly removal. Removing such hard fouling species can cause significant damage to paints, coatings and hard structures, such as the hull or propellers substructure. The trumpet tubeworm (among other species) has also been reported blocking submerged in-flow/out-flow pipes.
- **Increased infrastructure maintenance costs:** High densities of INNS in ports and harbours can result in the need for increases in cleaning and maintenance which may incur significant costs for harbour authorities.
- **Denial of entry to ports:** The implementation of the BWMC also provides the mechanism for punitive measures to be imposed against applicable vessels/operators which do not comply with the standards of the Convention. Although there is clause in the Convention's guidelines to prevent *undue delay* to a vessel, it is possible that noncompliant vessels will be denied entry to a port and/or instructed to bear the cost of port-side ballast water treatment.



Photo credit: David Tjokrorahardjo, [CC BY-SA 4.0](#), via Wikimedia Commons

Relevant INNS for commercial shipping

The tables below present INNS that are likely to spread via commercial shipping. Table 2 describes High and Medium risk INNS from the [Welsh Priority Monitoring and Surveillance List](#) (WPMSL) that are known to be present and breeding in Wales. Table 3 describes INNS that are not currently recorded as present in Wales (known as horizon species) but should be monitored for. It is important to identify species that may be on the horizon so that appropriate biosecurity actions can be put in place to prevent their introduction, or surveillance programmes can be implemented to aid timely detection and response. Some species are on the horizon for the UK and some are on the horizon for Wales. These species represent some of the most likely to be transported via commercial shipping. Note that this is not an exhaustive list, as there are other INNS known to be transported by commercial shipping that are not listed as High or Medium risk on the WPMSL.

The current distributions of INNS around Wales (and the UK more broadly) can be viewed by searching the database and maps on the [National Biodiversity Network Atlas](#) (NBN Atlas).

An overview of the different lists of INNS that are of interest to Wales can also be found on the [NBN Atlas](#). The current distribution of INNS included on those national lists can be found on the [Wales INNS Portal](#).

Further information and links to resources developed to aid identification of INNS are available below. Further species-specific information is also available from the searchable GB NNSS [Information Portal](#).

Table 2. High and Medium risk INNS established in Wales that are likely to spread via commercial shipping.

INNS name	Potential impacts	Image	Additional information
Trumpet tubeworm (<i>Ficopomatus enigmaticus</i>)	Major fouling organism on artificial surfaces & is a nuisance in ports & marinas where it clogs pipes & blocks tide-gates; ecosystem engineer.	 Photo credit: Cricket Raspet [CC BY, via iNaturalist]	Adults can foul hard to reach areas such as water inlets/outlets and sea chests; larvae can be carried in ballast/bilge water/sediment. Planktonic larval stage 1-3 months (high dispersal risk). Minimum water temperature of 18°C needed for reproduction. Wide salinity tolerance (1.6-55 ppt) but preference for brackish environments. For further information see the GB NNSS Information Portal and NBN Atlas. A link to the Species Action Plan can be found on the Wild Seas Wales website.

INNS name	Potential impacts	Image	Additional information
Red ripple bryozoan (<i>Watersipora subatra</i>)	Tolerant of copper and mercury in antifouling paint, thus easily foul vessel hulls; replaces similar native species through competition; increases habitat complexity, facilitating colonisation by other INNS.	 Photo credit: Jacqui Geux [CC BY, via iNaturalist]	Adults can foul surfaces such as the hull, keel & rudder; adults foul niche areas such as the sea chest and intake pipes; Problematic because <i>W. subatra</i> is resistant to most antifouling paints, thus providing non-toxic points of attachment for other organisms. Short free-swimming larval stage (less than 1 day) so natural dispersal risk is low. Wide temperature tolerance (12-28°C) and salinity range (25-49ppt) For further information see the GB NNSS Information Portal and NBN Atlas.

INNS name	Potential impacts	Image	Additional information
Carpet sea squirt (<i>Didemnum vexillum</i>)	Major fouling organism on artificial and natural surfaces; potentially decreases local biodiversity due to competition for resources; smothers substrate (including other species) and its acidic surface hinders settlement on it by other species. Costly to other sectors, including the aquaculture industry.	 Photo credit: Javier [CC BY, via iNaturalist]	Adults' foul flat surfaces such as the hull, keel & rudder; adults foul niche areas such as the sea chest and intake pipes; adults can also grow over the existing fouling community; small fragments can be transported in ballast/bilge water. Larvae are planktonic for a few hours (low dispersal risk). Fragments are viable for up to 30 days (high dispersal risk). Tolerant to temperatures between 2-24°C and salinities >26ppt. Reproduction occurs between 14-20°C. For further information see the GB NNSS Information Portal, Risk Assessment, NBN Atlas and the 2023 alert poster. A link to the Species Action Plan can be found on the Wild Seas Wales website.

INNS name	Potential impacts	Image	Additional information
Chinese mitten crab (<i>Eriocheir sinensis</i>)	Erosion of river / stream banks; affect fisheries by damaging nets, killing netted fish, consuming bait & damaging gear; clog water intake pipes; compete for food & space and predate on native species in freshwater & marine; burrowing activities affect water quality.	 Photo credit: The Food and Environment Research Agency [via GB NNSS]	Larvae can be carried in ballast/bilge water; Juveniles may stowaway in ballast sediments and spaces between the existing hull fouling community. Reproduction occurs in brackish/marine waters (15-30 ppt salinity). Larvae are planktonic in the marine environment for up to 2 months (high dispersal risk). For further information see the GB NNSS Information Portal, Risk Assessment and NBN Atlas. A link to the Species Action Plan can be found on the Wild Seas Wales website.

INNS name	Potential impacts	Image	Additional information
Devil's tongue weed (<i>Grateloupia turuturu</i>)	Outcompetes native algae and seagrasses, leading to changes in local ecosystems. Rapid growth and dense mats can smother other marine life, reducing biodiversity. Alters habitats by changing the structure of the seafloor, which affects the species that rely on these habitats for food and shelter. Can have cascading effects throughout the marine food web. Negatively affect fisheries and aquaculture operations by the fouling of nets, ropes, and other equipment.	 Photo credit: Elena_Sherehora [CC BY, via iNaturalist]	Strands can attach to surfaces such as the hull, keel & rudder; spores and juvenile stages can be carried in ballast/bilge water. Spores can develop at temperatures ranging between 15-20°C. Developed strands have a wide temperature tolerance (4-29°C). For further information see the GB NNSS Information Portal and NBN Atlas.

INNS name	Potential impacts	Image	Additional information
Japanese wireweed (<i>Sargassum muticum</i>)	Can interfere with recreational & commercial use of waterways, especially when detached & forming large floating masses; known for fouling fishing gear & boat props, as well as blocking intake pipes of coastal facilities; known to alter habitats; impacts to subtidal native assemblages through overgrowing & shading underlying species, with particular concern for seagrasses.	 Photo credit: Susan Marley [CC BY, via iNaturalist]	Strands can become entangled around vessel gear e.g., propellor and propellor shaft. Fragments viable for up to 3 months. Wide tolerances of temperature (10-30°C) and salinity (7-34ppt). For further information see the GB NNSS Information Portal, Risk Assessment and NBN Atlas.

