

Invasive Non-native Species Action Plan for Wales:

Chinese Mitten Crab (*Eriocheir sinensis*)



May 2026

Lucinda Lintott, Tom Hill, Dr Kate Dey & Dr Paul Stebbing

With contributions from Holly Peek and Chloe Powell-Jennings

APEM Ltd. And Natural Resources Wales

With thanks to Dr Paul Clarke from the Natural History Museum

This project was delivered by APEM Ltd. and NRW and funded through the Welsh Government's Nature Networks Programme, to strengthen the resilience of Wales's protected land and marine sites.

Cover photo by Chloe Powell-Jennings, Natural Resources Wales.

Table of contents

List of Figures	4
List of Tables	5
Crynodeb	6
Summary	7
Background	9
What are Invasive Non-Native Species (INNS)?.....	9
What are pathways?	9
What is biosecurity?	12
A biosecurity framework: what is the context for this Species Action Plan?	12
Scope, aims and objectives	14
The mitten crab: Background	15
Where did it come from?.....	16
What does it look like?	16
What habitat does it live in?	17
Behaviour and life cycle	17
Genetic strains of mitten crab	18
Does it have any predators?	18
What are its pathways and vectors?	18
What are its impacts?	20
Mitten crab in Wales: National context	22
Distribution of the mitten crab	22
MPA features at risk from the mitten crab	23
INNS and the Law	24
Challenges to INNS management	26
Biosecurity to manage the mitten crab	27
Who are the key stakeholders	27
Recommended strategic actions for authorities	29
Recommended actions for all stakeholders.....	33
1. Understanding roles and legal responsibilities	34
2. Information, guidance and research on the mitten crab	36
3. Raising awareness	39
4. Biosecurity processes and procedures	42
5. Species management.....	44

6. Monitoring and reporting	46
7. Collaborative working	51
Control and management methods	53
Monitoring and management in Wales	56
Useful Resources	58
Bibliography.....	60
General references	60
Control and management table's references	62
Appendix.....	63
Data References.....	65

List of Figures

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..... 11

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. 13

Figure 3. Chinese mitten crab, *Eriocheir sinensis*: A) preserved specimen © Yale Peabody Museum, CC0, obtained via Wikimedia Commons B) Live specimen in a bucket © Natural Resources Wales (NRW). 16

Figure 4. Map of recorded and confirmed mitten crab occurrences in (A) the UK and (B) Wales from open source NBN Atlas data (OGL and CC-BY licences) as of July 2023. Contains public sector information licensed under the Open Government Licence (OGL) v3.0, Public Domain Dedication (CC0) v1.0, Creative commons with attribution v4.0 (CC-BY). Data rightsholders, data providers, and dataset references are provided in Data References..... 23

Figure 5. Habitat risk (concern level) from the Chinese mitten crab, *Eriocheir sinensis*, based on the assessment carried out in the NRW evidence report: 'Assessing the impact of key Marine Invasive Non-Native Species on Welsh MPA habitat features, fisheries and aquaculture'. 24

Figure 6. Chinese mitten crabs caught as bycatch in the Chester fish trap from 2007-2024. 57

List of Tables

Table 1. A summary of the Chinese mitten crab (<i>Eriocheir sinensis</i>) background information.	15
Table 2. Potential impacts of the mitten crab to protected marine features. Information from NRW Report 454.....	21
Table 3. Species impact and risk assessments for the mitten crab.....	25
Table 4. Recommended strategic actions for authorities to address the introduction and spread of marine INNS via all pathways in Wales. The ID letters SS (Species Strategic) denote that the actions are aimed at addressing the management of species, differing from the ID letters PS (Pathway Strategic) in the Pathway Action Plans (PAPs) that are aimed at addressing the management of pathways.	29
Table 5. A list of control methods for the mitten crab that have been utilised elsewhere and are reported in scientific literature. The references used can be found in the control and management table's references section of the bibliography.	53
Table 6 Rightsholders and data providers for the open-source data downloaded from NBN Atlas for the purpose of this report.....	65

Crynodeb

- Mae [rhywogaethau estron goresgynnol](#) yn blanhigion, anifeiliaid neu bathogenau nad ydynt i'w cael yn naturiol mewn ardal ond sydd wedi cael eu symud yno, fel arfer gan weithgareddau dynol (naill ai'n ddamweiniol neu'n fwriadol) ac maen nhw'n achosi effeithiau amgylcheddol, cymdeithasol neu economaidd sylweddol. Rhai o effeithiau rhywogaethau estron goresgynnol 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 goresgynnol yn cael ei hwyluso gan drywyddau a gweithgareddau dynol o'r enw "[Llwybrau](#)", er enghraifft, llongau, cychod hamdden a dyframaethu.
- Er mai'r ffordd sy'n cael ei mabwysiadu fel arfer i leihau effaith rhywogaethau estron goresgynnol yw ymdrech i atal cyflwyniad a lledaeniad ar lefel y llwybr, mae sawl rhywogaeth estron goresgynnol wedi cael ei blaenoriaethu gan Cyfoeth Naturiol Cymru.
- Nod cyffredinol y Cynllun Gweithredu Rhywogaethau hwn yw lleihau'r risg o gyflwyno a lledaenu Cranc manegog Tsieina (*Eriocheir sinensis*), drwy gyflwyno camau gweithredu y gellir eu rhoi ar waith ar lefelau cenedlaethol (Cymru), rhanbarthol a lleol.
- Mae'r Cynllun Gweithredu Rhywogaethau hwn yn rhoi trosolwg o Granc manegog Tsieina, ei [ymddygiad a'i gylch bywyd](#), [llwybrau lledaenu](#) ac [effeithiau](#), yn ogystal â chamau y gellid eu rhoi ar waith i [fynd i'r afael â lledaeniad y rhywogaeth hon](#).
- Mae effeithiau negyddol Cranc manegog Tsieina yn cynnwys: newid cynefinoedd ac ansefydlogi glannau; ysglyfaethu ar rywogaethau brodorol; cystadleuaeth â rhywogaethau eraill; a throsoglwyddo pathogenau a pharasitiaid. Mae'r problemau hyn yn arwain at waith rheoli ac atgyweirio costus, yn ogystal â niwed uniongyrchol i'r amgylchedd morol naturiol.
- Mae'r camau gweithredu a amlinellir yn y Cynllun Gweithredu Strategol hwn yn darparu cyfres o gamau gweithredu i randdeiliaid amgylchedd morol Cymru y gellid eu rhoi ar waith lle mae Cranc manegog Tsieina wedi'i nodi fel blaenoriaeth neu risg uchel.
- 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 awdurdodau (h.y. cyrff sydd â phwerau i gyflwyno, diwygio a gorfodi rheoliadau, deddfwriaeth a pholisi), cyrff statudol, rhanddeiliaid anllywodraethol cenedlaethol (e.e. cyrff llywodraethu hamdden, cyrff anllywodraethol, cymdeithasau ac ymddiriedolaethau), gweithrediadau masnachol, awdurdodau porthladdoedd a harbwrfeistri, defnyddwyr hamdden ac unigolion. Gweler [Rhanddeiliaid allweddol](#) am enghreifftiau pellach.
- Mae'r Cynllun Gweithredu Rhywogaethau yn amlinellu saith cydran o ffocws bioddiogelwch i'w gwneud gan randdeiliaid sy'n mynd i'r afael â Chranc manegog Tsieina o fewn ardaloedd morol Cymru.

1. [Deall rolau a chyfrifoldebau cyfreithiol.](#)

2. [Gwybodaeth ac arweiniad ar Granc manegog Tsieina](#)
 3. [Codi ymwybyddiaeth](#)
 4. [Prosesau a gweithdrefnau bioddiogelwch](#)
 5. [Rheoli rhywogaethau](#)
 6. [Gwyliadwriaeth ac adrodd](#)
 7. [Gweithio ar y cyd](#)
- Bwriedir i'r cynllun hwn gael ei ddefnyddio i gefnogi'r [Cynlluniau Gweithredu Llwybrau \(PAPs\)](#) a'r [Cynlluniau Gweithredu Bioddiogelwch \(BAPs\)](#) cysylltiedig.

Summary

- [Invasive non-native species](#) (INNS) are plants, animals or pathogens that do not naturally occur in an area but have been moved there, usually by human activities (either accidentally or deliberately) and cause significant environmental, social or economic impacts. The impacts of INNS include outcompeting native species for food and space, altering habitats, spreading disease and incurring direct and indirect costs for local and national economies.
- The movement (i.e. introduction and spread) of INNS is facilitated by human mediated routes and activities called “[Pathways](#)”, for example shipping, recreational boating and aquaculture.
- Although reducing the impact of INNS is commonly approached through efforts to prevent introduction and spread at the pathway level, there are several INNS that have been prioritised by National Resource Wales.
- The overall aim of this Species Action Plan is to reduce the risk of the introduction and spread of the Chinese mitten crab, *Eriocheir sinensis*, by putting forward actions that can be applied at national (Welsh), regional and local levels.
- This SAP provides an overview of the invasive Chinese mitten crab, its [behaviour and life cycle](#), [pathways of spread](#) and [impacts](#), as well as actions that could be implemented to [address the spread of this species](#).
- The negative impacts of the Chinese mitten crab include: alteration of habitats and destabilisation of banks; predation on native species; competition with other species; and, transmission of pathogens and parasites. These issues lead to costly management and repairs, as well as direct harm to the natural marine environment.
- The actions outlined within this SAP provide stakeholders of the Welsh marine environment a series of actions that could be implemented where the Chinese mitten crab has been identified as a priority or high risk.
- Stakeholders are those that use, benefit from or are responsible for (e.g. managing, protecting or regulating) the marine environment. Here, this includes authorities (i.e. bodies with powers to introduce, amend and enforce regulations, legislation and policy), statutory bodies, national non-governmental stakeholders (e.g., recreational governing bodies, NGOs, associations and trusts), commercial operations, port authorities and harbourmasters, recreational users and individuals. See [Key stakeholders](#) for further examples.

- The SAP outlines seven components of biosecurity focus to be undertaken by stakeholders that address the Chinese mitten crab within Welsh marine areas.
 1. [Understanding roles and legal responsibilities](#)
 2. [Information and guidance on the Chinese mitten crab](#)
 3. [Raising awareness](#)
 4. [Biosecurity processes and procedures](#)
 5. [Species management](#)
 6. [Monitoring and reporting](#)
 7. [Collaborative working](#)
- This plan is intended to be used in support of the associated [Pathway Action Plans \(PAPs\)](#) and [Biosecurity Action Plans \(BAPs\)](#).

Preface

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

It is acknowledged that no single activity is solely responsible for the spread of INNS, and no single species should be targeted at the expense of wider holistic efforts. All users of the marine environment are encouraged to take the time to understand more about the Chinese mitten crab 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 aquaculture equipment, navigational aids and piers) and the introduction of diseases. The impacts of INNS (in all environments including marine) are estimated to cost the British economy £4 billion per year, of which, £499 million per year is attributed to impacts in Wales (see the [2023 paper from Eschen](#)).

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

What are pathways?

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

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

Pathways are broadly classified as two types:

- 1) Pathways of initial introduction: Those which transfer NNS to regions or locations that are geographically separate and isolated from their native range (referred to as

“introduction(s)” in this document). An example of this would be the movement of transoceanic vessels.

- 2) Pathways of further spread: These facilitate the movement of NNS populations beyond their initial introduction point (referred to as “spread” in this document):
 - a. Facilitating the short-range dispersal (i.e. spread from place of introduction to wider area) of an NNS population within a single habitat or location (e.g. paddle boarders spreading a seaweed within a bay), or
 - b. Facilitating regional spread where some small barriers exist (e.g., the movement of recreational boats between two nearby but separate harbours).

