BIM
Ireland's Seafood Development Agency

ALIEN SPECIES AND AQUACULTURE

A SUMMARY OF WORK TO SUPPORT THE AQUACULTURE SECTOR IN UNDERSTANDING, PREVENTING AND MANAGING IAS RISKS.

Rialtas na hÉireann
Government of Ireland

Arna chomhchistiú ag an Aontas Eorpach

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GiMaRIS

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CONTENTS

LIST OF TABLES AND FIGURES

LIST OF TABLES AND FIGURES

INTRODUCTION

Invasive Alien Species (IAS)[1] are animals and plants that are introduced accidentally or deliberately into a natural environment where they are not normally found, with potential negative consequences for the natural and human environment in which they become established.

Invasive alien species (IAS) are recognised as one of five key drivers of biodiversity loss globally sitting alongside climate change, changes in land & sea use, overexploitation, and pollution (IPBES, 2019 & 2023).

Recognising the potential for Aquaculture to both impact and be impacted by alien species, BIM has undertaken an ongoing IAS work programme, jointly funded by the Government of Ireland and the EU under the European Maritime and Fisheries Fund (EMFF) and most recently by the European Maritime Fisheries and Aquaculture Fund (EMFAF). The aim of this programme is to contribute to the establishment of baseline data, better understand interactions with Aquaculture activities and to empower the sector to minimise impacts through awareness raising, risk assessment and biosecurity planning.

The main component of the work programme has consisted of survey work in aquaculture and non-aquaculture areas to identify alien species and create a baseline. The programme also includes industry training and the development of Risk Assessment and Biosecurity Plans on a case-by-case basis. Having developed their knowledge, BIM have also contributed to wider policy programmes such as MSFD, provision of advice to DAFM with respect to aquaculture licensing issues and the development of a protocol to minimise risk to the environment and to aquaculture operations from invasive alien species.

Part 1 of this report summarises the work of BIM, its partners and industry on the IAS topic.

Part 2 provides a detailed overview of the data collected by species.

ALIEN SPECIES AND AQUACULTURE

Aquaculture can both be impacted by and be the cause of IAS introductions to an area.

Marine aquaculture operates on the foreshore area, thus any impact from IAS introduced via aquaculture practices not only threatens stocks and the natural environment upon which they rely, but also negatively impacts public image and acceptance of the sector. IAS can also impact production and profitability. It is therefore in the Aquaculture sector's best interest to minimise any risks related to introduction of IAS and remain alert to new introductions.

The routes by which alien species enter new areas are known as pathways while the way they travel to new destinations are known as vectors. IAS pathways can be both intentional and unintentional and include commercial shipping, recreational boating, aquaculture and natural dispersal. For aquaculture the main vector is stock movements. Risk assessment helps to identify the risks both arising from aquaculture activities and impacting upon aquaculture operations. The level of risk is influenced not only by the aquaculture activities carried out but also by the natural and human influences at site locations. In the same way that aquaculture businesses are already obliged to put in place biosecurity measures to prevent the introduction of disease, a similar approach can be taken in relation to marine Invasive Alien Species. A biosecurity plan defines measures to control and minimise risks, within the scope of the business activities. Compared with other marine activities, Aquaculture businesses can apply a high level of control. Engagement with neighbouring aquaculture businesses and other sectors further enhances the impact of biosecurity plans.

BIM has been working with aquaculture operators to carry out risk assessments and develop biosecurity plans. However, a key challenge for the process is identifying what action should be taken by whom in the event of an invasive alien species being found by an aquaculture operator or at an aquaculture facility. To ensure the effectiveness of biosecurity plans it is important that aquaculture operators understand and trust the process and the consequences in the event of an invasive species being confirmed.

1. Also referred to as invasive non-native species INNS. See Appendix 2 for definitions.

LEGISLATIVE & POLICY CONTEXT

The following section provides a short overview of the international and domestic legislative and policy context:

INTERNATIONAL

Convention on Biological Diversity (CBD)

On a global level, the Convention on Biological Diversity (CBD) considers Non-Indigenous Species (NIS) aiming to protect and restore all ecosystems, while the International Maritime Organization (IMO) aims to reduce the risk of NIS specifically within the marine realm.

The (Kunming-Montreal) Global Biodiversity Framework

Adopted by world leaders in December 2022, the framework has 23 targets and sets out to halt and reverse nature loss by 2030. Target 6 of the of the Framework relates to IAS: Eliminate, minimize, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing pathways of the introduction of alien species, preventing the introduction and establishment of priority invasive alien species, reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 percent, by 2030, eradicating or controlling invasive alien species especially in priority sites, such as islands.

EU

EU Biodiversity Strategy

The EU Biodiversity Strategy for 2030 contains the commitment to manage established invasive alien species and decrease the number of Red List species they threaten by 50% by 2030.