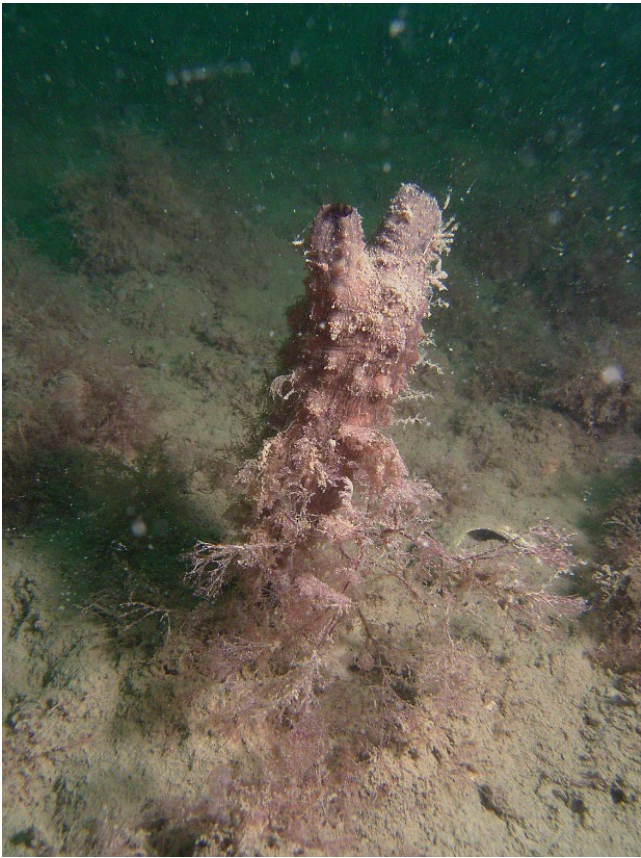
INNS name	Potential impacts	Image	Additional information
Leathery sea squirt (<i>Styela clava</i>)	Can be a major fouling organism on vessels, aquaculture & fishing equipment & other artificial structures; potentially decreases local biodiversity through outcompeting native species.	 Photo credit: Chris Wood, Marine Conservation Society [via GB NNSS]	Adults can foul surfaces such as the hull, keel & rudder; adults foul niche areas such as the sea chest and intake pipes They are hermaphroditic but not self-fertile. Spawning occurs in water above 15°C and larvae are planktonic for 1-3 days before they settle. For further information see the GB NNSS Information Portal and NBN Atlas.

Table 3. Examples of INNS that are not currently recorded as present in Wales (horizon species) but are likely to spread via and/or impact commercial shipping.

Horizon INNS name	Potential impacts	Image	Additional information
HORIZON SPECIES: Veined rapa whelk (<i>Rapana venosa</i>)	Predator of shellfish including commercially important species, has the potential to decimate bivalve fisheries, with associated economic loss.	 Photo credit: Nikita Gerasin [CC BY, via iNaturalist]	Larvae may be in ballast water. Planktonic larval phase of 24-80 days (high dispersal risk). Successful establishment of reproductive populations seen to occur between 18-26°C. For further information, see the GB NNSS Information Portal, Risk Assessment and the NBN Atlas.

Horizon INNS name	Potential impacts	Image	Additional information
HORIZON SPECIES: Brush clawed shore crab (<i>Hemigrapsus takanoi</i>)	Direct competitor of native shore crabs (in Holland, led to a drastic reduction in the juvenile native common shore crab and replaced the common shore crab in Dunkirk harbour). Predate on newly settled shellfish (e.g., mussel and oyster spat).	 Photo credit: Demian Hiß [CC BY, via iNaturalist]	Larvae and adults may be transported in ballast water. Adults can be moved with hull fouling communities, clinging to other species or hiding in crevices. Natural range expansion following initial introduction occurs when pelagic larvae are dispersed by currents. After hatching, larvae are planktonic for up to a month (depending on temperature). See the GB NNSS Information Portal and NBN Atlas.

INNS, pathways and the law

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

- 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](#).
- [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).
- [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. Pathway management helps to deliver the 2010 Regulations.
- [The Water Environment \(Water Framework Directive\) \(England and Wales\) 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 INNS are not specifically mentioned within the 2017 Regulations they could affect the ecological status of waterbodies. Pathway management would be a key aspect of managing the potential spread of INNS.
- [The Welsh National Marine Plan 2019](#) contains a cross-cutting policy specifically relating to INNS. Under Policy ENV_03, proposals should assess the likely risk of introducing or spreading INNS and put in place reasonable biosecurity measures where necessary to reduce or stop their introduction or spread.

Commercial shipping specific legislation

The following points provide a brief summary of legislation relevant to INNS and biosecurity that are specific to commercial shipping operations (at time of writing):

- [The International Convention on the control of harmful antifouling systems on ships](#) prohibits the use of harmful antifouling paints and other antifouling systems that contain harmful substances. In particular, the convention prohibits the use of organotin (e.g., TBT) in antifouling paints and puts in place mechanisms for scientific and technical research and monitoring, inspection of ships and enforcing sanctions for violations.

- The [Merchant Shipping \(Control and Management of Ship' Ballast Water and Sediments\) Regulations 2022](#) (2022 No.737) implements the [International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004](#) ("the Convention"), an international Convention made through the International Maritime Organization (IMO). The Regulations establish standards and procedures for the management and control of ships' ballast water and sediments. They also establish a survey and certification regime for ships and prescribe technical requirements relating to ballast water management systems installed on ships. They also require the provision of sediment reception facilities at shipyards where the cleaning or repair of ballast tanks, of ships to which the Regulations apply, occurs. A summary of the core requirements can be seen in table 4.

An additional international resolution of note:

- The IMO has replaced an existing resolution (MEPC.207(62)) with [Resolution MEPC.378\(80\) 2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species](#). These guidelines aim to provide a "globally consistent approach to stakeholders on the control and management of biofouling, which will contribute to minimizing the risk of transferring invasive aquatic species from biofouling on ships". These guidelines are recommended (i.e., not mandatory) but undertaking the recommendations would not only address the risk of transporting INNS but may also "improve a ship's hydrodynamic performance and can be effective at enhancing energy efficiency and reducing air emissions from ships". A summary of the core requirements can be seen in table 4.

Table 4. Summary of the core requirements for the Ballast Water Management Convention and the IMO Guidelines for the Control and Management of Ship's Biofouling.

Convention / Guideline	Core requirements
The International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWMC)	Vessels registered to a State which is party to the Ballast Water Management Convention must have: • A ballast water management plan - including a detailed description of the ship's implementation of the ballast water management requirements – i.e. its ballast water treatment system or ballast water exchange protocol. • A ballast water record book – which documents ballast uptake, treatment and discharge. • An International Ballast Water Management Certificate – issued by or on behalf of the State to certify that the ship carries out ballast water management in accordance with the BWMC. To obtain a certificate, the ship must have a Ballast Water Management Plan.

Convention / Guideline	Core requirements
IMO Guidelines for the Control and Management of Ship's Biofouling to minimize the transfer of invasive aquatic species, 2023	Adherence to the guidelines require that manufacturers and/or ship owners and operators: • Consider biofouling risks, and how they can be reduced, as early as ship design and construction phase. • Ensure use of appropriate Antifouling System (AFS) - based on technical advice and paying particular attention to hard to reach areas which are most susceptible to biofouling accumulation. • Develop and implement a Ship-Specific Biofouling Management Plan - to include details of the ship's hard to reach areas, the AFS in use, cleaning/ maintenance/ repairs procedures, monitoring and inspection schedule, contingency plan. • Undertake regular biofouling monitoring and inspections – prompting contingency actions to reduce biofouling risk when required. • Create and populate a Biofouling Record Book – includes cleaning and inspection reports.