The frequency and magnitude of pathways in the marine environment have been increasing since the 1800s with the beginning of rapid globalisation. A significant movement of marine INNS has been through the trans-oceanic voyages and shipping that has long supported growing global economies and international supply chains. For more information on other pathways in the marine environment, please see the Welsh Pathway Action Plans. Links can be found on the [Wild Seas Wales website](#).

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

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

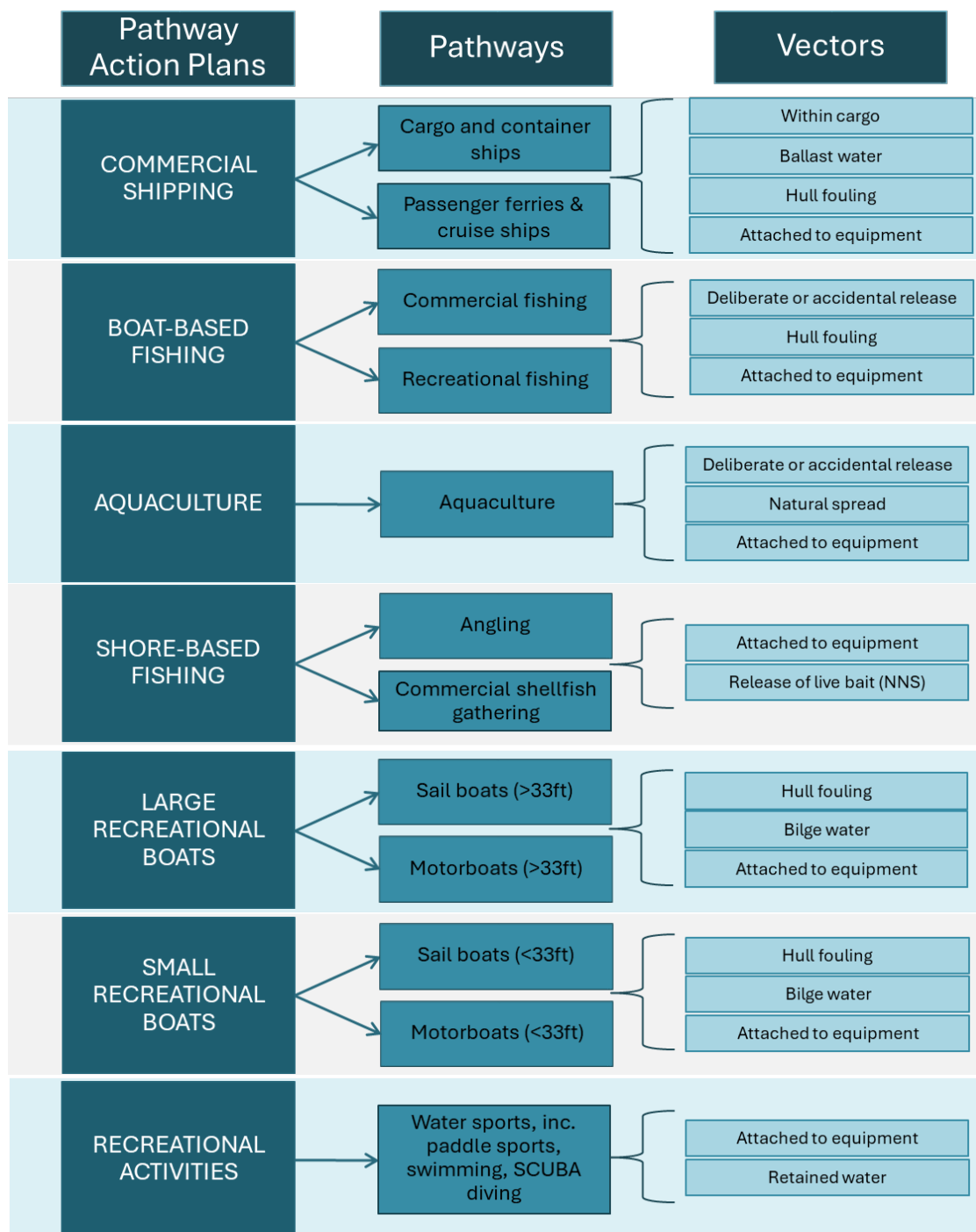


Figure 1. An overview of the Pathway Action Plans that have been developed for Wales, and the vectors associated with the pathways. Note that the list of vectors is not exhaustive.

What is biosecurity?

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

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

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

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

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

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

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

This framework has not been created with punitive or intentionally burdensome measures, and we encourage aquaculture operators to consider the benefits of improved biosecurity to both the sustainability and profitability of the industry.

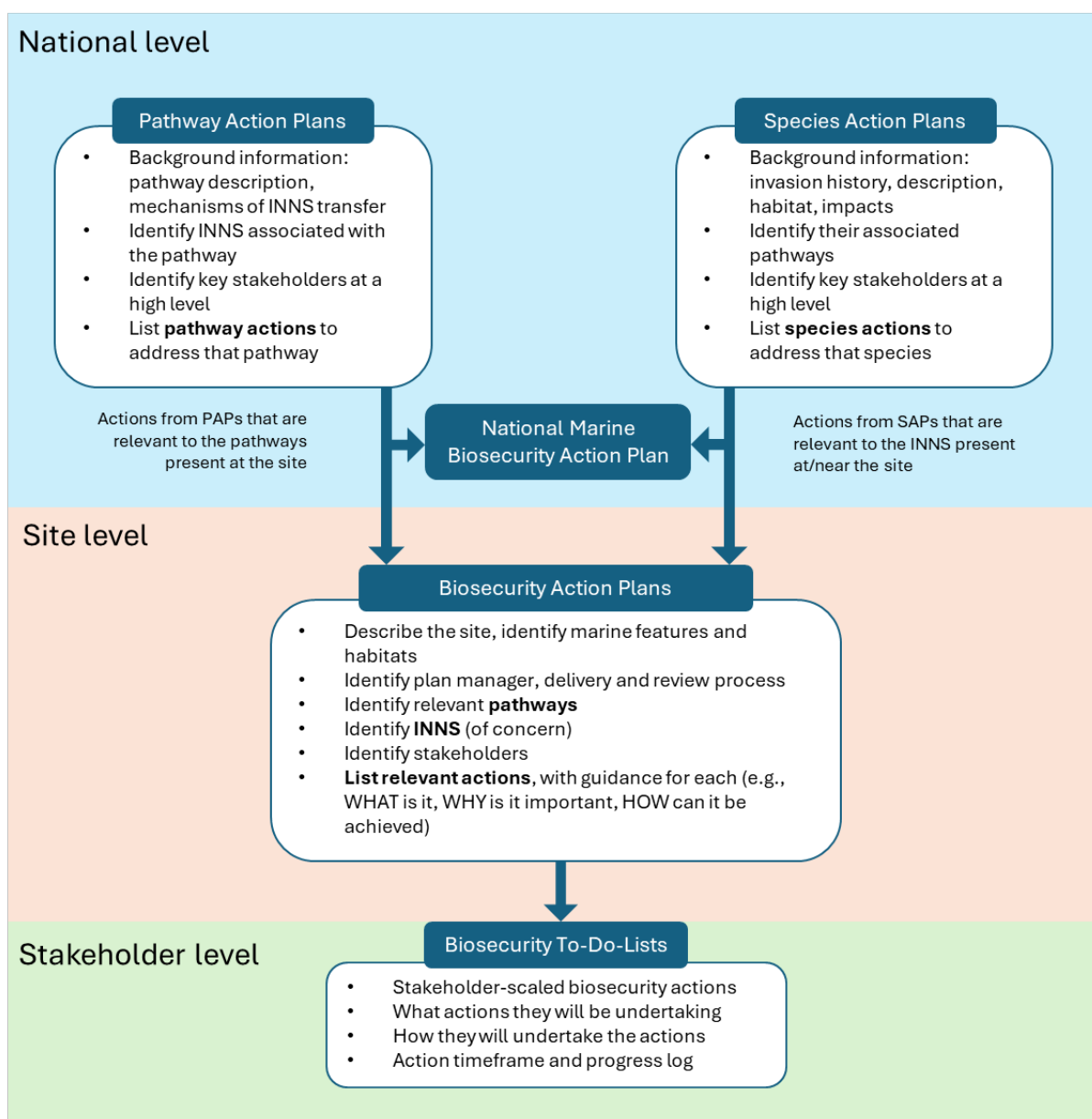


Figure 2. A flowchart showing the relationships between the Pathway Action Plans, Species Action Plans and the Biosecurity Action Plans created for the Natural Resources Wales Biosecurity Planning Project with APEM Ltd.

Scope, aims and objectives

Scope

This Species Action Plan (SAP) is intended to be applicable across all Welsh marine areas, presenting actions that can be undertaken by relevant parties (outlined below) to manage the introduction and / or spread of the Chinese Mitten crab, *Eriocheir sinensis* (referred to as the mitten crab from here onwards). The actions outlined in this document are intended to complement those within the PAPs (available on the [Wild Seas Wales website](#)) in order to be more readily incorporated into BAPs, as described in the [framework](#) above. As such, there will be some overlap between the actions recommended in this SAP and the actions recommended in the PAPs. This document is aimed at:

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

The actions and guidance outlined in this document encompass several dimensions of INNS management for the mitten crab including:

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

Aim

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

Objectives:

- Increase public awareness of the mitten crab and the risks it poses.
- Put forward recommendations for actions that aim to reduce the further introduction and spread of the mitten crab into and around Wales and improve surveillance and reporting of new individuals.
- Outline possible control methods for the mitten crab that have previously been employed elsewhere.

The mitten crab: Background

Table 1. A summary of the Chinese mitten crab (*Eriocheir sinensis*) background information.

Attribute	Details
Native range	Eastern and Northern China
Appearance	Hairy, equal-sized claws with white tips. Square-shaped and convex shell (carapace) with four prominent spines on either side and a notch between the eyes. 50-80mm carapace width. Greyish-green, light brown, orange-brown, dark brown, or purple.
Substrate	Burrows are created in banks of rivers and estuaries, usually finer sediments, such as mud or clay.
Depth	Up to 10m. Can survive for 31-70 hours out of water, depending on temperature and humidity and can survive for 35 days in wet meadows.
Temperature tolerance	4-32°C
Salinity tolerance	0-35psu (changes depending on life stage). Adults live in freshwater, migrating to the sea to breed.
Feeding method	Omnivore, food and feeding method changes between life stages.
Reproduction/Propagation	Sexual. Females can produce between 250,000 and 1 million eggs released as free-swimming pelagic larvae.
Predators	Likely predated on by larger crustaceans, fish, birds, cephalopods and mammals.
Pathways and vectors	Hitchhiking (e.g., on equipment, aquaculture stock, hull fouling communities), ballast and bilge water.
Impacts	Predation, competition, vectors of disease, habitat alternation and socioeconomic

Where did it come from?

The mitten crab, *Eriocheir sinensis*, is native to temperate and tropical regions in eastern and northern China.

Non-native range

The mitten crab has been introduced to the USA, Canada, and Europe, where it has been reported as far north as Finland, Sweden and Norway, and as far south as Spain. In Europe, the mitten crab was first recorded in 1912 in the River Aller, Germany. In the 1930s, millions of juvenile crabs were reported during their upstream migration in Germany. The success of the mitten crab in Europe is likely largely due to the lack of any closely related crabs, or other crabs that migrate between coasts and inland waters, with which it could compete.

What does it look like?