The Invasive Alien Species Regulation (Regulation (EU) 1143/2014)

This regulation provides for a set of measures to be taken across the EU in relation to invasive alien species. It includes a list of Invasive Alien Species of Union concern (the Union list). All species on the list are subject to specified restrictions and measures. This list is periodically reviewed and currently contains only two marine species – *Eriocheir sinensis* (Chinese Mitten Crab) and *Rugulopteryx okamurae* (a brown seaweed). The regulation requires Member States to:

- take action on pathways of unintentional introduction (i.e. prevention);
- take measures for the early detection and rapid eradication of these species;
- manage species that are already widely spread in their territory.

Marine Strategy Framework Directive (MSFD) 2008/56/EC

Descriptor 2 of the MSFD relates to Non-indigenous Species (NIS). It requires that NIS introduced by human activities are at levels that do not adversely alter ecosystems. It focuses on the assessment of the scale of the pressure and impacts of marine non-indigenous species in relation to the main vectors and pathways. New introductions of NIS and increases in the abundance and spatial distribution of established NIS should be prevented. It is recognized that there is only limited knowledge about the effects of the NIS on the marine ecosystem, which implies additional scientific and technical development focused on new potentially useful indicators.

Use of Alien & Locally Absent Species in Aquaculture Regulation (EC) 708/2007

These regulations require that member states take all appropriate measures to avoid adverse effects on biodiversity resulting from the movement of aquatic organisms for aquaculture purposes and from the spreading of those organisms from closed aquaculture facilities and during transport to and from such facilities.

NATIONAL

4th National Biodiversity Action Plan

The 4th NBAP is at the final stages of adoption and contains a number of actions specific to the control and management of alien species, including a **National Invasive Alien Species Plan**. This plan is currently in preparation and will take a whole of government, whole of society approach to its development and implementation. BIM hold a seat on the steering committee for the development of the plan.

European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)

Regulations 49 and 50 of the Birds and Natural Habitats Regulations relate to alien species introduction, dispersal and the prohibition on dealing in and keeping certain species. However, these regulations have not been enacted. New IAS legislation is currently being drafted by DHLGH to implement EU Regulation 1143/2014 in the national context and will also deal comprehensively with the provisions of Regulations 49 and 50.

Part 1

BIM ENGAGEMENT & WORK PROGRAMME

BIM has engaged with and lead on a range of alien species initiatives to support the aquaculture sector. Below is a summary of the key work since 2007.

INVASIVE SPECIES IRELAND (ISI)

The first Invasive Species Ireland project began in 2006 as an all-island initiative to take forward recommendations from a joint paper "Invasive Species in Ireland" presented to both Governments in 2004. BIM engaged actively with the project which ran until 2012, and contributed to the development of the first Aquaculture Risk Assessment template.

ENGAGEMENT & WORKING GROUPS

To address a void following the conclusion of the ISI project, and recognising a need to keep IAS issues on the radar for the aquaculture sector, in 2016, BIM established a working group with cross agency and departmental membership. The role of the group was to address relevant IAS issues including the development of a Risk Assessment and Biosecurity plan template for aquaculture businesses.

Additionally, BIM have been involved in a range of IAS projects and events, building contact and networks which in turn offer support to successful delivery of the work programme:

- UK Ireland Marine Pathways working group established by Natural Resources Wales to share information, carry out horizon scanning and address common challenges.
- GMIT Marine Invasive Alien Species (MIAS) project and workshop.
- National Alien Species Horizon scanning exercise.
- Marine Strategy Framework Directive D2 (Non-indigenous Species) working group.
- Most recently in 2023, BIM has participated on Steering Committee for the development of a National IAS Management Plan. This work is ongoing.

RISK ASSESSMENT & BIOSECURITY PLANNING

Together with the IAS & Aquaculture Working Group and industry, BIM developed a Risk Assessment and Biosecurity Protocol for the sector. The Risk Assessment & Biosecurity Plan template has been utilised nationwide for a range of purposes. Individual businesses have used it to address biodiversity targets as part of environmental or organic certification of their activities / products. It has also been used to assess individual movements, and address issues linked to specific alien species.

The protocol sets out actions for Shellfish Aquaculture and Aquatic Plant Aquaculture licence holders to assess IAS risks and to develop and implement biosecurity measures to minimise those risks identified. It follows a consistent six step process and helps direct management actions in relation to alien species for which shellfish movements are a known high-risk vector.

A key challenge for the process is identifying what action should be taken by whom in the event of an invasive alien species being found by an aquaculture operator or at an aquaculture facility. To ensure the effectiveness of Biosecurity Plans, it is important that aquaculture operators understand and trust the process and the consequences in the event of a high-risk invasive species being confirmed. The response is still evolving and is case specific.