Biosecurity to manage the Commercial Shipping Pathway

The following sections present information on existing biosecurity within the commercial shipping sector as well as actions that, if undertaken, would improve biosecurity in this sector and, ultimately, reduce the risk of INNS impacting stakeholders and commercial shipping operations.

Who are the key stakeholders

Within the context of this PAP, a stakeholder is anyone who uses, benefits from or is responsible for (e.g. managing, protecting or regulating) the marine environment.

Biosecurity for commercial shipping requires engagement and actions taken at national, regional and local scales by specific stakeholders including, but not limited to individuals, businesses, site managers, statutory bodies, and authorities. To note, the term “authorities” here refers to bodies with powers to introduce, amend and enforce regulations, legislation and policy.

For successful implementation of the actions recommended in this PAP and across the [biosecurity framework](#), stakeholders must work together to engage, support and secure resources where needed.

Examples of relevant stakeholders include:

Authorities Stakeholders

- Government departments, organisations and agencies (e.g., Welsh Government, the Maritime Management Organisation and the Maritime and Coastguard Agency)
- Regulatory bodies (e.g., Natural Resources Wales)
- County councils and local authorities
- National Park Authorities

National Stakeholders

- Managing bodies for protected sites (e.g., National Trust)
- Environmental charities and Non-Governmental Organisations (NGOs) (e.g., The Wildlife Trusts)
- Major landowners (e.g., the Crown Estate)
- Commercial shipping associations (e.g., Associated British Ports)
- UK Chamber of Shipping
- Maritime UK
- British Rig Owners Association
- British Tug Owners Association
- Merchant Navy Training Board

Local Stakeholders

- Harbour/port authorities and harbour/port staff
- Commercial shipping businesses and operatives
- Point of sale (e.g., marine brokers, vessel manufacturers)

Existing biosecurity in commercial shipping

This PAP [and the wider biosecurity framework](#) (within which this PAP sits) are intended to complement and improve the existing biosecurity actions undertaken by the commercial shipping sector (some examples included below). The INNS biosecurity actions recommended here do not replace the legal requirements or associated guidance, or best-practice activities currently undertaken by the sector.

Site-specific biosecurity planning

Site-specific biosecurity action planning is an important tool to help ensure that a thorough and planned approach to biosecurity is taken. The [biosecurity framework](#) associated with this PAP allows for biosecurity planning to be scaled as deemed appropriate by stakeholders. For instance, stakeholders, such as port authorities, or harbourmasters, could create site-specific biosecurity plans that take into account all pathways that are relevant to the site. At whatever scale, plans should include:

- A summary of the site background, activities and staff overview (e.g., environmental information, INNS present, site use).
- A broad assessment of the INNS pathways that might be present at the site (i.e., identify the pathways and vectors/determine how INNS might be spread to and from the site).
- Appropriate and proportional biosecurity actions to address the risks identified see [action scaling](#) and [Site construction and maintenance actions](#).
 - If there are multiple pathways at the site, consider what other actions there may be to address these risks. These can be found in the other PAPs (see [Useful Resources](#)).
 - The [biosecurity components](#) within this PAP provide guidance and example actions which operators could consider for implementation.
- Plan details (e.g., biosecurity manager/responsible staff, review period, etc.)

The following resources provide additional guidance for producing a site-specific biosecurity plan:

- [Marine Biosecurity Planning \(2015\)](#)
- [Marine Biosecurity Planning – Guidance for Specific Operational/Construction related Activities \(with template\)](#)
- [INNS Management Toolkits](#)

Plans should be regularly evaluated to review the progress, successes, failures and modifications of the actions within them. They should then be updated to reflect these outcomes by, perhaps, amending approaches, altering timescales or allocating additional resources. The plan could also be updated with current information on the distribution of any

key INNS or changes to site use. Operators should consider discussing any biosecurity plan with NRW.

The use of antifouling

The application of antifouling paint and copper-containing epoxy coatings can help to reduce the fouling levels on the hull due to their biocidal effects, meaning that most organisms cannot survive on them. However, the efficacy of the paints and coatings decreases over time, and they must be reapplied. The frequency of reapplication depends on a number of factors including the antifoulant used, the frequency of vessel usage and chemical variables in the water. There are regulations on the chemicals that can be used in antifoulants which is controlled by the Health and Safety Executive (HSE) and the Control of Pesticides Regulations (COPR). A link to the [COPR approved biocidal products can be found here](#).

The use of biocidal coatings with organotins (e.g., tributyltin, TBT) was banned in 2008 (see [Legislation](#)) due to their significant harmful impact on the environment. This has facilitated the development of more environmentally benign alternatives, like slip-release coatings (which are silicone-based) from which fouling organisms are more easily dislodged when underway. Biocidal coatings are still in use and often use copper as their active agent.

Ballast Water Exchange and Ballast Water Management Systems (BWMS)

As outlined in the [legislation](#), there are standards that must be met under the BWMC. Standard D-1, relating to ballast water exchange, requires all ships to which the convention applies to exchange at least 95% of their ballast water by volume offshore. This is applicable from the date of entry into force of the BWMC (8th September 2017). From this date, all new ships would need to be compliant with Standard D-2 (specifying the maximum amount of viable organisms allowed to be discharged, as described above). As of the 8th of September 2024, all ships must now comply with Standard D-2, meaning that a Ballast Water Management System (BWMS) is required (Standard D-3). This may be an onboard system that treats ballast water when underway (see the [list of IMO type approved BWMS](#)) through, for example, the application of active substances, UV treatment or mechanical separation processes. There are also onshore BWMS that have been made available at some ports that offload and treat a ship's ballast water while port-side operations take place. More information can be found on the [IMO Ballast Water Management](#) information pages and the [GloBallast Partnerships project](#) pages.

The BWMC has been written into UK law through the provisions of the Merchant Shipping (control and management of ships' ballast water and sediments) Regulations 2022. Guidance on the application of the Convention within UK waters can be found [Guidance on the application of the Convention within UK waters can be found here](#). Further information can be obtained through NRW or the Maritime and Coastguard Agency.

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 marine INNS pathways in Wales, including the commercial shipping pathway**. 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 PS (Pathway Strategic) denote that the actions are aimed at addressing the management of pathways, differing from the ID letters SS (Species Strategic) in the Species Action Plans (SAPs) that are aimed at addressing the management of species.

ID	Strategic action	Purpose
PS-1	Develop a national (Welsh) position statement for key pathways in the marine environment	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 pathways. • 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 pathway risk, surveillance and monitoring, and INNS 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 pathway 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 pathways management strategies.

ID	Strategic action	Purpose
PS-2	Review existing legislation	A review should be undertaken of current legislation in Wales and the wider UK relating to INNS 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 for introducing / amending legislation relating to pathways in Wales.
PS-3	Introduce legislation relating to pathways in Wales	The introduction of new legislation (or the amendment of existing legislation) in Wales relating to marine pathways can ensure a consistent and enforceable approach to biosecurity. Authorities should use evidence gathered as part of the review of existing legislation (see PS-2) as justification for new legislation. For example, the adoption of existing international resolutions (e.g., the International Maritime Organisation resolution MEPC.207(62) on biofouling) can facilitate a robust approach to pathway management in line with international standards. Legislation may not be required for, or applicable to all pathways.
PS-4	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.
PS-5	Identify and prioritise high risk areas/locations for marine INNS introductions and impacts	Pathway and species risk assessments are a valuable tool for identifying and prioritising high-risk locations for marine INNS and more effectively allocating resources. Data gathered from previous reports (e.g., NRW evidence 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 and species risk assessments is currently limited and further data collection is required.