The mitten crab's distinguishing features are its hairy claws which create the illusion of mittens (Figure 3). In fact, the scientific name for the mitten crab is from the Greek meaning "wool hand of the Chinese". These hairs may not be apparent until the shell of the crab (called a carapace) is about 2.5 cm (1 inch) in width, and they are more apparent on the males. Both claws are of equal size and typically end in a white tip. The length of the legs is approximately twice as long as the carapace is wide. The carapace is relatively square-shaped and convex (curved), with four prominent lateral spines on either side and a notch between the eyes. The width of the carapace is generally 50-80 mm, with a maximum of approximately 100 mm. The colour of the adults can vary, but they are generally greyish-green, light brown, orange-brown, dark brown, or, in rare instances, purple. Juveniles are typically brownish yellow. Identification guides have been developed by several organisations and links can be found linked in [Useful Resources](#).



Figure 3. Chinese mitten crab, *Eriocheir sinensis*: A) preserved specimen © Yale Peabody Museum, CC0, obtained via Wikimedia Commons B) Live specimen in a bucket © Natural Resources Wales (NRW).

What habitat does it live in?

Adult mitten crabs spend most of their time in freshwater environments such as rivers and lakes, particularly where there are dense patches of floating vegetation. They can tolerate a wide range of environmental conditions, including highly polluted waters and temperatures of 4-32°C. Adults are able to tolerate wide ranging salinities of 0-35 ppt and can be found at depths of up to 10 m. When the adults are ready to breed, females and males migrate to more saline conditions near the coast, to estuaries, intertidal areas and marshes. Movement may take several months and migrations with distances of 1,500 km have been reported. Mitten crabs are adept climbers and can overcome substantial barriers. However, if they encounter obstacles such as dams that are impossible to climb, adult crabs are capable of travelling across land to continue their migration. They can survive for 31-70 hours out of water, depending on temperature and humidity and can survive for 35 days in wet meadows. Mitten crabs create burrows along the banks of rivers and estuaries, where the wetted area might fluctuate i.e., between high and low water levels. Burrows are usually 20 to 80 cm long and comprise a tunnel that slopes slightly downwards and a rounded opening of typically 2-12 cm. They are usually created in finer sediments, such as those with a high proportion of mud or clay. One or more mitten crabs may occupy a single burrow.

Behaviour and life cycle

The life expectancy of the mitten crab is related to its reproductive cycle. Crabs spend between 2-5 years in freshwater as subadults (sexually immature). During the autumnal migration to higher salinity waters, crabs become sexually mature. Adults will only make a single reproductive migration, though they can produce multiple broods during the reproductive season, dying once the spawning season is over.

Reproduction takes place in brackish or marine water, in salinities ranging from 15-30 psu (practical salinity units), and in their native range, usually takes place in the autumn. During mating, the male deposits sperm packets in specialised receptacles within the female, allowing her to fertilise multiple batches of eggs over the spawning season. The male dies after mating. Females can produce between 250,000 and 1 million eggs which are visible on the underside of her carapace for up to two months before they are released in the open ocean as free-swimming pelagic larvae (also known as planktonic larvae). The hatched larvae go through multiple stages, remaining in the water column for up to 2 months before they settle and develop into the typical crab form. Juvenile crabs then migrate upstream into freshwater where they develop into subadults. The time required for each stage of development is variable and depends on multiple factors, including temperature and food availability.

The mitten crab's diet changes depending on their life stage. Larvae eat plankton, juveniles eat plants, and adults have a broad meat-based diet including small invertebrates, fish and fish eggs. Juveniles and adults create burrows along the banks of rivers and estuaries where they spend most of their time in the day, before emerging to forage at night. As the migration period approaches, they can also be found foraging during the day. In the native range of the mitten crab, feeding is usually at its height in the summer.

Genetic strains of mitten crab

DNA testing of the mitten crab population in the Dee Estuary confirmed that they are genetically different to those found in other parts of England, suggesting the populations originate from independent introductions. Genetic analysis of the Dee mitten crab population also indicates that there are two non-native mitten crab species present in the Dee. For more information, see the [2022 Palero](#) paper.

Does it have any predators?

The potential predators of the mitten crab are not well documented. However, small juvenile crabs may be consumed by larger crustaceans, fish, birds, cephalopods and mammals, particularly just after moulting when their soft exoskeleton makes them more vulnerable.

What are its pathways and vectors?

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

Aquaculture and commercial fishing

Mitten crabs have been imported to some countries as living specimens for aquaria and human consumption. In Asia, mitten crabs are widely cultivated for consumption.

The ongoing cultivation of commercial shellfish species continues to act as a pathway of spread of marine INNS around the UK. Adult and juvenile mitten crabs can hitchhike on other species or equipment, like oyster frames, trestles and pots, and can be unintentionally transferred to new locations when these are moved during operations. For example, when moving mussel seed from one area to stock another, mitten crabs may be inadvertently introduced to the receiving area if present in the original site.

The larvae of mitten crabs pose a significant risk as they can attach to clothing, boots or other gear worn by operators who may move from one site to another. They can be easily overlooked, allowing them to establish in new locations and contribute to the further spread of mitten crabs.

Ballast and bilge water

Ballast water is taken up by some vessels (e.g., cargo ships and some ferries) to aid stability while underway. The larval stages of mitten crab are likely to be susceptible to ballast water transfer, as they can be taken up in ballast, transported and then introduced into new locations when the ballast water is discharged. It is thought that this is how they were first introduced to Europe.

The UK Merchant Shipping (control and management of ships' ballast water and sediments) Regulations 2022, which implement the requirements of the international convention for the control and management of ships' ballast water and sediments (2004), mandate the offshore exchange of ballast water or the treatment of ballast water to remove or destroy organic matter (e.g., larvae, phytoplankton) before the water can be discharged. If this legislation is enforced, this would decrease the risk that this pathway poses as a long-distance vector for the mitten crab. Bilge water on smaller leisure crafts, however, is not regulated.

Similar to ballast, bilge water that may be carrying organic matter is taken up at one location and moved to another location, releasing water and associated propagules into the receiving environment. As with ballast water, bilge water could contain mitten crab larvae. However, unlike commercial vessels that take on ballast water, smaller leisure craft typically travel shorter distances and, as such, may be viewed as a pathway of further spread within the UK.

Hitchhiking on hull fouling

Hull fouling, of both commercial and recreational vessels is a process by which sessile animals, plants, algae and/or microorganisms attach to and accumulate on submerged parts of vessels (e.g., hulls, rudders, sea chests, propellers). This is also known as 'biofouling'. Larvae and adults of the mitten crab can cling onto or live among fouling communities on, for example, ship hulls or on other mobile marine infrastructure such as floating pontoons. Vessels that spend extended periods of time in ports or marinas (days to months) present a higher risk of being colonised by fouling INNS which may provide a habitat for the mitten crab. If the biofouling is not removed and the vessel departs to a new location, the mitten crab, along with any other INNS present, may be introduced into this new location.

Dredging and hopper water

Mitten crabs may be transferred during dredging operations via ballast water carried on the vessels and fouling on vessel hulls. Another potential vector is hopper water. Instead of ballast, some barges that are used to transport dredged sediment will fill the hopper (cavity that holds the sediment) with water to stabilise the vessel. In this way, the pelagic larvae of INNS (such as the mitten crab) could be taken into the hopper. Once the barge arrives at the dredging site, the hopper water is released. While this could result in the transfer of INNS, hopper water is often exchanged at specified boundaries to mitigate for this risk. Similarly, larvae could also be transferred in water that is mixed in with sediment when it is dredged. However, survival is not guaranteed.

Another potential vector is the dredged sediment itself, however, the potential of INNS to be transferred via dredged sediment has received limited research and as such the viability of this pathway is poorly understood. Mitten crab mortality may be caused by sediment burial and other environmental stressors which are likely to occur during sediment transfer and upon discharge at the disposal site. More research is required to understand whether the mitten crab can be spread via the transfer of dredged sediment.

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

A note on natural spread

Although not a human-mediated pathway, natural spread by currents can facilitate the dispersal of a species beyond the initial site of introduction in its non-native environment. Adult mitten crabs are highly mobile and can migrate hundreds or thousands of kilometres in their reproductive season and are able to travel over land. This ability to travel over land increases the likelihood of crabs spreading to nearby estuaries and water bodies beyond their initial introduction site. Additionally, they can use canals, tributaries and other connected waterways to extend their range. They can also spread via water currents, potentially many kilometres, during their pelagic larval stage. Both larvae and adults could also potentially hitchhike on floating material and be moved by wind or currents to new locations, for example, driftwood and vegetation.

What are its impacts?

Environmental

Habitat alteration

The burrows created by the mitten crab can cause riverbanks to collapse which can, in turn, cause siltation and a reduction in light levels in the water. The growth of vegetation on the riverbanks can be negatively affected. Additionally, burrowing activity can cause nutrients (e.g., phosphate) and pollutants to be released from sediment, potentially reducing water quality.

The mitten crab grazes on plants in freshwater habitats and can grasp and pull up shoots. This can lead to a decrease in vegetation and associated impacts to the structural complexity within that habitat.

The impacts to some of the marine protected features, which support diverse and important habitats and species, are outlined in Table 2.

Table 2. Potential impacts of the mitten crab to protected marine features. Information from [NRW Report 454](#).

Key protected features	Potential impacts on protected features by the mitten crab
Coastal saltmarshes and reed beds	Vegetation may be vulnerable to uprooting and consumption
Blue mussel beds	Mussel reefs, and the biodiversity they support may be vulnerable to high levels of predation
Sand, mud and mixed sediment habitats	Sediments and banks destabilised by burrowing

Predation

The diet of mitten crab adults is very broad, including freshwater macrophytes and seaweed, small invertebrates (e.g., worms, snails, shrimp) and small fish. Mitten crabs are known to feed on common mussels (*Mytilus edulis*), which are an important habitat-forming species and food source. Mitten crabs are also known to feed on the eggs and larvae of salmonids, which puts further pressure on salmon and trout in Wales (see the [2005 Culver](#) paper). As a result, this predation is likely to disrupt the food webs of freshwater and marine environments.

Competition

Particularly high densities of mitten crabs may occur during the breeding period, increasing the potential for food and space competition. More specifically, the mitten crab has the potential to outcompete the native, white-clawed crayfish (*Austropotamobius pallipes*) and other benthic invertebrates in freshwater and marine environments.

Transmission of disease

The mitten crab is known to transmit the crayfish plague pathogen, which is fatal to native crayfish species. In its native range, the mitten crab is known to be a secondary host of the oriental lung fluke (*Paragonimus westermanii*), a parasite which, if the crab is eaten uncooked, can infect humans. In the UK, it is currently too cold for a necessary intermediate host species (a gastropod). However, with a warming climate, this could be a concern for the future.

Socio-economic

The burrows of mitten crabs can cause the banks in which they are built to become unstable and collapse. This could have significant consequences, depending on the function of the bank (e.g., for flood defence) and result in the need for costly repairs. In addition, bank reduction and collapse can cause siltation and the movement of gravels, which commercially important fish, such as trout and salmon, use for spawning. As outlined above, burrowing can cause nutrients and pollutants to be released from sediment, reducing water quality and negatively impacting commercially important species.

Mitten crabs can impact commercial fisheries and recreational anglers by feeding on the eggs of commercial species, consuming netted fish and damaging nets. Due to the mitten crab's habit of stealing fishing bait, anglers sometimes have to move from previously favoured fishing locations, this has been seen in the Dee. Water intakes (e.g., for industrial cooling systems and water supplies) can become blocked with mitten crabs when mass migrations occur. In their native range, mitten crabs can be a pest when migrating to breed since they can end up in urban areas such as gardens, playgrounds and houses, forming large piles of hundreds or thousands of individuals.

Mitten crab in Wales: National context

Distribution of the mitten crab

The maps in Figure 4 show the confirmed records of the mitten crab in the UK (A) and in Wales (B), as reported to the NBN Atlas as of July 2023. An up-to-date map of Chinese mitten crab records in the UK can be found on the [NBN Atlas](#).