To date, there have been more than 20 assessments, two thirds of which relate to business level assessment of general practices and one third for assessments to inform decision-making linked to specific movements.

SPECIES IDENTIFICATION

To ensure the success of risk assessment process, it is important that aquaculture operators and officials are aware of the alien species of concern and whether they are already present in Ireland or likely to arrive in the near future. In many cases non-native species appear similar to native species and identification is difficult. Together with GiMaRIS a number of species ID cards have been produced for Crabs, Tunicates, Molluscs and Bivalve Molluscs. Figure 1 show an example ID card for invasive crab species.

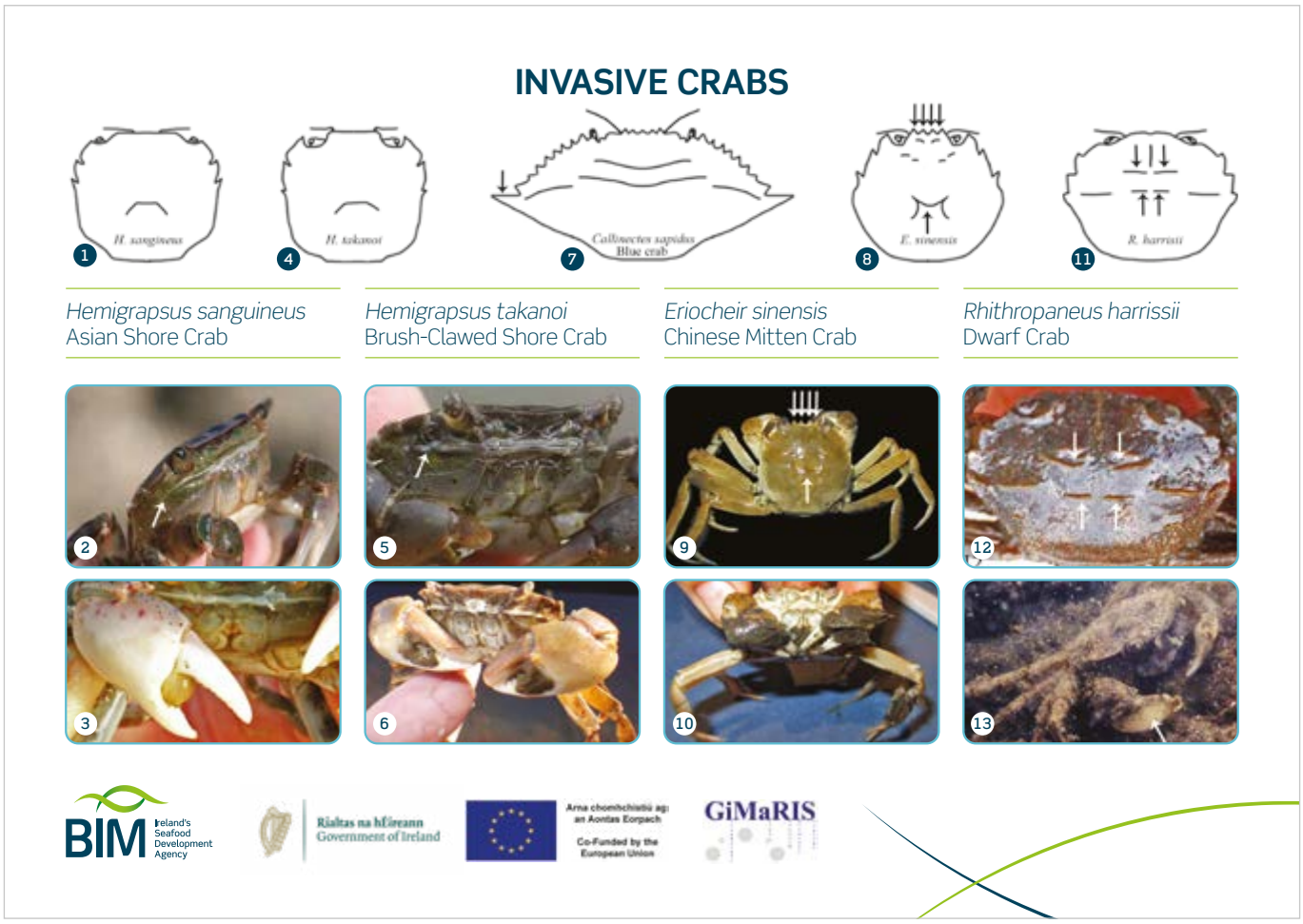

Figure 1: Example of laminate ID card provided to industry during practical training sessions.

Information on key alien species of relevance to the aquaculture sector are available on the BIM website: https://bim.ie/aquaculture/sustainability-and-certification/marine-invasive-species/.

The approach for identification that is promoted by BIM is to be able to provide a description and take useful photographs of species that will allow for expert identification. If a species cannot be identified at this stage, sampling will be arranged to facilitate morphological or DNA identification and confirmation.