ID	Strategic action	Purpose
PS-6	Develop a national plan for monitoring marine INNS pathways	A national plan should develop a standardised approach to monitoring marine pathways and implementing monitoring programs in high-risk locations (see PS-5). 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 stakeholders from all levels. A cost-benefit analysis could also be undertaken to ensure that the implementation of inspections will not damage Welsh businesses.
PS-7	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 new species. General contingency plans for marine INNS have been developed for 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, July 2025).
PS-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 BES Invasion Science Special Interest Group. 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.

ID	Strategic action	Purpose
PS-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 commercial shipping pathway within Welsh marine areas. Stakeholder-specific guidance, including example actions for each component, 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 biosecurity components in this plan complement those outlined in the SAPs and other PAPs. They can serve as a foundation for creating a new biosecurity plan or modifying and enhancing existing procedures. For each component, high-level 'priority issues' have been identified through discussions with stakeholders. These priority issues inform the initial context for developing tailored actions.

These components are:

1. [Understanding roles and legal responsibilities](#)
2. [Information and guidance on INNS and biosecurity](#)
3. [Raising awareness](#)
4. [Biosecurity processes and procedures](#)
5. [Biosecurity facilities](#)
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 commercial shipping.

PRIORITY ISSUE: There is a lack of clarity within stakeholder groups (for all pathways) regarding 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 PS-1 to PS-4), 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 the commercial shipping sector to develop appropriate and achievable policy, without undue impact to Welsh blue growth and individual operators. • Ensure consistency with wider legislation and regulation (e.g., international conventions). • 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 trade association newsletters or governing body communications to relevant stakeholders (e.g., updates from national trade associations, the MMO or MCA etc.) so that all stakeholders are aware of any legal responsibilities with regards to INNS. This information should be clearly defined and included in communications to organisations and staff, e.g., ports/harbours clarifying requirements under the Ballast Water Management Convention (BWMC) so that all parties are aware of their legal responsibilities. 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
Commercial shipping operators	It is essential to ensure a clear understanding of the Welsh Government/NRW policy on INNS within commercial shipping, as well as the associated legislation. Operators should ensure they are fully aware of what is required and expected to achieve compliance.	• Include an overview of the requirements under legislation and policy within toolbox talks/training for new employees. • Make employee adherence to INNS-focused policy a condition of employment. • Consult with the authority to communicate industry practice and experience and offer expert advice on the development of national legislation and policy.

2. Information and guidance on INNS and biosecurity

To ensure that information and guidance on INNS and biosecurity within Welsh marine areas are consistent, high-quality and appropriate for the commercial shipping pathway.

PRIORITY ISSUE 1: 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.

PRIORITY ISSUE 2: Targeted, sector-specific (i.e. pathway specific) biosecurity guidance is limited, resulting in stakeholders being unsure of what to do and when to do it.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	This biosecurity component aims to address information resources on INNS for commercial shipping stakeholders, ensuring that these resources are appropriate for the pathway. However, it should be noted that the provision of INNS information resources is expected to overlap significantly across all marine PAPs, SAPs and BAPs. Therefore, 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. Targeted guidance is needed to help integrate proportional, industry-beneficial and focused biosecurity actions into existing practices.	• Download or request a copy of the NRW marine INNS identification guide (see Useful resources). Identification sheets for several marine species can also be found on the GB NNSS website. • Refine guidance to increase relevance for different commercial shipping sectors (e.g., ports/harbour and vessel operators).

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	Engaging the industry in consultation during policymaking, co-developing best practice advice, and fostering collaborative efforts to raise INNS awareness in Welsh marine areas are essential steps toward achieving balanced and effective biosecurity improvements. All stakeholders should ensure that resources are appropriate for commercial shipping operators, tailoring specific guides to relevant operations and risk factors. Codes of good practice require regular review and updates to incorporate new research and information on the distribution of invasive species. Authorities could consider leading a consultation with other stakeholders on the production/review of these codes of practice. Regional INNS alerts or best practice guidance could be disseminated through maritime safety updates from harbourmasters or port authorities.	See actions above.

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 considerable existing material is 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.	• Produce pathway-specific training resources which can be provided to other stakeholders. • Consult with stakeholders on the update / production / endorsement of best practice codes for INNS and biosecurity in Welsh commercial shipping.

Responsible stakeholder	Guidance for Development of Actions	Example actions
National & Local stakeholders	In the absence/interim of the action above, national stakeholders should look through available INNS information and decide whether it is suitable for / relevant to their operating practices. Relevant information that could be integrated into operation-specific material could include: • Key INNS to look out for • Impacts of INNS • Biosecurity best-practice Material could include self-produced resources; however, a lower effort option could review and compile the existing material already in existence. Sources of existing, high-quality INNS biosecurity information for shipping include the International Maritime Organisation (IMO) (see Useful Resources for links). Where possible, information material should prioritise increasing knowledge of relevant INNS (to pathway or region) and key biosecurity messages.	• Review existing biosecurity information and tailor to the commercial shipping pathway

3. Raising awareness

To facilitate and encourage the active sharing of information and guidance, relevant to the commercial shipping pathway, among all stakeholders within Welsh marine areas.

PRIORITY ISSUE 1: Some stakeholders operating within Welsh marine areas are not aware of INNS 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.