As shown in Figure 4(A), in the UK, the mitten crab is most widely distributed in the east of England. Since the 1990s, the mitten crab has been particularly prevalent in the Thames catchment, although (as of July 2024) it has also been recorded from the rivers Medway, Ouse, Nene Washes, Mersey, Humber and Tyne, and on the Devon coast and one recorded in the River Clyde in Scotland.

Figure 4(B) shows the distribution of the mitten crab in Wales from open source NBN Atlas data (as of July 2023). The mitten crab was first reported from Wales in the early 2000s in the Dee Estuary. This report occurred in the years following the presence of several Dutch dredging operators in the Dee Estuary. The mitten crab has since been recorded in the Bristol Channel near Chepstow and Lydney and, in March 2024, mitten crabs, including a berried female were reported in the Conwy Estuary, at Deganwy marina and Conwy Bridge. These Conwy mitten crabs were reported by an angler who found them in their gutter traps intended for green shore crabs. A single dead male was recorded in Swansea Bay and a mitten crab carapace was recorded in Llandudno.

It is important to note the following.

- If a record is made at a location, it may not mean that there is an established population there.
- Conversely, if there is no record present, it may not mean that there is no population present. There may be a lack of monitoring, a delay in reporting or a lag in communication.

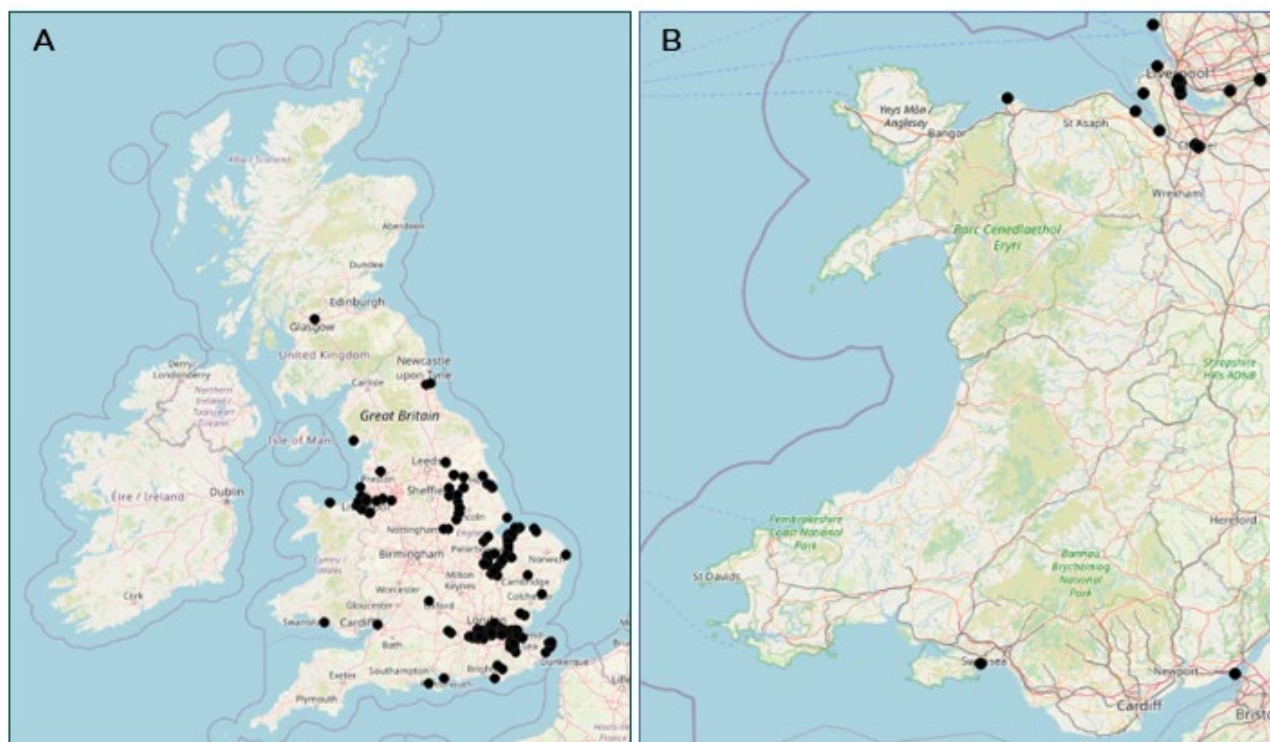


Figure 4. Map of recorded and confirmed mitten crab occurrences in (A) the UK and (B) Wales from open source NBN Atlas data (OGL and CC-BY licences) as of July 2023. Contains public sector information licensed under the Open Government Licence (OGL) v3.0, Public Domain Dedication (CC0) v1.0, Creative commons with attribution v4.0 (CC-BY). Data rightsholders, data providers, and dataset references are provided in [Data References](#).

MPA features at risk from the mitten crab

The potential impact of the mitten crab to Marine Protected Area (MPA) habitat features in Wales was assessed in [NRW Report 454](#) and then mapped (see Figure 5) in the [NRW evidence report](#) “Marine Protected Areas: Features at risk from marine invasive non-native species” (pending publication). The mapping shows that habitat features at major risk from this species are relatively restricted in extent and that greatest concern is for estuarine habitats. Although the maps suggest that there are extensive areas of offshore habitat at moderate risk this is likely to be overestimated since there is no evidence of impacts from this species for deeper offshore areas and this species is likely to be restricted to shallower areas (apart from overwintering females before they hatch their eggs).

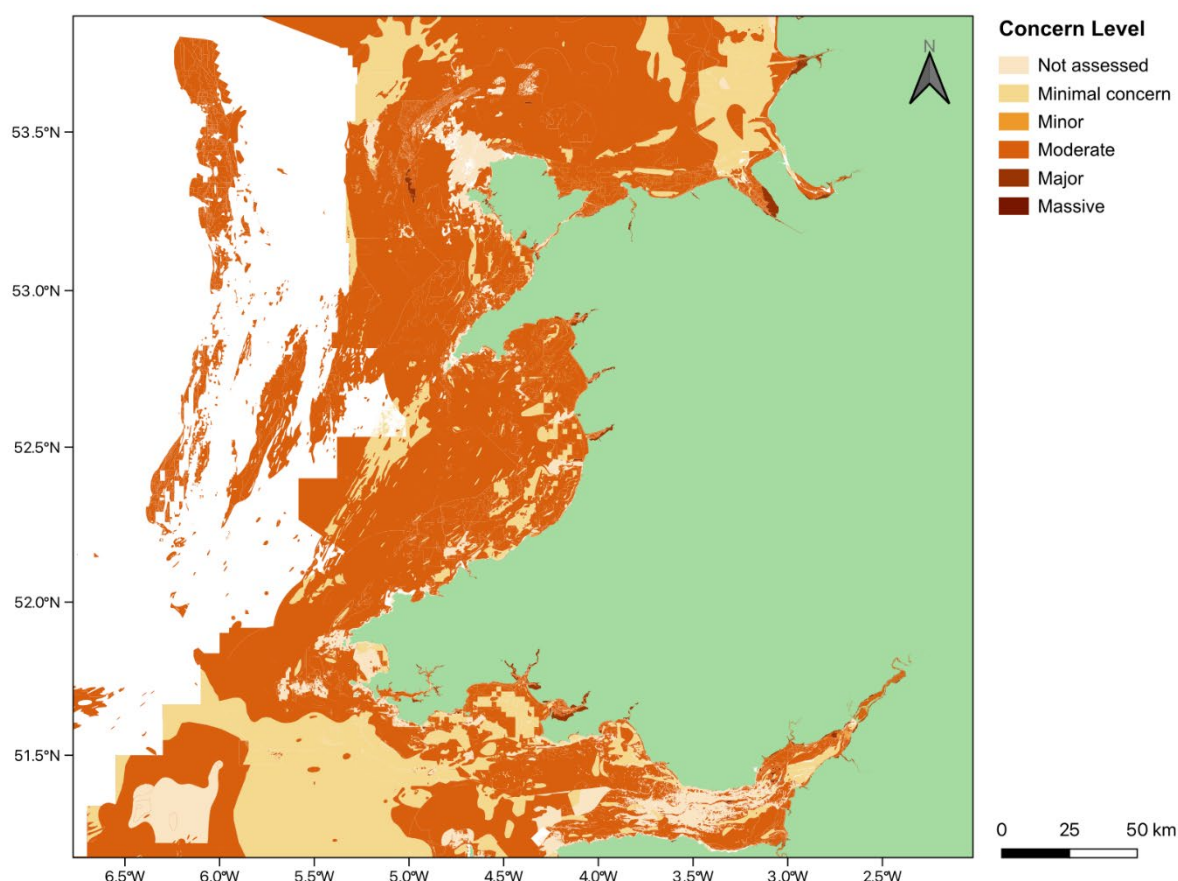


Figure 5. Habitat risk (concern level) from the Chinese mitten crab, *Eriocheir sinensis*, based on the assessment carried out in the NRW evidence report: ‘Assessing the impact of key Marine Invasive Non-Native Species on Welsh MPA habitat features, fisheries and aquaculture’.

INNS and the Law

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

- [The Wildlife and Countryside Act 1981](#) makes it an offence to release or allow to escape into the wild any plant or animal which is not ordinarily resident in Great Britain (i.e. non-native) and is not a regular visitor to Great Britain in a wild state (i.e. migratory).
- [The Marine Strategy Regulations 2010](#) transpose into domestic law the EU Marine Strategy Framework Directive. The Directive aims to reduce human impacts on the marine environment, including INNS. The programme of measures is intended to reduce the introduction and spread of INNS. INNS pathway management helps to deliver the 2010 Regulations.
- [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 is a key aspect of managing the potential spread of INNS.

- Pathway management and the development of pathway action plans are specifically mentioned under the EU Regulation ([1143/2014](#)) on the prevention and management of the introduction and spread of invasive alien species. The regulation also puts forward a list of “species of special concern”, on which the mitten crab is included. The core provision of this regulation is a series of restrictions preventing the import, keeping, breeding, transport, sale or release of a species on this list. This regulation was retained in domestic law under the European Union (withdrawal) Act 2018 as the [Invasive Alien Species \(Enforcement and Permitting\) Order 2019](#).

There are pathway-specific regulations that would relate to the movement of this species. Please see the relevant PAPs on the [Wild Seas Wales website](#).

Under the legislation and policy summarised above, the mitten crab has been assessed for the risks and impacts it poses to UK marine ecosystems. The outcomes of these assessments are listed in Table 3 below. The GB Non-native Species Secretariat (GB NNSS) commission and approve risk assessments of NNS to determine the risk of them entering, establishing, spreading and causing impacts in GB. These risk assessments support the Invasive Non-native Species Regulations and the wider GB legislative framework. Additionally, the Welsh Government’s [Marine INNS Priority Monitoring and Surveillance List for Wales](#) summarises the INNS that are referred to directly in relevant legislation and/or their supporting documents. The list identifies INNS present in Wales and those that are “horizon species” (species that are not yet present but are likely to arrive in the future). The document also includes an assessment of the risk posed by INNS in Wales (in terms of invasiveness, spread and impact), which draws upon risk assessments developed by the GBNNSS.

Table 3. Species impact and risk assessments for the mitten crab.