INDUSTRY AND STAFF TRAINING

BIM has facilitated GiMaRIS to deliver six separate workshops for industry groups and officials. Most recently, a workshop on species identification was conducted as part of wider shellfish workshops – Rope Grown Mussels in 2022 and Oysters in 2023.

The workshops are practical and for the most part focuses on how to describe and photograph / draw a species of interest so that when presented with the information, it is easier for a taxonomist to confirm identification.

BOTTOM GROWN MUSSEL SECTOR

Permission for seed fishing to supply the bottom grown mussel sector, and retention of Marine Stewardship Council (MSC) certification requires risk assessment for the movement of mussel seed and stocks from seed beds to licensed sites and between licensed sites. This is conducted annually following seed bed surveys and prior to opening of the fishery.

DATA COLLECTION / SASI

Through working with the bottom grown mussel sector as far back as 2013, BIM first became aware of SASI monitoring being conducted in Ireland by GiMaRIS in order to meet legislative requirements for Dutch imports.

In order to reduce the risk of transporting new alien species into Dutch waters with shellfish transports, the Dutch government (Bleker, 2012) requires monitoring surveys in the export area (Shellfish Associated Species Inventory, SASI) and test sampling of the shellfish upon arrival. These mandatory surveys are described in the Shellfish Import Monitoring & action Protocol (SIMP). The SIMP was first developed in 2010 and has been optimized over the years (Gittenberger, 2018). Initially Dutch importers organised SASI surveys directly with Irish growers who were selling to the Netherlands and already a good baseline of data was established. Since 2018, BIM have been supporting this monitoring and have expanded its geographic scope to cover all main shellfish growing areas and some additional non aquaculture areas. Part 2 of this report is dedicated to the results of survey work in Ireland using the SASI method. Since 2010, researchers have used the SASI method in various regions of northwest Europe (Fig. 2), including areas with shellfish farming and wild fisheries, as well as protected areas, to evaluate the diversity of both native and non-native species. These surveys help implement protocols that aim to decrease the risks associated with transporting shellfish, as well as to establish and prioritize management strategies for non-native species in dedicated protected areas.

SPECIES RISK ASSESSMENTS AND ACTION

Species specific risk assessments were developed for four key species of relevance to aquaculture in an Irish context following the international non-native organism risk assessment scheme: *Crepidula fornicata; Eriocheir sinensis; Mulinia lateralis; and Undaria pinnatifida.*

BIM supported practical PhD research on control of *Didemnum vexillum*, an invasive tunicate. Practical guidance was developed and shared with growers dealing with *Didemnum vexillum* on their oyster sites to control and minimise spread.

In autumn 2020, the Chinese Mitten Crab *(Eriocheir sinensis)* was detected in Morecombe Bay in the UK following a movement of seed mussel from that area to Carlingford Lough earlier that year. The movement had been approved following development of a Risk Assessment & Biosecurity plan, meaning that a working relationship was already established with UK officials. While the risk of movement of Chinese Mitten Crab with the seed mussel consignment was considered to be low, a rapid response assessment was undertaken in Carlingford Lough and as Chinese Mitten Crab is an Invasive Alien Species of Union Concern, this was followed up by a more comprehensive survey of the East coast of Ireland during 2021. This resulted in the unrelated detection of Chinese Mitten Crab in Waterford estuary. This was reported to the National Biodiversity Data Centre who in turn followed EU notification procedures as per legislative requirements.

The bottom grown mussel sector supported and engaged fully with this process. This example demonstrates the combined success of the IAS work programme including monitoring, engagement, industry training, risk assessment and biosecurity planning.

Figure 2: Areas in northwest Europe where SASIs (Shellfish Associated Species Surveys) have been conducted since 2010. To remain relevant and produce a consistent time series, surveys are typically repeated once every three years in most regions. The survey data primarily serves the purposes of managing marine alien species and ensuring compliance with both EU legislation (e.g., MSFD, Natura2000) and international guidelines (of e.g., OSPAR, HELCOM, IMO and UNESCO, depending on the area concerned).

In 2019 the annual mussel seed surveys revealed the presence of a small white ascidian colony, which raised concerns as it was potentially the invasive species *Didemnum vexillum*. A week after the discovery, the researchers conducted a follow-up study that comprised several components. These included conducting an additional survey at the site where the didemnid was found, re-examining the original didemnid material collected, and performing various rapid assessments along the east coast of Ireland. The main focus of these assessments was to evaluate the distribution of *Didemnum vexillum* at that specific time. The purpose of all these efforts was to assess the potential risk associated with moving mussel seed. Based on these assessments, more insight was gained on the distribution of *Didemnum vexillum* and in the end the ascidian colony detected was confirmed to be a native species creating no risk.