PRIORITY ISSUE 2: The guidance available for the industry could be better targeted at specific operations and provide clearer justification. Stakeholders' buy-in may be enhanced through targeted awareness-raising efforts that recognise their existing biosecurity activities and offer appropriate support (e.g. codes of practice) for implementing proportionate and industry-relevant procedures.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	This biosecurity component aims to increase the awareness of INNS biosecurity with commercial shipping stakeholders. The materials produced under component 2 are intended to provide the consistency and appropriateness of biosecurity information for the commercial shipping pathway. However, it should be noted that raising awareness is expected to overlap significantly across all marine PAPs, SAPs and BAPs. Therefore, it is critical that all stakeholders (including authorities) integrate/coordinate their biosecurity activities. By doing so, they can ensure a cohesive and unified effort that maximising the effectiveness (and reach) of INNS information-sharing.	• Engage in 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). • Become familiar with existing and newly developed commercial shipping-focused guidance.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	All stakeholders can have a role in raising awareness of INNS and biosecurity by promoting and disseminating existing information regarding INNS and key biosecurity messages. This could be achieved both digitally (e.g., through social media and relevant websites) and in print (e.g., newsletters, trade publications and magazines). 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 PAP 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, commercial shipping 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. Where appropriate (e.g. portside, storage areas, maintenance locations/staging) 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 (see Useful Resources for links to signage resources). Landowner permission should be considered (if applicable or required). Equipment cleaning guidance (e.g., the GB NNSS Check, Clean, Dry campaign) should be shared by all relevant organisations and staff. For submerged infrastructure, guidance should include information on cleaning all underwater surfaces (e.g., pontoons, buoys etc.) as well as information on antifouling (e.g., the suitability of different coating types and how they should be maintained).	• Share information resources with other stakeholders as widely as possible. • Provide ad hoc information/facts on INNS to staff, colleagues, members of the public, customers etc.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	Authorities should ideally be a primary source for INNS and biosecurity information in Wales. Information on available funding and resources for biosecurity should be shared with stakeholders. Messaging should ensure that stakeholders are aware of critical information, such as existing legislation, updates to policies or species records/alerts.	• Issue regular updates/social media posts offering INNS and biosecurity advice. • Continue to engage with stakeholders, with a particular focus on communication improving links with the commercial shipping sector. • Include links or QR codes to online resources (including ID guides) with communications. Where appropriate, stock/disseminate hard copies of resources.
Commercial shipping operators and port authorities	Operators should ensure that staff are aware of the potential impacts of INNS, of biosecurity best-practice, inspection/monitoring methods and INNS reporting. This could be included as part of job inductions/ toolbox talks. Training and educational resources are available on the GB NNSS website (GB NNSS Training resources). Also see Component 2. However, specific/bespoke training at an operation scale should be considered.	• Use appropriate biosecurity resources to ensure staff are aware of INNS risks and trained in proportional biosecurity, e.g., IMO e-learning platform. • Train staff on biosecurity best-practice, inspection/monitoring methods and INNS reporting as part of job inductions. Ensure that staff can identify high risk INNS and know where to report suspected sightings to. • Consider communicating how improved biosecurity is beneficial to the industry and products.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Commercial shipping operators and port authorities continued	Guidance documents could be provided to (or produced by) vessel operators and crew to ensure that effective INNS inspection processes are defined (e.g. an assessment of hull fouling to coincide with scheduled maintenance inspections).	• Add in a link to biosecurity information on the GB NNSS website in staff updates. • Put up identification images of key INNS at the site office with a QR code to the iRecord web browser and/or to more information. • Install relevant signage at locations where it is visible to relevant stakeholders (e.g., Check Clean Dry signs at equipment stores, INNS ID images in mess rooms, best practice port-side). • Guidance documents could be provided to (or produced by) vessel operators and crew to ensure that effective INNS inspection processes are defined (e.g., an assessment of hull fouling to coincide with scheduled maintenance inspections).

4. Biosecurity processes and procedures

To improve INNS biosecurity procedures being undertaken by stakeholders relevant to the commercial shipping pathway, ensuring consistency and efficacy.

PRIORITY ISSUE: Although many operators undertake biosecurity procedures (e.g., ballast water systems, antifoul application, port/harbour biosecurity planning and procedures) continuous improvement and inclusion of best practice in standard procedures should be prioritised.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	This biosecurity component is primarily intended to encourage operators within Welsh commercial shipping operations to enhance biosecurity procedures for INNS. However, this guidance is also highly relevant to other stakeholders interacting with the marine environment, such as (but not limited to) NRW, Local Authorities, and County Council field or operational teams. At the most basic, INNS biosecurity can be achieved simply through ‘Check Clean Dry’ procedures (see GB NNSS information). At a high level, stakeholders are encouraged to review and update their protocols and practical procedures to ensure that operational biosecurity comprehensively addresses INNS and is consistently applied. Continuous improvement should also be a priority. These updates do not need to be onerous or burdensome. Enhancements can leverage existing best practices, integrate example practical biosecurity actions, or adopt innovative approaches tailored by operators themselves.	• Authorities could provide support to national and local port and harbour operators for the implementation of improved biosecurity at relevant sites. • Inspect the Ballast Water Management Convention compliance of visiting vessels. • Consult and collaborate with the industry 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. • 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.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	<u>Appoint Biosecurity Managers or Champions</u> For operations of varying scales, appointing a biosecurity manager or champion can be beneficial. 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. Within ports/harbours and commercial operations, a biosecurity manager should be appointed to act as a central point for all INNS queries (e.g., on identification or procedure), enforce biosecurity protocols and facilitate action in response to new INNS detections and issues. The biosecurity manager could be a member of staff already in post and familiar with the site and biosecurity plan. They could be trained in the role and provided with the tools to train other staff members. The biosecurity manager should act as a point of contact for staff. BWMC applicable vessels should have nominated ballast water compliance officer(s) whose role could be extended to include other biosecurity considerations. Vessels outside the remit of the BWMC should consider following guidelines on biofouling or, for example, including INNS within the remit of routine pollution control (i.e. MARPOL) procedures. A responsible officer(s) is likely to be required for both examples; INNS awareness/training within their role should be ensured.	- Consider collaborating with researchers to advance INNS management technologies. - Ensure innovative approaches and updated best practice is shared within the industry e.g. trial different antifouling against different INNS, trial use of ballast water monitoring methods, trial ballast water treatment methods.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	<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.	See actions above.
Port, harbour and marina operators	To reduce the risk of INNS introduction and spread by arriving vessels, port operators could implement ballast water compliance monitoring or hull inspection. Clean vessel policies could be introduced in sites like harbours and ports. These should provide the site's requirement(s) for visiting vessels to operate in a biosecure manner. For example, no ballast discharge in port unless the conditions of the BWMC are met; vessels should be in good order with minimal hull or equipment fouling, etc. Depending on a ports' level of biosecurity priority this could include restrictions or penalties on infringing vessels. Any restrictions should be included in the Terms and Conditions for entry or otherwise communicated to vessel operators. Port authorities, harbour masters, site owners and site managers (or any other relevant party) should develop an inspection strategy. This should outline procedures for inspection and to enforce relevant actions (e.g., refusing entry). Enforcement of clean vessel policies may require some legislative support.	• Ensure that existing protocols meet national responsibilities and provide additional actions of relevance to their operations and priority INNS. • Consider the feasibility, cost-benefit, and legality of imposing biosecurity restrictions on visiting vessels. • Include clean vessel or BWMC compliance clauses in the Terms & Conditions of entry, mooring or berthing. • Improve the procedures for on-site staff, to include Check Clean Dry and INNS inspection of visiting vessels.

Responsible stakeholder	Guidance for Development of Actions	Example actions
Vessel operators	Vessels which are subject to the requirements of the BWMC can be expected to have a ballast water management plan in place. This includes compliant ballast water operations and recording and, possibly, the installation of an IMO type-approved ballast water treatment system. Vessel operators should also consider implementing a biofouling management plan following the IMO’s “2023 guidelines for the control and management of ships’ biofouling to minimise the transfer of invasive aquatic species” (link in Useful resources).	• Undertake operations in alignment with the BWMC. • Implement a biofouling management plan. • Review and update any existing biosecurity protocols including staff movement on/off shore.

5. Biosecurity facilities

The availability of a biosecurity facility (or the supply of appropriate equipment) can help promote effective cleaning, reducing the risk of INNS being transferred to or from a location.

PRIORITY ISSUE: Washdown facilities are critical for enabling the physical cleaning of equipment, personal protective equipment (PPE), and vessels. Enhancing the availability, accessibility and waste management of these facilities can substantially improve biosecurity effectiveness.