Assessment	Legislative driver	Mitten crab assessment outcome
INNS prioritisation (according to invasiveness, impact and spread)	Marine Strategy Regulations 2010	UK Priority Species
WFD UK Technical Advisory Group classification of aquatic alien species (according to their impact level)	The Water Environment Regulations 2017	High Impact
GB NNSS risk assessment	The Invasive Non-Native Species Regulations 2019. Wider GB legislative framework.	High Risk Entry Risk = Very Likely Establishment Risk = Very Likely Spread = Rapid Impacts = Major

Assessment	Legislative driver	Mitten crab assessment outcome
Marine Invasive Non-native Species Priority Monitoring and Surveillance List for Wales	Marine Strategy Regulations 2010	High Risk

Challenges to INNS management

1. Eradication of an INNS in the marine environment is extremely difficult. It is more feasible to focus efforts on preventing the introduction of the mitten crab to new locations, as much as is possible, and reducing or controlling existing populations so as to reduce the risk of its spread.
2. In the marine environment, control strategies that are undertaken to reduce the density of an INNS population can be both expensive and indiscriminately destructive, risking impacts to non-target species. Cost-benefit analyses must be undertaken in addition to considering the local ecosystem and minimising any impacts to protected species or sites. Habitat Risk Assessments (HRAs) may be required for control strategies.
3. The mitten crab produces many offspring, its larvae have a long planktonic stage during which time it can be dispersed widely by currents. Additionally, the mitten crab can travel large distances over land and overcome barriers. By decreasing the population size there will be fewer spawning adults. This will mean that fewer larvae will be released, limiting the opportunity to disperse and for the population to increase, resulting in lesser impacts on the environment and native species.
4. There is an additional complexity when considering both the impacts of the mitten crab and the approach to control or management strategies due to the nature of the mitten crab life stages that involve both fresh and marine environments. As such, management approaches necessarily require cooperation from multiple stakeholders and specialists.
5. A major identified challenge has been the humane dispatching and disposal of trapped of mitten crabs, especially if caught in large numbers. Current legislation means that crabs cannot be transported live without a licence so they must be humanely killed at the trapping site. Guidance is currently being sought by NRW from the Office of the Chief Veterinary Officer (OCVO) as the responsible Welsh Government department for all policy related to animal health and welfare in Wales, including eradication and associated control strategies.
6. Feasibility studies should be undertaken for potential control and eradication programs to assess the efficacy and impacts of different methods (see Table 5).
7. More information is required on the biology and ecology of the mitten crab to improve the effectiveness of monitoring and management.
8. There are limitations and challenges for the enforcement, regulation and monitoring of national legislation, e.g., the Ballast Water Convention.

Biosecurity to manage the mitten crab

The following sections present recommendations for actions that, if undertaken, will improve biosecurity in Welsh marine areas and, ultimately, reduce the risks posed to the environment and economy from the mitten crab.

Who are the key stakeholders

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

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

Importantly for mitten crab management, due to the nature of its life cycle, stakeholders include those related to marine, estuarine and freshwater environments.

Examples of authorities and stakeholders are included below.

Authorities

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

National stakeholders

- Non-regulatory government bodies (e.g., Cefas)
- Management bodies for protected sites (e.g., National Trust)
- Recreational governing bodies (e.g., RYA Cymru, Paddle UK, Angling Cymru)
- Environmental charities and Non-Governmental Organisations (NGOs) (e.g., the Marine Biological Society and Wildlife Trusts)
- Commercial operations governing bodies, organisations and groups (e.g., International Maritime Organisation, Maritime UK, Association of British Ports)
- Major landowners (e.g., the Crown Estate)
- Commercial fishing associations (e.g., Welsh Fisherman's Association, WFA-CPC)

Local stakeholders

- Water companies (e.g., Dŵr Cymru – Welsh Water)
- Local environmental groups;
- Aquaculture site owners, managers and operatives
- Port authorities and commercial shipping operators (including dredge operators);
- Marina managers and harbourmasters
- Commercial boat businesses and operations (including shipping and dredging)
- Point of sale (e.g., marine brokers, boat manufacturers, chandleries)
- Commercial fishers
- Recreational boating tour operators and event organisers;
- Recreational anglers, shellfish gatherers and bait collectors
- Recreational clubs and boating organisations (including boating event organisers)
- Individual users

Recommended strategic actions for authorities

Table 4 contains a list of possible strategic actions which could be taken by national authorities. Achievement of these actions support a solid statutory basis for robust management of all INNS in Wales. However, it is acknowledged that any statutory changes require extensive and time-consuming legislative assessments and consultation which is at odds with the urgency required for pathway and INNS management at present. It is therefore recommended that these strategic actions act as long-term goals for authorities and that priority is placed on actions that can be undertaken and achieved on shorter timescales by all stakeholders (see [Recommended actions for stakeholders](#)).

Table 4. Recommended strategic actions for authorities to address the introduction and spread of marine INNS via all pathways in Wales. The ID letters SS (Species Strategic) denote that the actions are aimed at addressing the management of species, differing from the ID letters PS (Pathway Strategic) in the Pathway Action Plans (PAPs) that are aimed at addressing the management of pathways.

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

ID	Strategic action	Purpose
SS-2	Review existing legislation	A review should be undertaken of current legislation in Wales and the wider UK relating to key INNS (and their pathways) to identify legislative gaps and highlight opportunities to strengthen INNS and biosecurity legislation. The review should identify primary legislation under which INNS management can be enforced (e.g., Wildlife and Countryside Act, 1981). The outcomes of this review could provide evidence, justification, and legislative support for national position statements or introducing / amending legislation relating to key INNS and their pathways in Wales.
SS-3	Review and prioritise resource allocation in support of policy and legislation related to INNS	Enforcement / enactment of existing and new policy and legislation should be considered. Resources, roles and responsibilities should be agreed and assigned to ensure that prioritised policy and legislation is being effectively enacted (e.g., provisions for enforcement officers to carry out inspections). Incentives for following legislation could be outlined in biosecurity-related award schemes or accreditations, which should be investigated, created and/or developed and endorsed by the Welsh Government or Natural Resources Wales. Penalties for offences could include fines or suspension of relevant licences as per The Invasive Alien Species Order 2019 . Importantly, legislative policy needs to be clearly communicated to stakeholders.
SS-4	Identify and prioritise high risk areas/locations for marine INNS introductions and impacts	Species and pathway risk assessments are a valuable tool for identifying and prioritising high-risk locations and more effectively allocating resources. Data gathered from previous reports (e.g., NRW Report 459 and NRW evidence report “Marine Protected Areas: Features at risk from marine invasive non-native species” (pending publication) and information from the SAPs and PAPs in the biosecurity framework should be used to inform strategies for species and pathway management and surveillance. It is recognised that data used to inform pathway risk assessments is currently limited and further data collection is required.
SS-5	Develop a national plan for monitoring marine INNS	A national plan should develop a standardised approach to monitoring marine INNS and their pathways and implementing inspection programs in high-risk locations (see SS-4). The

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

ID	Strategic action	Purpose
SS-8	Improve collaboration and links between stakeholders and authorities	Invite stakeholders to participate in existing platforms and/or forums for ongoing communication, collaboration, and knowledge exchange, such as the British Ecological Society Invasion Science Special Interest Group (BES IS SIG). Platforms like this serve as a hub where researchers, policymakers, government agencies, industry representatives, and wider stakeholders come together to share expertise, data, and resources related to INNS management. Key features should include: 1. Regular meetings and workshops; 2. Agreements for data sharing and data integration; 3. Collaborative research, leveraging the expertise and experience of the industry; 4. Capacity building; and 5. Research and monitoring priorities communicated between stakeholders. Promote the Natural Resources Wales list of high priority evidence needs and research ideas page: Natural Resources Wales / Marine and coastal evidence priorities.
SS-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 mitten crab within Welsh marine areas. Stakeholder-specific guidance, including example actions for each, is provided to support the development of tailored actions. Stakeholders are encouraged to define their own biosecurity actions, appropriately scaled and proportional to their activities, using the guidance provided.

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

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

These components are:

1. [Understanding roles and legal responsibilities](#)
2. [Information, guidance and research on the mitten crab](#)
3. [Raising awareness](#)
4. [Biosecurity processes and procedures](#)
5. [Species management](#)
6. [Monitoring and reporting](#)
7. [Collaborative working](#)

1. Understanding roles and legal responsibilities

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

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

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

2. Information, guidance and research on the mitten crab

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

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

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	To improve INNS biosecurity in Welsh marine areas, authorities should consider creating/aligning a national-level marine INNS and biosecurity awareness raising campaign. This should provide common resources and consistent messaging for all marine stakeholders. Key highlights of the campaign could include: • A centralised location for biosecurity and INNS awareness-raising materials. While there is considerable existing material available for this action, ensuring a common repository and "endorsement" of primary materials will help stakeholders maintain consistency. • A defined list of priority INNS of concern. • Publication of INNS alerts when a population is newly established or spreading. • Clear points of contact for stakeholders seeking support and advice. Factsheets should be created to raise awareness of the mitten crab among key stakeholders. The factsheets should contain information on the impacts the species causes and what actions can be / are being undertaken to minimise it's further spread. Existing species factsheets from the GB NNSS could be used as a basis for any Wales-specific resources.	• Develop and update sector-specific factsheets on the mitten crab. Identification sheets of several marine species can be found on the GB NNSS website. • Produce training resources on the mitten crab that can be provided to other stakeholders. • Print (and disseminate) ID guides (such as the Welsh and English ID guide booklets produced by NRW) to as many relevant stakeholders as possible (e.g., local groups, aquaculture operations, points of sale). (see useful resources).

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities continued	Factsheets should be developed in co-ordination with sector representatives to ensure that the information is relevant and outlines best practice. Language and writing style should be considered for different stakeholder groups / audiences – it is critical that information is presented appropriately and accessibly. The fact sheets should be disseminated to key stakeholders in all parts of Wales, particularly to those undertaking any monitoring work. They should be made available on-line and in printed format to ensure consistency of messaging. A simple identification guide could also be included with instructions on how sightings (or suspected sightings) of the species should be reported. Species surveys and mapping of occurrence records should be undertaken to establish where populations currently are. Species distribution maps will provide insight into where the mitten crab is present and absent, and therefore where it may be at risk of spreading from and to. Pathway analyses and risk assessments should be carried out to identify hot spots (see recent, related work above). This, in turn, will allow for effective prioritisation of resources for biosecurity and surveillance (either in relation to population management or prevention).	• Keep ID guides up to date, accounting for new and horizon INNS. • Map the distribution of mitten crab and carry out pathway analyses to facilitate resource prioritisation.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All Stakeholders	It is critical that authorities, as well as local and national stakeholders, take a holistic approach by integrating and co-ordinating their biosecurity activities. By doing so, they can ensure a cohesive and unified effort that builds on and enhances existing measures, maximising the effectiveness of INNS management across all marine pathways and action plans. All stakeholders should ensure that resources are appropriate for their sector, reviewing national guidance and tailoring outputs to reflect relevant operations and risk factors. Authorities could consider leading a consultation with other stakeholders on the production/review of these guidance documents. A simple presentation (e.g., PowerPoint slide pack) should be prepared and made openly available for all to use. The slide pack should contain a summary of key points on mitten crab identification, how it's introduced and spread, the impacts it has, and how it should be reported. A simple script or recording should be included in the notes section to aid presenters. Use should also be made of the mitten crab specimens that are included in the INNS kit from the National Museum of Wales, detailed in Useful Resources. Investigations into the sources of mitten crab populations should also be prioritised. The investigations should comprise a genetic component to see how the mitten crabs in the Dee relate to other populations in Wales. This may determine the sources and pathways of this recent established population and identify priority pathways for biosecurity. This should include investigating whether the mitten crabs in the Conwy Estuary are genetically similar to those in the Dee to ascertain whether movement of larvae from the Dee was the likely source of introduction. This could be coupled with larvae dispersal modelling from the Dee Estuary. Research councils (e.g. NERC, BBSRC) could be influenced to highlight this area of investigation as a priority programme. Investigations should be undertaken in collaboration with universities and researchers to provide scientific robustness. These evidence needs should be noted in NRWs marine evidence needs process and flagged as potential collaborative university student projects.	• Refine existing biosecurity guidance to increase relevance for different sectors. • Provide identification training aids for the mitten crab. • Undertake research to fill knowledge gaps in understanding of mitten crab risk factors. • Conduct investigations into the sources of existing and newly recorded mitten crab populations. • Create an accessible central website to host biosecurity resources and information to make navigation to the most relevant information easier.