CONCLUSIONS & RECOMMENDATIONS

- Alien species will continue to arrive in marine and coastal environments and impact our natural environment and seafood activities.

- A strong baseline on marine alien species has been established and it is important to build upon this into the future both for the protection of the environment and of the aquaculture sector.

- Risk assessments support decision making and should continue to be used in relation to aquaculture activities.

- As a result of this work programme the Irish aquaculture sector is better informed and educated on the risks from and to their business activities and are able acting accordingly through the implementation of appropriate biosecurity measures.

- Data collection jointly funded by the Government of Ireland and the EU under EMFF and EMFAF, presented in this report has wider applications, for example, MSFD, and can be used to support management and decision making in relation to other marine issues.

- BIM have acquired a lot of knowledge and experience in the area and are able to contribute more widely to national work programmes such as the implementation of the National Biodiversity Action Plan and MSFD Programmes of Measures. Collaboration and partnership with other government departments and agencies, as well as with industry, should continue, as it will work to avoid duplication and maximise the effective use of available resources.

Part 2

ALIEN SPECIES MONITORING IN IRISH AQUACULTURE BAYS

The Dutch government (Bleker, 2012) has implemented measures to minimize the introduction of alien species into Dutch waters during shellfish transports. These measures necessitate the implementation of Shellfish Associated Species Inventories (SASIs) in the export areas, as part of the Shellfish Import Monitoring & action Protocol (SIMP). The development of this protocol dates back to 2010. Over the years, there has been a continuous effort to optimize the process (Gittenberger 2018), while the method for performing a SASI has remained unchanged.

During a SASI, multiple samples are collected in a shellfish area, are searched for all native and non-native species that are visible to the naked eye. At least one detailed photograph is taken of each species. Species that cannot be identified directly in the field, such as amphipods, sponges and algae, are collected in tubes with seawater awaiting identification post fieldwork. Animals are preserved in 96% ethanol and algae are preserved in ethanol 96% and formaldehyde 4%. DNA-analysis is also sometimes used to assist with identification. Typically, when conducting surveys, 70 to 90 samples are collected from various locations within the designated survey area. Subsequently, a species accumulation curve analysis is performed in order to evaluate the comprehensiveness of the survey.

To gain a more holistic understanding of the distribution of marine alien species around Ireland, researchers also conducted searches at a selection of marinas. Recent studies have identified recreational craft and other vessels as the primary introduction vectors for marine alien species in almost all European countries, including the Republic of Ireland. The assessments of species in marinas primarily relied on visual inspections, where specific samples were collected for further analysis in the laboratory, both morphologically and molecularly, and photographs were taken of all recorded species. The main focus of these surveys was to study fouling communities on various floating objects like buoys and pontoons. Additionally, the surveys also covered other structures such as harbour walls and, for instance, ropes that were found submerged in water. In order to increase the likelihood of detecting non-native species, the harbour masters, if they were present, were questioned about the maintenance schedules of the pontoons. The researchers prioritized pontoons that had not undergone cleaning for the longest period of time, as they expected to find a higher prevalence of fouling species. When doing a visual inspection, an area or habitat within a marina was searched until the researchers expected to find less than one more species within double the time. Once a species was recorded, the survey would then allocate the remaining time to actively seek for other species. It was found that within most areas of a marina, virtually all species were recorded within the first few minutes of the search.

ALIEN SPECIES RECORDED IN IRELAND DURING SURVEYS BETWEEN 2010 AND 2022

Between 2010 and 2022, GiMaRIS has conducted a total of 114 SASIs in Ireland, covering 40 shellfish production areas. These production areas differ in the shellfish produced, i.e. mussels or oysters, and the way in which the shellfish are produced, i.e. bottom culture, rope culture or trestles (Table 2). Furthermore, 11 additional surveys were carried out at different locations, including marinas and ports, since 2020 (Fig. 3 & Table 2)

The species records presented in the following sections are from surveys completed for the Dutch shellfish importers from 2013 to 2017, and from 2018 to 2022 from surveys commissioned by BIM and funded by EMFF and EMFAF.

During these surveys, a total of 672 different species have been identified. Of these species, 45 were of alien or cryptogenic origin (Table 1). The locations and years in which these alien species were found, are specified in this report. This data on the distribution of species over time and space along the Irish coastline has wider applications than simply being used to inform risk assessments of proposed shellfish transports. It can be used more generally for developing management protocols and actions to minimise the risk of introduction and subsequent spread of marine alien species in Ireland.

Eight of these species were first recorded for the Republic of Ireland within these surveys. These are: the seaweeds *Grateloupia turuturu, Ulva australis, Ulva rhacodes, Undaria pinnatifida* and *Lomentaria hakodatensis;* the sea-squirt *Asterocarpa humilis;* and the bryozoans *Bugulina simplex* and *Smittoidea prolifica*. This was concluded from a recent review study on marine NIS found in the Republic of Ireland up to 2020, which strongly depended on the results of these surveys (Gittenberger et al, 2023). The eight “new” species were reported between 2011–2020 in areas with shellfish aquaculture, fisheries and/or in marinas.