To note: A review of available washdown facilities within Welsh marine areas was not included in the scope of the biosecurity framework, leaving the overall status of such facilities unknown.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	Stakeholders who manage or own assets (e.g., marina and harbour operators) should consider the installation or upgrade of biosecurity facilities. It is acknowledged that biosecurity facilities may be multi-purpose at many locations and that facilities do not need to be overly complicated or technical. When planning installations, the following requirements, among other aspects like space and financial resources, should be considered: • The scale of the facility in proportion to the risk posed by the activity. • Infrastructure required for the collection and disposal of wastewater and waste material in a biosecure way to prevent INNS re-entering the environment (e.g., water tanks and biological waste bins). • Supply of necessary resources, like water and electricity. Guidance on the use of equipment at the facilities should be prominently displayed to ensure the correct application of the biosecurity measures.	• Install a freshwater (and if possible, hot water) supply. • Ensure that waste is controlled in a way that minimises the risk to wider habitats. • Participate in the research and development of improved cleaning facilities/equipment for vessels and associated infrastructure • Partner with a research body/professional who can provide advice, for example, work with a local university.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	Additional note: It is difficult to provide a one-size-fits-all recommendation for biosecurity facilities without understanding the nuances of a particular site. The GBNNSS provides good background information and a biosecurity facility support tool, which, although currently focused on recreational pathways, offers a useful overview of facilities. Stakeholders should be reminded that biosecurity facilities do not need to be complex and could just represent a minor upgrade to existing facilities. New technologies are being developed that facilitate hull fouling assessment (e.g., aquatic underwater video) and removal of fouling organisms from vessels and infrastructure efficiently whilst containing waste and preventing its return to the marine environment. Investing and participating in the development and testing of new technologies can facilitate advances.	See actions above
Port and harbour operators	Ensuring that on-site personnel have access to washdown facilities can improve day-to-day operational biosecurity. It is important for operators that offer dry-dock or maintenance services to ensure that any facilities used minimise the risk that INNS waste could be released into the wider environment. This critical consideration should be focused on waste capture and appropriate disposal. Operators could consider the installation of a port-side ballast water treatment system if operating a facility which has a high-risk of ballast water operations. This could present an opportunity as a chargeable service.	• Review existing/install new facilities and how they are being used. Enact small changes, following Check Clean Dry guidance and industry/biosecurity best practice to enhance the efficacy of biosecurity. • Ensure waste management and drainage is appropriate to minimise the risk of INNS reaching the environment. • Install a port-side ballast water treatment system at a cost to visiting vessels.

6. Monitoring and reporting

To establish a robust understanding of what INNS are present in Welsh marine areas and facilitate the early detection of introductions and spread.

INNS sightings must be reported to an appropriate platform, with records included in national databases.

To ensure that up to date species distribution data is available to facilitate rapid responses to new INNS 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	This focus area aims to increase the INNS monitoring and surveillance effort by commercial shipping stakeholders. Stakeholders should take an integrated approach to monitoring (see action PS-6). 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 should consider implementing regular monitoring for INNS. 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 in, for example, a port include: • Rapid Assessment Surveys (optimal for detecting fouling organisms but not for planktonic or soft bottom habitat species). • Settlement plates/panels (panels placed in key areas for a pre-determined amount of time and checked periodically for marine growth or analysed in a lab). • 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 Simple training and guidance should be provided to staff, focusing on recognising priority INNS, or being encouraged to report “unusual” growth or fouling. 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).	• Promote and encourage the use of reporting / recording platforms. • Check Welsh biosecurity communications for opportunities to coordinate monitoring and collaborate. • Consider proactive monitoring through citizen science programmes. • Promote opportunities for integrated or collaborative monitoring efforts. • 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
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 data flow for national INNS records should be considered, with the primary aim to improve the consistency, accuracy and timeliness of reports.	• 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 notifications).

Responsible stakeholder	Guidance for Development of Actions	Example actions
Commercial shipping operators	Individual operators will already have expert understanding of the "normal" plants and animals within their site - monitoring does not necessarily need to be a formal or costly process. Reporting unexpected fouling or growth noticed during normal operations can still provide valuable information and trigger a quick response. Monitoring at sites: Where possible, relevant staff should check the equipment (ropes, buoys, pontoons etc.), within the site for INNS. This could be included as part of general maintenance procedures; however, the intent is not for inspections to be operationally burdensome but to be carried out in tandem with normal procedures. INNS sightings should be recorded on relevant reporting platforms or reported to NRW. Monitoring on vessels: Monitor vessels for unusual biofouling or growth patterns. Take advantage of opportunities to survey vessels for INNS during other statutory or maintenance needs e.g. when structural surveys, International Oil Pollution Prevention (IOPP) certification, antifoul application are undertaken. Encourage an open culture of reporting unusual sightings including photographing and recording extent and location (latitude / longitude). Encourage staff to be aware of and report any heavily fouled vessels. Seek opportunities to work in partnership with research organisations or conservation groups to improve monitoring, training and reporting.	• Brief employees on the importance of INNS monitoring and provide ID guides (links to digital versions or paper copies). • Report unusual growth or fouling to iRecord or NRW - Download the iRecord app onto work phones and encourage staff to download the app on their personal phones if they are not supplied with a work phone. Add a QR code for the iRecord web browser on relevant signage on site. • Partner with universities to provide the opportunity for students to monitor INNS presence at sites by installing settlement panels at the site between April and September each year. • Train staff to be alert to unusual growth in the marine environment.

7. Collaborative working

To improve the collaboration between all stakeholders within Welsh marine areas where commercial shipping operations take place.

To 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 of all 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 is crucial, complemented by inter-stakeholder collaboration. 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 biosecurity 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 the commercial shipping sector 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, carpet sea squirt 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. Authorities should ensure close working and collaboration with relevant authorities (and other stakeholders) in England (e.g., the Environment Agency) and Europe.	- Ongoing stakeholder engagement to keep INNS at the forefront of stakeholders' activities and awareness. - Establish/task an existing working group with coordinating collaborative working. - Engage and coordinate with stakeholders to monitor progress and assess future support needs.

Action scaling: a commercial vessel example

Table 6 provides examples of how the biosecurity components and actions listed above (under “Recommended actions for stakeholders”) could be scaled for implementation within a vessel or fleet-specific biosecurity plan.

Table 6. Example actions for a commercial vessel.

Component	Example approach for commercial vessel/fleet operator
1. Understanding roles and legal responsibilities	Include information on INNS legislation (including the statutory requirements for the vessel under the applicable conventions and guidelines) in employee guides and/or vessel/fleet information that is accessible to relevant employees.
2. Information and guidance on INNS and biosecurity	If guidance/information is received from authorities, review it to see if it is appropriate for inclusion in vessel or operation-specific guidance. Provide feedback on guidance/information if appropriate.
3. Raising awareness	Put up identification images of key INNS at appropriate locations, e.g., mess rooms. Add in a link to the biosecurity information on the IMO website in digital crew communications. Meet training needs as required under the BWMC, MARPOL, and other environmental commitments. Provide crew with quick reference guides for portside INNS assessments e.g., when undertaking routine vessel inspections.
4. Biosecurity processes and procedures	Provide staff with relevant training, including requirements for biosecurity compliance. Appoint a Ballast Water Management compliance officer and extend their training to include INNS considerations under other relevant vessel procedures (e.g. pollution control). Appoint an operative as biosecurity manager. Review and update the Ballast Water Management Plan. Ensure regular testing and log book is completed accurately. Record ballast water management non-compliance within log book.
5. Biosecurity facilities	Ensure the correct functioning of an IMO type-approved ballast water management system. Consider the availability and use of a dry dock with biosecurity protocols (e.g., waste-capture) in place. Explore the use of novel antifouling systems for vessels.
6. Monitoring and reporting	Assign an appropriate crew member to undertake port-side inspection of the vessel’s hull when docked, e.g., qualitative assessment of visible biofouling. Communicate observations to ships master and/or biosecurity manager. Ensure that operatives report unusual growth or fouling to the vessel’s master / biosecurity manager who then take the appropriate action to report suspected INNS to the relevant port authority or record sighting on iRecord.