3. Raising awareness

To facilitate and encourage the active sharing of information and guidance on mitten crab among all stakeholders within Welsh marine areas.

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

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities	Authorities should ideally be a primary source for INNS and biosecurity information in Wales. Messaging should ensure that stakeholders are aware of critical information, such as updates to policies (e.g. in-water cleaning rules) or species records/alerts.	• Issue regular updates/social media posts offering INNS and biosecurity advice. • Continue to engage with stakeholders • Include links or QR codes to online resources (including ID guides and factsheets) with communications. Where appropriate, stock/disseminate paper copies of resources.
All stakeholders	It should be noted that raising awareness actions are expected to overlap significantly across all marine PAPs, SAPs and BAPs. Therefore, it is critical that authorities, along with local and national stakeholders take a holistic approach by integrating/coordinating their biosecurity activities. By doing so, they can ensure a cohesive and unified effort that builds on and enhances existing measures, maximising the effectiveness of INNS management across all marine pathways and action plans.	• Become familiar with the existing mitten crab guidance and resources.

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., in tackle shops, newsletters 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 SAP include links to existing high-quality information sources which can be used as the basis for awareness raising. However, it is hoped that as national awareness increases, stakeholders will expand their knowledge and activities in this area, eventually producing their own tailored resources (where they have not already done so), further amplifying awareness and engagement. Developing awareness raising materials that highlight the economic and environmental risks of the mitten crab (based on the information provided in this SAP and the useful links) can provide targeted warnings where the mitten crab is a particular problem. Although, it is recommended that targeted awareness raising of individual species is created and disseminated in parallel with general INNS awareness raising. Biosecurity signage is known to be successful in raising awareness. Where appropriate (e.g. angling hotspots, staging areas, recreational launches etc.) signage can be installed in visible (to employees or the public) areas. Information contained within signage can range from general actions and national guidance (e.g., the GB NNSS Check, Clean, Dry campaign), 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).	- Engage in any national awareness raising campaigns such as Invasive Species Week . Use approved or provided biosecurity resources in communications and training. A marine INNS workshop kit comprised of preserved specimens and information sheets can be borrowed from Amgueddfa Cymru (see Useful resources). - Share information resources with other stakeholders as widely as possible. - Provide ad hoc information/facts on the mitten crab and INNS in general to staff, colleagues, members of the public, customers etc.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All Stakeholders continued	Equipment cleaning guidance (e.g., the GB NNSS Check, Clean, Dry campaign) should be shared by all relevant organisations and staff. For boats or submerged equipment, guidance should include information on cleaning all underwater surfaces (e.g., trestles, pontoons, buoys etc.) and removing standing/entrained water from bilges, as well as information on anti-fouling (e.g., the suitability of different coating types and how they should be maintained). It is important to educate and enthuse younger generations on issues relating to INNS and biosecurity. Engagement with local schools or school groups to explore the most suitable way in which the topic of INNS and biosecurity can be incorporated into national education. Materials and resources produced as part of component 2 should be shared with educators. Marine INNS and biosecurity could be integrated in the Ocean Literacy Strategy for Wales 2025 project “Y Môr a Ni” This strategy should be promoted.	• Add in a link to biosecurity information on the GB NNSS website in staff updates. • Put up ID posters of the mitten crab on notice boards or at the site office with a QR code to the iRecord web browser and/or to more information. Install Check Clean Dry signs at equipment stores. • Integrate mitten crab information into education activities with schools or school-age groups (e.g., rockpooling trips)

4. Biosecurity processes and procedures

To improve INNS biosecurity procedures, especially those which reduce the risk of introducing and spread the mitten crab, being undertaken by stakeholders, ensuring consistency and efficacy.

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

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	A pathway-based approach to biosecurity, rather than a species-based approach, is often taken preferentially as it means that all species associated with that pathway can be managed at the same time. This can improve efficiencies in cost, time and effort. In this way, all stakeholders operating within the Welsh marine environment are encouraged to implement or enhance biosecurity procedures. However, biosecurity could also be prioritised in areas where the mitten crab is present. At the most basic, INNS biosecurity can be achieved simply through ‘Check Clean Dry’ procedures (see GB NNSS information). 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, particularly as many stakeholders may already implement effective INNS biosecurity measures (e.g. aquaculture operators). Enhancements can leverage existing best practices, integrate example biosecurity actions (see Table 5), or adopt innovative approaches tailored by operators themselves. Best practice for marine sectors has been created as part of the RAPID LIFE project. Codes for good practice in aquaculture have already been developed, e.g., the Code of Good Practice for mussel seed movements from the Menai Strait Fishery Order Management Association (MSFOMA).	• Authorities could define and provide support to national and local stakeholders for the implementation of improved biosecurity. • Review and update existing codes of good practice (e.g., for aquaculture) • Develop codes of good practice for all activities/operations in the Welsh marine environment. • Consult and collaborate with all sectors to ensure best practice is encouraged and enabled. The onus should be placed on pragmatic changes to procedures which do not negatively impact Welsh blue growth or individual operators.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All Stakeholders continued	Reviews and updates to best practice or codes of conduct should be carried out with a process of consultation with relevant operators to ensure that the code appropriately reflects practical and operational conditions as well as implementing improvements to biosecurity. <u>Appointment of Biosecurity Managers or Champions</u> For operations of varying scales, appointing a biosecurity manager or champion can be beneficial for the different sectors that are relevant to most pathways, keeping in mind the operational scale. This individual, equipped with relevant knowledge and a defined responsibility for biosecurity, can oversee and ensure that biosecurity actions are conducted appropriately and effectively for their site, business, or organisation. <u>Research and develop INNS management measures</u> Invest and participate in the development and testing of new methods and technologies to manage INNS. For example, working with a research body / professional.	• Regularly review emerging methods and technologies that offer INNS risk reduction. • Appoint a biosecurity manager or champion to act as a central point of contact for INNS related queries. • Consider collaborating with researchers to advance INNS management technologies. • Ensure innovative approaches and updated best practice is shared within the industry

5. Species management

To effectively manage (i.e. control or eradicate) the mitten crab.

PRIORITY ISSUE: Removal of mitten crab is challenging and presents a considerable additional risk of spread. Coordination of control efforts and guidance for stakeholders could be improved, and efficacious methods for removal could be researched, developed and shared with stakeholders.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders	Removal of mitten crab is challenging and carries a significant risk of causing further spread. Recommended control methods can be considered (see Table 5), but expert guidance with detailed planning and risk mitigation should be sought before any removal efforts are undertaken. The potential environmental impacts, financial costs, and health and safety considerations must be factored into all control measures. Funding sources for further research should be considered and shared, with research councils like NERC and BBSRC prioritising invasive species management. Collaborative projects with universities will ensure scientific robustness, and NRW's marine evidence needs process should highlight invasive species as a research priority. University student projects should be encouraged to address knowledge gaps. This action should include continuing work already carried out in Wales, investigating the use of semi-permanent traps as a control measure (see information about the River Dee Catchment project below). Coordination and guidance for stakeholders must be improved to ensure best practices are followed in all management efforts. For example, clear guidance should be provided on how particular methods should be deployed, with any marine licencing or need for approvals identified. Guidance on how to monitor and assess efficacy and management endpoints should also be considered.	• Conduct investigations into novel control methods and the efficacy of current methods for the mitten crab • Where feasible, develop control plans for known populations of the mitten crab

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	A structured plan should outline yearly objectives such as population reduction, containment, or eradication. It should define responsible stakeholders, control methods, agreed actions, milestones, success indicators, timelines, and funding strategies. Regular reviews should assess progress, refine strategies, and integrate new research findings. A structured and collaborative approach will help mitigate the impact of mitten crab, protecting marine biodiversity and economic interests.	• Ensure innovative approaches and updated best practice is shared within the industry

6. Monitoring and reporting

To establish a robust understanding of mitten crab distribution in Welsh marine areas and facilitate the early detection of new introductions or spread.

To ensure that mitten crab sightings are reported to an appropriate platform and records are included in national databases.

To ensure that up to date species distribution data is available to facilitate rapid responses to new carpet sea squirt 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	To understand the distribution of the mitten crab within Wales, monitoring of both existing populations and locations where the mitten crab is not currently known to have invaded is required. Existing populations should be identified, prioritised and monitored. This includes understanding the population status of established populations, like those in the Dee Estuary. To further the understand of rate of spread from known populations and facilitate management decisions, high-risk (hot spot) locations may also be prioritised for monitoring. Surveillance of such high-risk locations where the species is yet to be detected will be essential in being able to react quickly and take appropriate action. Ideally monitoring should be of a consistent effort and persistent at a regional level for comparability between years. It is suggested that monitoring at locations considered as high risk should be funded to ensure quality and consistency. Citizen scientists, including individuals, NGOs, charities and local action groups should be engaged with and encouraged to report sightings of the mitten crab.	• Promote and encourage the use of INNS reporting / recording platforms. • Check Welsh INNS biosecurity communications for opportunities to collaborate on monitoring efforts. • Consider proactive INNS monitoring through citizen science programmes.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	Importantly, recreational anglers should be encouraged through engagement and communications (see Component 3) to report mitten crabs as they are likely to come across them more frequently while undertaking their activity. A robust monitoring strategy should include the training of more ID specialists and the creation of a network of specialists. Currently there is no formal monitoring programme for mitten crab in Wales. Incidental trapping at the Chester fish trap continues to be the most effective tool for monitoring the mitten crab population on the Dee and this should continue. Additional monitoring is required to better understand the size of the population and the movements of this species within the Dee Estuary and river catchment system. The use of conservation detection dogs to survey for mitten crab is also currently being trialled. Initial tests conducted at the University of Aberystwyth are promising. This non-invasive method would allow for detection of mitten crabs within burrows and would act as a quicker and more efficient method when surveying shores where crabs may be buried or under rocks. Further information on monitoring methods can be found below and in this NRW Report: Monitoring of Chinese Mitten (<i>Eriocheir sinensis</i>) on the River Dee. The NRW INNS identification guide (links in Useful resources) is clear and concise and includes information on how to report marine INNS. This guide should be disseminated and maintained to facilitate effective reporting. General advice includes: looking below the first barrier in a system, such as a dam or weir; checking quiet pools at a creek's edge; looking for leg movement in areas with leaf litter; looking for oblong burrows along stream banks; looking for exoskeletons of the mitten crab (often more commonly found than the crab itself); surveying at night (crabs tend to move at night, so periodic night surveys, especially during migration periods, are more likely to result in spotting crabs than daytime searches); focusing searches on the bottom and sides of water bodies (crabs are typically not found in the water column).	• 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). • Promote opportunities for integrated or collaborative INNS monitoring efforts. • Conduct regular monitoring for the mitten crab

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	However, surveillance and reporting should still generally target all INNS and be coordinated at a national level rather than focusing on individual species. Although, providing awareness materials and supplementary mitten crab identification guides at high-risk locations, or in reference to high-risk operations, can support prioritised monitoring efforts. Although this component aims to increase the INNS monitoring and surveillance effort by stakeholders, it should be noted that INNS monitoring is multi-faceted and there is an expectation that authorities and local and national stakeholders should take an integrated approach to monitoring. By doing so, they can ensure a cohesive and unified effort that builds on and enhances existing programmes, maximising the effectiveness of monitoring across all marine pathways and action plans. Stakeholders who own or manage assets (e.g. marina and harbour operators, local authorities etc.) should consider implementing regular monitoring for INNS/priority species. Monitoring can either be undertaken and reported by stakeholders individually or could be through a collaborative effort with other stakeholders, for example those in academia. It is best to use standard procedures for monitoring high-risk INNS. Procedures may be directed from a new national approach or from existing monitoring. The best approach to monitoring for current and horizon INNS is to employ multiple methods in tandem to achieve maximum coverage of habitat and species detection. Some of the monitoring methods that could be employed include:	See actions above.