Table 1 - Alien Species recorded in Irish waters during GiMaRIS surveys between 2010 and 2022.

Alien Species recorded in Irish waters during GiMaRIS surveys between 2010 and 2022.														
	Species	Group	Louth	Dublin	Wicklow	Wexford	Waterford	Cork	Kerry	Clare	Galway	Mayo	Sligo	Donegal
1	cf. *Agardhiella subulata*	Algae					x							
2	*Antithamnionella spirographidis*	Algae	x			x	x		x					x
3	*Antithamnionella ternifolia*	Algae						x	x	x	x			x
4	*Asparagopsis armata*	Algae							x			x		
5	*Bonnemaisonia hamifera*	Algae	x	x			x	x	x			x		x
6	*Codium fragile*	Algae					x	x	x		x			x
7	*Colpomenia peregrina*	Algae		x				x	x			x		x
8	*Cryptonemia hibernica*	Algae						x						
9	*Dasysiphonia japonica*	Algae	x							x	x	x		x
10	*Gracilaria vermiculophylla*	Algae				x	x							x
11	*Grateloupia turuturu*	Algae		x		x		x	x					
12	*Lomentaria hakodatensis*	Algae						x	x					
13	*Melanothamnus harveyi*	Algae		x		x		x	x	x	x	x		x
14	*Sargassum muticum*	Algae	x			x		x	x		x	x	x	x
15	*Ulva australis*	Algae				x		x	x					x
16	*Ulva rhacodes*	Algae						x						
17	*Undaria pinnatifida*	Algae		x		x			x					x
18	cf. *Neodexiospira brasiliensis*	Annelida		x							x			
19	*Aplidium glabrum*	Ascidiacea						x	x	x	x	x		x
20	*Asterocarpa humilis*	Ascidiacea		x										
21	*Botrylloides violaceus*	Ascidiacea	x	x		x	x	x	x	x	x	x		x
22	*Didemnum vexillum*	Ascidiacea	x	x					x	x	x	x		x
23	*Molgula manhattensis*	Ascidiacea		x		x		x	x					x
24	*Perophora japonica*	Ascidiacea	x			x			x	x	x	x		x
25	*Phallusia mammillata*	Ascidiacea						x						
26	*Styela clava*	Ascidiacea		x	x	x		x	x		x	x		x

	Species	Group	Louth	Dublin	Wicklow	Wexford	Waterford	Cork	Kerry	Clare	Galway	Mayo	Sligo	Donegal
27	*Bugula neritina*	Bryozoa		x			x	x						
28	*Bugulina simplex*	Bryozoa				x	x							
29	*Bugulina stolonifera*	Bryozoa					x							x
30	cf. *Fenestrulina delicia*	Bryozoa												x
31	*Smittoidea prolifica*	Bryozoa				x			x					
32	*Tricellaria inopinata*	Bryozoa		x			x	x						
33	*Watersipora subatra*	Bryozoa		x										
34	*Cordylophora caspia*	Cnidaria					x							
35	*Diadumene lineata*	Cnidaria									x			
36	*Amphibalanus improvisus*	Crustacea				x	x		x					
37	*Austrominius modestus*	Crustacea	x		x	x	x	x	x	x	x	x	x	x
38	*Caprella mutica*	Crustacea		x		x		x	x		x	x		x
39	*Jassa marmorata*	Crustacea		x				x	x			x		x
40	*Monocorophium acherusicum*	Crustacea	x											
41	*Calyptraea chinensis*	Mollusca									x			
42	*Crepidula fornicata*	Mollusca												x
43	*Magallana gigas*	Mollusca	*			*	*	x	x	*	x	*	*	x
44	*Mya arenaria*	Mollusca							x					
45	*Teredo navalis*	Mollusca												x

* *Magallana gigas* only recorded in bags on trestles.