Component	Example approach for commercial vessel/fleet operator
7. Collaborative working	Share information with other stakeholders, attend relevant workshops / events and provide feedback to authorities.

Action scaling: a commercial port example

Table 7 provides examples of how the biosecurity components and actions listed above (under “Recommended actions for stakeholders”) could be scaled for implementation within a port-specific biosecurity plan.

Table 7. Example actions for a port.

Component	Example approach for commercial vessel/fleet operator
1. Understanding roles and legal responsibilities	Communicate the port’s conditions and statutory requirements (including required compliances under the BWMC). Ensure staff and visiting vessels are aware of the requirements.
2. Information and guidance on INNS and biosecurity	If guidance/information is received from authorities, review it to see if it is appropriate for inclusion in port-specific guidance. Provide feedback on guidance/information if appropriate.
3. Raising awareness	Put up identification images of key INNS at the port office with a QR code to the iRecord web browser. Install Check Clean Dry signs at port equipment stores. Include an INNS ID guide (paper or digital) during induction training. Download the iRecord app (or an internal reporting system from which INNS records are subsequently uploaded to iRecord) onto work phones. Provide port-side crew with a (regularly updated) priority list of INNS ID cards and quick reference guidance on assessing the level of biofouling. Add in a link to the biosecurity information on the GB NNSS website in staff communications. Provide each new staff member with a briefing on INNS and biosecurity (e.g., during inductions). Provide 3 rd party visitors (e.g., external contractors) with a briefing on INNS and biosecurity.

Component	Example approach for commercial vessel/fleet operator
4. Biosecurity processes and procedures	Consider how activities at the site may influence the spread of INNS – engage with the Welsh biosecurity framework in some capacity. Establish a protocol for the inspection and maintenance / cleaning of port vessels and infrastructure. Strengthen the inspection procedures for arriving vessels and unloaded cargo. Appoint a biosecurity manager to inspect vessel hulls and port structures, and to coordinate the implementation of biosecurity at the port. Ensure vessel compliance with required standards immediately on arrival. For example, ballast water management plan compliance inspection, or adoption of a rule to ban entry to vessels with visible heavy hull fouling (equal to or above rank 4 on the Ashton scale, see Table 1).
5. Biosecurity facilities	Consider the cost-benefit of installing port-side ballast water treatment systems as a chargeable service. Implement a waste-capture procedure at dry-dock facilities. Install new jet wash systems at port storage facility (for cleaning of equipment and removable structures).
6. Monitoring and reporting	Train staff to undertake inspections of port structures, e.g., qualitative assessment of visible biofouling and awareness of changing growth. Train appropriate staff to undertake port-side inspection of vessel hulls when docked. Communicate observations to the biosecurity manager. Upload records of INNS as quickly as possible. Ensure that operatives report unusual growth or fouling to the biosecurity manager who can then take the appropriate action to report suspected INNS to the relevant authority (e.g., NRW) or record sighting on iRecord.
7. Collaborative working	Share information with other stakeholders, attend relevant workshops / events and provide feedback to authorities.

Considerations for site maintenance and construction operations

The following guidance is for consideration by site owners, site operatives and other relevant actors when planning or undertaking minor work at a site.

[The Welsh National Marine Plan 2019](#) contains a cross-cutting policy specifically relating to INNS. Under Policy ENV_03, proposals for inshore and offshore developments in Welsh marine areas should assess the likely risk of introducing or spreading INNS and put in place reasonable biosecurity measures where necessary to reduce or stop their introduction or spread.

Some general operational activities might risk spreading INNS. These include minor works, repairs, maintenance and construction that would not necessarily need a marine licence so there may not be an assessment or an understanding of the risk that the activity might pose in spreading INNS.

Activities which may fall under Band 1 licencing eligibility, are listed below. It is important to note that the NRW Permitting Service may still be required to consider the appropriateness of the activity before determining the licence application (see [Natural Resources Wales website](#) for more information).

- Repairing, replacing or reasonably improving parts or ancillary equipment attached to existing structures (e.g., bolts, flaps, valves, cathodic protection, access covers, grills, joints, decking on a pier or pontoon, health and safety equipment etc.)
- Installing scaffolding/access towers to facilitate the maintenance of existing structures.
- Replacing render or concrete, including resurfacing slipways (excludes work on coast protection structures, such as sea walls)
- Removal of marine growth and/or guano from any structure (other than from vessels)
- Installing ladders at any building or structure
- Dropping or removing posts for marking channels, shallow water areas, outfalls and groynes
- Dropping or removing marker buoys
- Removing discrete pieces of debris associated with construction, demolition, damage or disrepair of a building / structure (using a vehicle or vessel)
- Removing litter (using a vehicle or vessel)

The movement of material and equipment on or off a site risks inadvertently transferring INNS. INNS (as adults, juveniles, larvae or fragments) could be attached to surfaces, entrained in any water-retaining features/crevices (including in porous materials like concrete), living within sediments or among other species (like fouling communities). If the material or equipment is not thoroughly cleaned (e.g., washed down with freshwater) and dried before moving on or off the site, any INNS that are present would also be moved on or off the site. Additionally, equipment, parts or materials that have been static in the water for prolonged periods of time can build up fouling which can be dislodged into the water during maintenance, cleaning or replacement. In this way, fouling INNS can be helped to spread to new areas (e.g., fragments of carpet sea squirt, which can form new colonies elsewhere).

Biosecurity is not necessarily considered when undertaking each of the above activities and guidance on how to address the risks of this minor pathway is not as well developed (or specialised) as it is for other pathways in the marine environment (see [Useful resources](#)). As such, it is important to set out general procedures for operatives to follow to reduce the risks of introducing or spreading INNS into, around or out of their site. However, the intention is not to add onerous risk assessments and checks to everyday operations but to ask operatives to be mindful of potential risks and take basic steps to minimise them. The aim of the following guidance is for it to be considered by marina managers, harbourmasters, site owners, site operatives and any others when planning or undertaking minor work at a site.

Activity: Cleaning, maintenance or removal of structures / items in the water

Suggested Biosecurity Actions

- Visually inspect them before disturbing them.
- If they have fouling on them, try to minimise the risk of releasing the species into the water:
- Bring the structure out of the water before carrying out the work and retain the detritus that comes off the item (collect it and dispose of it on land)

Activity: Bringing new infrastructure / equipment and material on site

Suggested Biosecurity Actions

- Ensure it is fully clean and dry before it is deployed.
- If unclean when it arrives, take to a suitable location for cleaning, this should be a contained area of hard-standing with appropriate drainage. Wastewater and waste material should be collected and disposed of in a biosecure way to prevent INNS (including larvae, fragments, etc.) re-entering the environment (e.g. water tanks and biological waste bins).
- If possible, check the source of the item(s) and understand what INNS are present at that site (this can be done by searching the location on the [NBN Atlas](#) or on [iRecord](#)) which are both open-access and free to use).

Activity: General operational good practice for infrastructure

Suggested Biosecurity Actions

- Where practical, remove man-made structures from the water when not in use.
- Temporarily move items out of the preferred growth zone. For example, dropping the mooring chain to the seabed when not in use will smother fouling (in muddy sediments) or prevent new growth.