Responsible stakeholder	Guidance for Development of Actions	Example actions
All stakeholders continued	Methods used for monitoring should be adapted to the season: • If it is late summer / early autumn, mitten crabs will be migrating downstream out of rivers into estuarine water, so use visual surveys, fyke nets and seine nets. • In winter, mitten crabs will be in deeper marine water, so use trawl bycatch, trap bycatch and seine nets. • In Spring, mitten crabs will be migrating back into rivers, so use visual surveys, fyke nets and seine nets. 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 some notes about the surroundings (e.g., substrate type, other species in the area, tidal height). The reporting platform should be mentioned / linked on educational materials, at workshops and in social media engagements (see Component 2).	See actions above.

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

7. Collaborative working

To improve the collaboration between all stakeholders within Welsh marine areas and foster open communication, build trust, and align on shared goals to drive effective outcomes.

To cooperate in decision-making, share resources, and leverage the experience and knowledge of stakeholders to address challenges and achieve success together.

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

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

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

Responsible stakeholder	Guidance for Development of Actions	Example actions
Authorities continued	Authorities should ensure close working and collaboration with relevant authorities (and other stakeholders) in England (e.g., the Environment Agency) and Europe to address the mitten crab. See the INTERREG Clancy Project.	• Establish/task an existing working group with coordinating collaborative working. • Engage and coordinate with stakeholders to monitor progress and assess future support needs

Control and management methods

Table 5 contains a list of control methods for the mitten crab that have been used elsewhere and identified from available literature. These methods may be employed to prevent the spread and reduce the abundance of INNS populations. **Inclusion in this table is by no means an endorsement of any of these methods as some methods listed below could have detrimental effects on the surrounding environment and wildlife. Any control action that is taken for the mitten crab should be done so following the direction, advice and approval from the relevant authorities.** There may be limitations to the application of any of these methods if being undertaken in a protected site (e.g., SSSI, SAC or MCZ) and appropriate disposal of mitten crab material and treatment waste should always be considered. Marine licenses and Habitat Regulations Assessments may also be required to undertake any of the following control methods.

Table 5. A list of control methods for the mitten crab that have been utilised elsewhere and are reported in scientific literature. The references used can be found in the [control and management table's references](#) section of the bibliography.

ID	Action	Information
C-ES-1	Activity restriction	Restricting activity in an outbreak area will reduce the speed at which the species can spread to other water bodies. Activities such as boating, water sports, and angling can act as vectors for the movement of mitten crab, particularly in early life stages. However, restricting activity or access will inherently impede the normal use of an area and potentially result in operational and financial impacts to businesses. As such, it may be deemed unacceptable by stakeholders, and/or prove extremely difficult to enforce.
C-ES-2	Physical barriers	Physical barriers implemented at the edge of the invaded range can restrict the movement of this species to undertake its natural migratory patterns. Barriers will likely have to be designed on a case-by-case basis to best suit the target location. Due to the high mobility of the crabs over their life cycle (both in water and on land), physical barriers are unlikely to be completely efficacious. Exclusion devices that can be used on intake structures include barriers installed along intake channels to divert mitten crabs, and rotating 'grizzly' screens that allow water, but not crabs, to pass through.

ID	Action	Information
C-ES-3	Trapping and netting	Ramp trap This trap consists of a custom-made stainless steel rectangular container, spanning the river channel, with a longitudinal slit 15cm wide, accessed by ramps either side at 45° to the riverbed. Migrating crabs cannot pass under or around the trap so must climb up the ramps and fall into the slit, from which they cannot escape due to their limited swimming ability. Crabs exit the trap via PVC tubes, leading to storage containers, from which they can be removed easily by hand. Fish and amphibians can swim out of the channel, so this method has no bycatch compared to fish traps. Since 2018, about two million mitten crabs have been removed from the Kleine Nete River using these traps. The simple design and robust construction of the trap make it possible to use it in principle in almost any watercourse. However, paved bank areas are particularly suitable. When choosing a location, it should also be considered that large numbers of crabs may have to be removed. Good accessibility of the trap site therefore simplifies both the installation and the removal of the crabs. The trap can also be used as an effective barrier against crab invasion, for example to protect particularly sensitive waters. If regular emptying of the trap is not possible or too cost-intensive, the crabs can also be guided back into the water in front of the trap instead. A similar trap design, which uses textured vertical walls in place of ramps, was installed at Pode Hole in Lincolnshire in 2023. Condo refuges A pipe is arranged vertically in a crate, covered on all sides and bottom with netting and left open at the top. It is engineered to attract the mitten crab, as opposed to being baited. They act as a refuges for mitten crabs. Additional weights may be used in strong currents. The trap can also be used in shallow and deep waters, where there are strong currents and fine sediments. However, as these condos act as refuges rather than traps, crabs are able to escape. Snare trap Bait a cage with monofilament snares that can be cast with a fishing rod. Attach a single whole sardine to the outside of the trap. This trap captures adults and is best used in slow currents, preferably at slack tide.

ID	Action	Information
C-ES-3	Trapping and netting continued	Crab pots These pots are a baited mesh trap, consisting of a wire mesh or netted frame, a funnel entrance and a lid. Mitten crabs have difficulty exiting via the funnel and so remain in the trap. However, previous trials have had limited results. The intention is to capture juveniles and adults. They can be used in emergent or submerged aquatic vegetation, in shallow and deep water, in strong currents (additional weights needed). Fyke netting This consists of a long cylindrical netting bag, usually with several netting cones fitted inside the netting cylinder, making entry easy and exit difficult. They are placed perpendicular to the river/stream in depths of 2-5 meters. They are intended to capture juveniles and adults. The nets should be checked every 48 hours to allow release of any non-target species and to prevent mitten crabs destroying the nets and escaping. Nets can be modified to allow eels caught as bycatch to escape. Modified fyke net trapping trials were conducted in 2013 and 2014 in the Dee were not successful in capturing mitten crab in the locations tested. Several reasons may explain this including incorrect equipment type for the target species, inappropriate deployment locations, adverse working conditions or limited sampling effort in relation to the relatively low mitten crab population size (at time the report was written). Despite the lack of mitten crab in the modified fyke nets, this method may still be viable with revised equipment and more suitable deployment locations. More information can be found in NRW Report 154. Otter trawling The otter trawl is pulled by a boat and consists of a trawl net fitted with otter boards (heavy plates) on each side which keep the mouth of the net open. Additionally, a long rope with steel weights keeps the mouth of the net open along its bottom edge. This method is used to capture mitten crabs on the seabed. This captures adults and possibly juveniles depending on mesh size. To note, vegetation can cause clogs, and the trawl may snag on rocky outcrops in structurally complex environments.

Monitoring and management in Wales

Monitoring methods

Listed below are some of the methods that have been used for monitoring mitten crab populations. The [NRW Evidence Report 154](#) trialled a number of monitoring techniques and details lessons learned and further methods to trial.

- **Mark release recapture** (there is a plan to undertake this method around the Chester fish trap to find out how the mitten crabs are using the weir and fish trap and provide a better idea of population numbers)
- **Condo / refugia traps** (there is a plan for these to be used in the future to gain a better understanding of mitten crab distribution in Wales)
- **Otter scat surveys to test for mitten crab DNA**
- **Acoustic tagging** (done by the Environment Agency in 2021 where they looked at the movement of mitten crabs along several waterbodies in the Cambridgeshire Fens, tracking how active the mitten crabs are and how far and frequently they move up and down these waterbodies)
- **eDNA / PCR Assay**

A species-specific digital droplet PCR assay was developed for mitten crab by Ironside et al. (2023). This could be used for monitoring, to detect mitten crab environmental DNA (eDNA) in water samples. Their PCR assay was able to detect mitten crab at Chester weir, where migrating mitten crabs occurred in large numbers, but not further downstream at sites on the Dee Estuary. Ironside et al. (2023) attempted to use a PCR assay that would detect both species of mitten crab and differentiate between them. This was partially successful but requires further testing and optimisation before it can be used with complete confidence of species specificity.

River Dee catchment project

Feasibility of semi-permanent traps as a method for control of mitten crab in the River Dee catchment. Collaborative project between Natural Resources Wales and The University of Aberystwyth.

The aim of this project is to investigate the feasibility and efficacy of using semi-permanent traps to monitor and control the population of mitten crab in the River Dee catchment. The project started in September 2023 and is ongoing at time of writing (June 2025).

The objectives are to:

- Assess the suitability of potential locations on the River Dee for a semi-permanent trap.
- Select a site for installation of the first trap.
- Design a semi-permanent trap suitable for the selected site (use data from pre-existing traps in Belgium and Lincolnshire to inform design).
- Produce a report outlining the work undertaken and next steps including the feasibility of using traps to control the mitten crab population in the River Dee catchment.

A location has been selected directly upstream of the existing Chester fish trap where it is planned to be installed in 2025. The trap follows a similar design to traps which have already been used in Belgium by the CLANCY project: [Crab trap trial on the Zwalm, Flanders Clancy | Interreg North Sea](#).

Chester fish trap

Although located in England, the Chester weir fish trap is managed by NRW and has been the main source of mitten crab data in the Dee catchment. It is designed to capture and sample upstream migrating adult fish to estimate their total return, as well as provide information on their biology. Mitten crabs have been caught as bycatch in the trap since 2007 and total numbers recorded have increased massively since 2020 (see Figure 6). The timing of these records is very similar to the timing of adult downstream migrations recorded for other populations (Rudnick et al. 2005), and may indicate that the vast majority of crabs recorded at the fish trap are passing the trap whilst migrating from further upstream.

We do not know how the crabs navigate this section of the river. It is known through in person monitoring and the use of condo traps that both migrating adult and juvenile crabs pass through Chester weir fish trap.

Year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2007									2	1	1	4
2008						1		4	14	2		21
2009								1	6	6		13
2010					1	1	1	2	12	2		19
2011					1	1	1		1	1		5
2012							3	1	9	1		14
2013								5	56	21		82
2014						3		2	52	19		76
2015				4	6	3	4	6	117	58		198
2016					1			2	35	23	2	63
2017						3	1	4	23			31
2018					1	2	6	18	41	6		74
2019					2	3	6	5	48	10	1	75
2020					9	13	7	22	293	12		356
2021					6			10	536	31	4	588
2022		3			1		2	17	398	34	5	460
2023			2		4	2	3	2	116	2		131
2024					6	2		4	244			256
Grand Total	3	2	4	38	34	34	105	2003	229	13	1	2466

Figure 6. Chinese mitten crabs caught as bycatch in the Chester fish trap from 2007-2024.