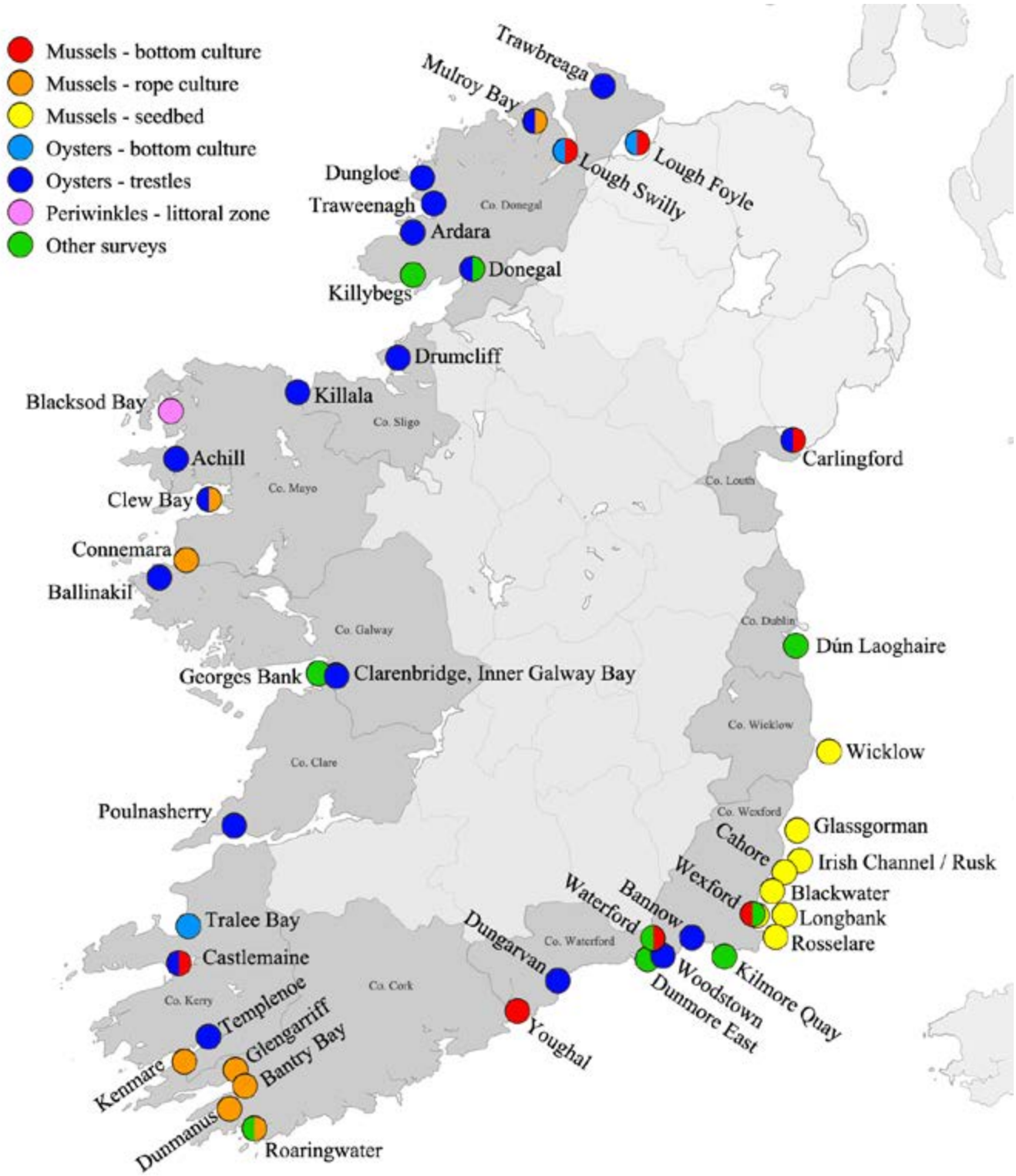

Figure 3: The research locations where surveys have been conducted between 2010 and 2022 (Table 1).

TABLE 2 - The 55 areas where surveys were conducted between 2010 and 2022 (Fig 3). Where SASIs are concerned, the specific species (mussels, oysters or periwinkles) for that area are noted, together with the aquaculture method (bottom grown culture, seed fishery, rope culture, trestles). For other surveys, there is no specific aquaculture species. The habitat/ human activity on which the survey was focused is indicated. Co-ordinates are a median point in the bay where the surveys were conducted.

	Area	Culture Species	Culture Method / Habitat Type	Year	Coordinates	
County Louth						
1	Carlingford Lough	Mussels	Bottom culture	2011	54.07025	-6.21433
				2014	54.07595	-6.22750
				2017	54.06328	-6.20368
				2020	54.09773	-6.23445
2		Oysters	Trestles	2016	54.02061	-6.12318
				2019	54.01928	-6.12493
				2022	54.02070	-6.12468
County Dublin						
3	Dún Laoghaire Harbour	n.a.	Floating dock, buoy	2019	53.29783	-6.13674
				2020	53.29783	-6.13674
County Wicklow						
4	Wicklow	Mussels	Seedbed	2019	52.90987	-5.99234
				2022	52.94035	-5.93642
County Wexford						
5	Bannow Bay	Oysters	Trestles	2021	52.23613	-6.78055
				2022	52.23303	-6.78370
6	Blackwater	Mussels	Seedbed	2021	52.44082	-6.28460
7	Cahore	Mussels	Seedbed	2020	52.52880	-6.16905
				2021	52.48617	-6.24947
				2022	52.47992	-6.26387
8	Glassgorman	Mussels	Seedbed	2021	52.60773	-6.14631
9	Irish Channel / Rusk	Seedbed	Seedbed	2022	52.51000	-6.17582
10	Kilmore Quay	n.a.	Full marina	2020	52.17240	-6.58802
11	Longbank	Seedbed	Seedbed	2022	52.34902	-6.25068