- Air dry what you can, when you can. Identify opportunities to dry out equipment or infrastructure as often as possible, e.g., drying room/area for dive kit, PPE etc.
- Expose to fresh water. Make the most of any natural flows of freshwater into your site. Expose INNS to fresh water through immersion or wash down.
- Photograph fouling on buoys / pontoons when they are taken out for maintenance to keep a record of growth and inspect for any new INNS.

Useful resources

- [Health and Safety Executive list of approved biocides](#)
- [IMO GloFouling resources](#)
- [IMO guidance on implementing the Ballast Water Management Convention](#)
- [Maritime information note on the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004](#)
- [IMO GloBallast Partnerships webpage](#)
- [IMO GloBallast Partnerships e-learning course](#)
- [IMO e-Learning platform](#)
- [IMO 2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species](#)
- [Guidance on Marine Best Practice by sector from the RAPID INNS Management Toolkit \(RAPID LIFE was a European Union funded project led by the Animal and Plant Health Agency \(APHA\) in partnership with Natural England and Bristol Zoological Society and supported by a number of further technical partners\)](#)
- [Wales Biodiversity Partnership INNS Group](#)
- [Natural Resources Wales report on the impacts of marine INNS on MPA features](#)
- [Welsh marine INNS priority list](#)
- [Natural Resources Wales Marine INNS Pathway Assessment Evidence Report No: 459](#)
- [Natural Resources Wales marine INNS guide in Welsh](#)
- [Natural Resources Wales marine INNS guide in English](#)
- [Marine Biological Association INNS ID guide](#)
- [GB NNSS Information Portal](#)
- [GB NNSS Marine Biosecurity](#)

- Welsh marine INNS workshop kit: May be borrowed by anyone who is running a supervised workshop for adults. It includes specimens, images, distribution maps and species information. For more information or to borrow the kit, contact:

anna.holmes@museumwales.ac.uk

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

Links to the action plans listed below can be found on the [Wild Seas Wales website](#).

- American slipper limpet, *Crepidula fornicata* SAP
- Chinese mitten crab, *Eriocheir sinensis* SAP
- Carpet sea squirt, *Didemnum vexillum* SAP
- Trumpet tubeworm, *Ficopomatus enigmaticus* SAP
- American oyster drill, *Urosalpinx cinerea*, & Japanese oyster drill, *Ocenebrellus inornatus* SAP
- Recreational Boating (large vessels) PAP
- Recreational Boating (small vessels) PAP
- Recreational Activities PAP
- Aquaculture PAP
- Shore-based Fishing PAP
- Vessel-based Fishing PAP

Additional reading of interest

- Davidson, I.C., Scianni, C., Minton, M.S. and Ruiz, G.M., 2018. A history of ship specialization and consequences for marine invasions, management and policy. *Journal of Applied Ecology*, 55: 1799-1811
- Buskens, P., Wouters, M., Rentrop, C. and Vroon, Z., 2013. A brief review of environmentally benign antifouling and foul-release coatings for marine applications. *Journal of Coatings Technology and Research*, 10(1):29-36
- Piola, R., Grandison, C., Shimeta, J., del Frate, A. and Leary, M., 2022. Can vessel sea chest design improve fouling control coating performance? *Ocean Engineering*, 256

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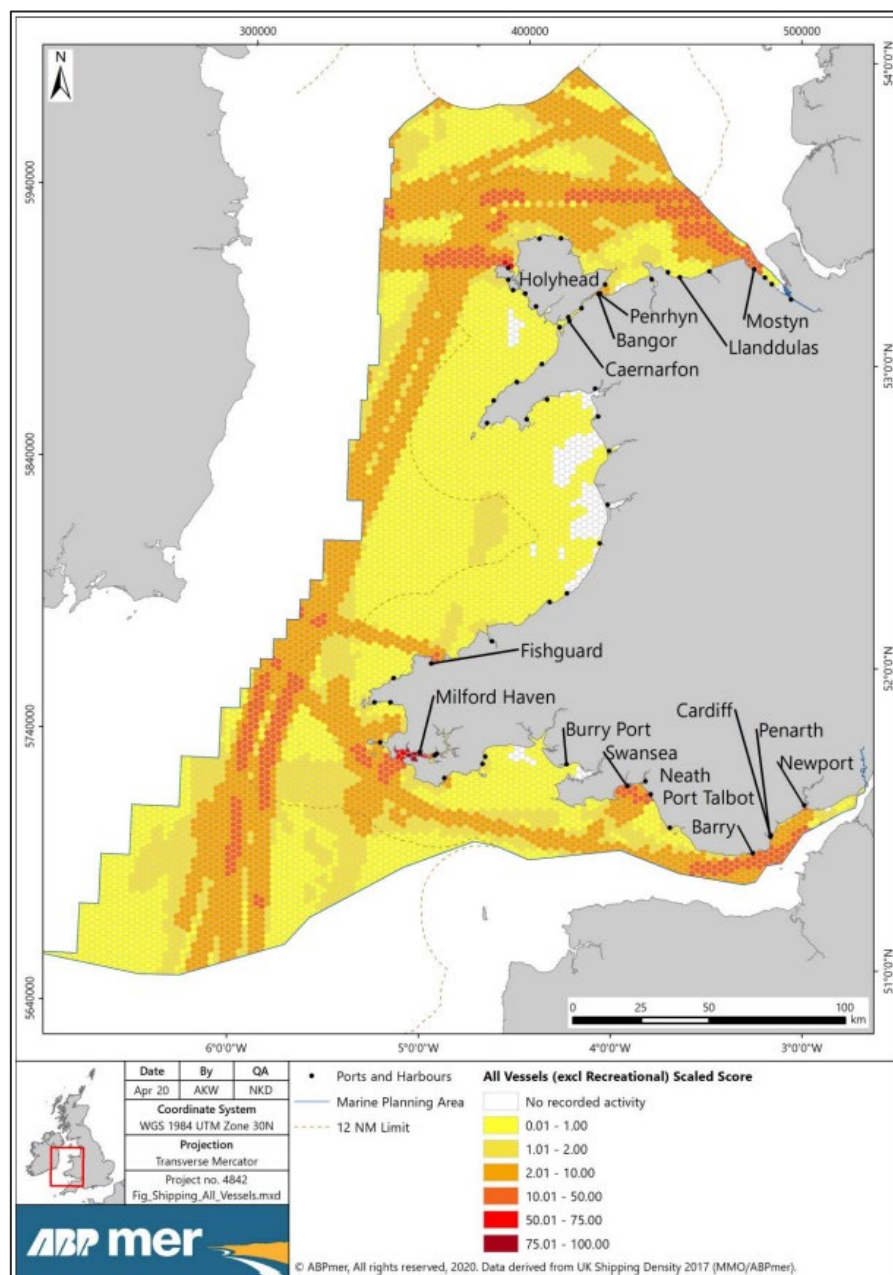


Figure 4. Map of the commercial shipping pathway for Wales from NRW Report 459. The map uses combined data from the UK AIS Density Grid 2017 (Marine Management Organisation / ABPmer) and Ports and Harbours of the UK (ports.org.uk/ABPmer).

The map above shows a heatmap of commercial shipping around Wales from a 2020 report (see the [NRW Evidence Report No:459](#)). As described in the map key, the darker red areas show where the intensity (i.e., frequency and amount) is greater. The areas with the highest commercial shipping intensity, and therefore a higher risk of introducing and spreading INNS, include Milford Haven, Holyhead and Mostyn. These locations are in or near protected marine areas, such as Special Areas of Conservation. As such, it is important to focus attention on these areas for biosecurity.