Useful Resources

- [GB NNSS mitten crab identification guide](#)
- [GB NNSS mitten crab information page](#)
- [GB NNSS mitten crab risk assessment](#)
- [CABI Compendium mitten crab information page](#)
- [Global Invasive Species Database information page](#)
- [Marine Life Information Network \(MarLIN\) mitten crab information page](#)
- [Nature Biodiversity Network \(NBN\) Atlas mitten crab records](#)
- [Clancy | INTERREG North Sea Chinese mitten crab project](#)
- [Welsh marine INNS priority list](#)
- [Natural Resources Wales marine INNS guide in Welsh](#)
- [Natural Resources Wales marine INNS guide in English](#)
- **Links to Pathway Action Plans (PAPs) and other Species Action Plans (SAPs):**

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

- Chinese mitten crab, *Eriocheir sinensis* SAP
- American slipper limpet, *Crepidula fornicata* SAP
- Trumpet tubeworm, *Ficopomatus enigmaticus* Species Action Plan
- American oyster drill, *Urosalpinx cinerea*, & Japanese oyster drill, *Ocenebrellus inornatus* SAP
- Recreational Boating (large boats) PAP
- Recreational Boating (small boats) PAP
- Recreational Activities PAP
- Commercial Shipping PAP
- Aquaculture PAP
- On-shore Fishing PAP
- Boat-based Fishing PAP
- **Marine Invasive Non-Native Species (INNS) Kit for Wales**

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

The kit consists of the following major groups:

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

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

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

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

**AMGUEDDFA
CYMRU**



With many thanks to Chloe Powell-Jennings (NRW), Morag Taite and Joe Ironside (Aberystwyth University), Dawn Thomas (N Wales Wildlife Trust) and Katherine Slade (Amgueddfa Cymru) for their enthusiasm, knowledge, and teamwork. Financial support was provided by the European Maritime and Fisheries Fund.

Bibliography

General references

- Bishop, J., Wood, C., 2020. Identification guide for selected marine non-native species. UK: Marine Biological Society. Available at: <https://plymsea.ac.uk/id/eprint/9075/1/MBA%20NNS%20Guide%202020%20%281.6%20MB%29.pdf> Accessed 6th December 2023.
- Bouma, S., Soes, D.M., 2010. A risk analysis of the Chinese mitten crab in The Netherlands. Culemborg, The Netherlands: Bureau Wardenburg BV. 54 pp.
- Culver, C.S., 2005. Assessing the potential for Chinese mitten crab predation on eggs and larvae of salmonids. Marine Science Institute, University of California.
- Dittel, A.I. Epifanio, C.E., 2009. Invasion biology of the Chinese mitten crab *Eriocheir sinensis*: A brief review. Journal of Experimental Marine Biology and Ecology, 374
- Eberhardt, A., Pederson, J., Bisson, B., 2016. Rapid response plan for management and control of the Chinese mitten crab - Northeast United States and Atlantic Canada. New Hampshire, USA: MIT and Maine Sea Grant Programs.
- Eschen, R., Kadzamira, M., Stutz, S., Ogunmodede, A., Djeddour, D., Shaw, R., Pratt, C., Varia, S., Constantine, K. and Williams, F., 2023. An updated assessment of the direct costs of invasive non-native species to the United Kingdom. *Biological Invasions*, 25, 3265-3276
- Fialho, C.; Banha, F.; Anastacio, P. M., 2016. Factors determining active dispersal capacity of adult Chinese mitten crab *Eriocheir sinensis* (Decapoda, Varunidae), *Hydrobiologia*, 767: 321-331
- Garcia-de-Lomas, J., Dana, E.D., López-Santiago, J., González, R., Ceballos, G. and Ortega, F., 2010. Management of the Chinese mitten crab, *Eriocheir sinensis* (H. Milne Edwards, 1853) in the Guadalquivir Estuary (Southern Spain). *Aquatic invasions*, 5(3), pp.323-330.
- Global Invasive Species Database, 2023. Species profile: *Eriocheir sinensis*. Available at: <http://www.iucngisd.org/gisd/speciesname/Eriocheir+sinensis>. Accessed 6th December 2023.
- Gollasch, S., 2011. NOBANIS – Invasive Alien Species Fact Sheet – *Eriocheir sinensis*. In: Online Database of the European Network on Invasive Alien Species – NOBANIS [online]. Available at: www.nobanis.org. Accessed 16th January 2024.

- Hewitt, M.J. and McDonald, J.I., 2013. The efficacy of crab condos in capturing small crab species and their use in invasive marine species monitoring. *Management of Biological Invasions*, 4(2), pp.149-153.
- Ironside J, Detheridge A, Griffith G, Zejc K. 2023. Developing and testing methodologies for environmental DNA monitoring of marine invasive non-native species in the Pen Llŷn a'r Sarnau Special Area of Conservation. NRW Evidence Report No: 645, 46pp, Natural Resources Wales, Bangor.
- Lin, F.S., 1987. Valuable and rare aquatic animals in China. Survey and Zoning of China Fishery Resources. Zhejiang, China: Zhejiang Scientific and Technological Press. 170.
- Neal, K.J. 2005. *Eriocheir sinensis* Chinese mitten crab. In Tyler-Walters H. and Hiscock K. Marine Life Information Network: Biology and Sensitivity Key Information Reviews, [online]. Plymouth, UK: Marine Biological Association of the United Kingdom. Available at: <https://www.marlin.ac.uk/species/detail/2057> Accessed 7th December 2023.
- Palero, F., Ferrer-Mateu, I., Wray, B., Hughes, R., Morritt, D., Lepage, M., Kotterman, M., van der Meer, M., Tate, M., Kamanli, S.A. and Smith, L., 2022. Presence of a second *Eriocheir* species in Europe as confirmed by molecular and morphological data. *Aquatic Invasions*, 17(3).
- Qin, J., 2023. *Eriocheir sinensis* (Chinese mitten crab). In: Invasive Species Compendium. Wallingford, UK: CAB International. Available at: <https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.84120> Accessed 6th December 2023. Accessed 16th January 2024.
- Rudnick, D.A., Chan, V. and Resh, V.H., 2005. Morphology and impacts of the burrows of the Chinese mitten crab, *Eriocheir sinensis* H. Milne Edwards (Decapoda, Grapsoidea), in south San Francisco Bay, California, USA. *Crustaceana*, pp.787-807.
- Schoelynck, J., Loon, P. V., Heirmans, R., Jacobs, S., Keirsebelik, H., 2020. Design and testing of a trap removing Chinese mitten crabs (*Eriocheir sinensis*, H. Milne Edwards, 1853) from invaded river systems. *River Res Applic.* 1-11. Available at: <https://acrobat.adobe.com/link/review?uri=urn%3Aaid%3Aascds%3AUS%3A484f9668-6445-49a6-b570-82a78d9f4c3c>
- Sewell, J., 2016. Chinese mitten crab, *Eriocheir sinensis*. In: Non-native species information portal. Great British Non-native Species Secretariat (GBNNSS). Available at: <https://www.nonnativespecies.org/non-native-species/information-portal/view/1379> Accessed 7th December 2023.
- Tillin, H.M., Kessel, C., Sewell, J., Wood, C.A., Bishop, J.D.D. 2020. Assessing the impact of key Marine Invasive Non-Native Species on Welsh MPA habitat

features, fisheries and aquaculture. NRW Evidence Report. Report No: 454, 260pp, Natural Resources Wales, Bangor.

Tillin, H.M. Pegg, S. 2025. Marine Protected Areas: features at risk from marine Invasive Non-Native Species. NRW Evidence report. [not published at time of writing]

Veldhuizen T, Corcoran D. 2000. Chinese mitten crabs habitat use study. IEP Newsletter 13(2):6.

Control and management table's references

Eberhardt, A., Pederson, J., Bisson, B., 2016. Rapid response plan for management and control of the Chinese mitten crab - Northeast United States and Atlantic Canada. New Hampshire, USA: MIT and Maine Sea Grant Programs.

Falkingham, A., Yeardley, J. and Hughes, R., 2016. Monitoring of Chinese Mitten Crabs (*Eriocheir sinensis*) on the River Dee. NRW Evidence Report No: 154, 90 pp, Natural Resources Wales, Bangor
<https://naturalresources.wales/media/684746/evidence-report-154-chinese-mitten-crabs-eriocheir-sinensis-river-dee.pdf>

Schoelynck, J., Loon, P. V., Heirmans, R., Jacobs, S., Keirsebelik, H., 2020. Design and testing of a trap removing Chinese mitten crabs (*Eriocheir sinensis*, H. Milne Edwards, 1853) from invaded river systems. River Res Applic. 1-11.

Qin, J., 2023. *Eriocheir sinensis* (Chinese mitten crab). In: CABI Compendium. UK: CAB International. Available at:
<https://www.cabdigitallibrary.org/doi/10.1079/cabicompendium.84120#sec-42>
Accessed 20th February 2023.

Appendix

Posters (English and Welsh) produced by Natural Resources Wales to raise awareness of the mitten crab and encourage reporting.



Alert: Chinese Mitten Crab sightings in your area!

This invasive non-native species can erode river banks, damage fishing gear and impact our native species.

It can be easily identified by its hairy claws. It is also the only crab in the UK which can be found in fresh water.



WE NEED YOUR HELP!

Your Sightings

Recently Chinese Mitten Crabs have been seen in new areas, including the Conwy estuary. We want to know where this species is and how far it has spread upstream.

You may come across this species close to muddy river banks, under rocks and vegetation.

If you find this species please submit records to the **iRecord app**
Or email enquiries@naturalresourceswales.gov.uk



Remember to always
Check, Clean, Dry to help
prevent the spread of
invasive species



Rhybudd: Cranc Manegog Tsieina wedi'i weld yn eich ardal chi!

Gall y rhywogaeth estron oresgynnol hon erydu glannau afonydd, difrodi offer
pysgota ac effeithio ar ein rhywogaethau brodorol.

Mae'n hawdd ei adnabod gan ei grafangau blewog. Hwn hefyd yw'r unig granc
yn y Deyrnas Unedig sydd i'w weld mewn dŵr croyw.



MAE ANGEN EICH HELP CHI!

Ydych chi wedi'i weld?

Yn ddiweddar gwelwyd Crancod Manegog Tsieina mewn ardaloedd newydd, gan gynnwys aber
afon Conwy. Fe hoffen ni wybod ble mae'r rhywogaeth hon a pha mor bell mae wedi ymledu i
fyny'r afon.

Efallai y dewch ar draws y rhywogaeth hon yn agos at lannau afonydd lleidiog, o dan greigiau a
llystyfiant.

Os dewch o hyd i'r rhywogaeth hon, cyflwynwch eich cofnodion i'r ap iRecord

Neu e-bostiwch ymholiadau@cyfoethnaturiol.cymru



Cofiwch Edrych, Golchi,
Sychu bob tro er mwyn
helpu i atal ymlediad
rhywogaethau goresgynnol



iRecord

Data References

Table 6 Rightsholders and data providers for the open-source data downloaded from NBN Atlas for the purpose of this report.

Rights Holder	Data Provider
Environment Agency	Environment Agency
Marine Biological Association	Marine Biological Association
Marine Biological Association and Biological Records Centre	National Trust
National Trust	Natural History Museum, London
Nottinghamshire Biological and Geological Records Centre	Nottinghamshire Biological and Geological Records Centre

Data Set References:

DASSH Data Archive Centre volunteer sightings records by Marine Biological Association under licence CC BY.

Environment Agency (2023). Crayfish data update for Environment Agency Thames Region March 2009. Occurrence dataset on the NBN Atlas

Environment Agency (2023). England Non Native Species records 1965 to 2017. Occurrence dataset on the NBN Atlas

Environment Agency (2023). Protected and Invasive Species Records Collected Through Environment Agency Survey 1995 - 2021. Occurrence dataset on the NBN Atlas

National Trust (2023). National Trust Species Records. Occurrence dataset on the NBN Atlas

Natural History Museum (2023). Data Portal query on 1 resources

<https://doi.org/10.5519/qd.i4tk4lrk>

Records provided by Nottinghamshire Non-Native Invasive Species Dataset, accessed through NBN Atlas website.

RISC and ALERT Marine Non-Native Species (Chinese Mitten Crab, Wakame and Carpet Sea Squirt) Records by Marine Biological Association under CC-BY

Verified marine records from Indicia-based surveys by Marine Biological Association and Biological Records Centre under licence CC BY. Released under DASSH terms and conditions - See <http://www.dassh.ac.uk/terms-and-conditions>