Area		Culture Species	Culture Method / Habitat Type	Year	Coordinates	
County Wexford						
12	Rosslare	Mussels	Seedbed	2017	52.25970	-6.30678
				2020	52.26095	-6.31070
				2021	52.25393	-6.30272
13	Wexford	Mussels	Bottom culture	2011	52.32627	-6.43193
				2014	52.34783	-6.40430
				2017	52.34490	-6.44493
				2019	52.34413	-6.44868
				2022	52.33725	-6.44032
14		Mussels	Seedbed	2019	52.34387	-6.25063
15		n.a	Bottom	2020	52.32434	-6.35563
County Waterford						
16	Dungarvan	Oysters	Trestles	2018	52.07443	-7.59048
				2021	52.06672	-7.58875
17	Dunmore East	n.a.	Full marina	2020	52.14815	-6.99014
18	Waterford Harbour	Mussels	Bottom culture	2011	52.35245	-6.40965
				2014	52.22752	-6.94807
				2017	52.23388	-6.94605
19	Waterford Marina	n.a.	Full marina	2020	52.25783	-7.10079
20	Woodstown	Oysters	Trestles	2017	52.19212	-6.97148
				2019	52.18838	-6.97168
				2022	52.19183	-6.96902

Area		Culture Species	Culture Method / Habitat Type	Year	Coordinates	
County Cork						
21	Bantry Bay	Mussels	Rope culture	2012	51.70595	-9.47745
				2015	51.71513	-9.47955
				2018	51.69092	-9.47848
				2020	51.71072	-9.48692
22	Dunmanus Bay	Mussels	Rope culture	2012	51.60687	-9.55190
				2015	51.60672	-9.55293
				2018	51.60923	-9.54805
				2020	51.60772	-9.55397
23	Glengarriff	Mussels	Rope culture	2014	51.72835	-9.54460
				2017	51.72703	-9.54280
				2020	51.73302	-9.54705
24	Roaringwater Bay	n.a.	Floating dock	2020	51.53650	-9.41385
25		Mussels	Rope culture	2020	51.53650	-9.41385
26	Youghal Bay	Mussels	Bottom culture	2011	51.97395	-7.84325
				2014	51.96705	-7.83735
				2017	51.96065	-7.84812

Area		Culture Species	Culture Method / Habitat Type	Year	Coordinates	
County Kerry						
27	Castlemaine Harbour	Mussels	Bottom culture	2010	52.12995	-9.81853
				2013	52.13212	-9.91743
				2016	52.13303	-9.91867
				2019	52.13403	-9.91792
				2022	52.13302	-9.92195
28		Oysters	Trestles	2018	52.15447	-9.83017
				2021	52.15462	-9.83182
29	Kenmare River	Mussels	Rope culture	2012	51.75072	-9.87587
				2015	51.75072	-9.87587
				2018	51.76840	-9.83500
				2021	51.77318	-9.81273
30	Templenoe	Oysters	Trestles	2016	51.86683	-9.66242
				2019	51.86507	-9.67350
				2022	51.86522	-9.67140
31	Tralee Bay	Oysters	Bottom culture	2012	52.26838	-9.79720
				2015	52.26835	-9.85895
				2018	52.26753	-9.82558
				2021	52.26777	-9.85820
County Clare						
32	Poulnasherry	Oysters	Trestles	2018	52.63600	-9.54822
				2021	52.63810	-9.54770

Area		Culture Species	Culture Method / Habitat Type	Year	Coordinates	
County Galway						
33	Ballinakill	Oysters	Trestles	2016	53.55498	-9.99208
				2019	53.55680	-9.98795
				2022	53.55113	-10.00001
34	Clarenbridge, Inner Galway Bay	Oysters	Trestles	2016	53.21563	-8.92088
				2019	53.17848	-8.95598
				2022	53.20232	-8.94098
35	Connemara / Killary	Mussels	Rope culture	2012	53.61980	-9.84712
				2015	53.61907	-9.84528
36	Georges Bank	n.a.	Bottom culture	2020	53.19843	-8.96445
County Mayo						
37	Achill	Oysters	Trestles	2016	53.91925	-9.92007
				2019	54.00001	-9.89040
				2022	53.92163	-9.91712
38	Blacksod Bay	Littorina	Bottom culture	2021	54.15185	-9.94705
39	Clew Bay	Mussels	Rope culture	2021	53.86483	-9.63003
40		Oysters	Trestles	2012	53.88298	-9.67427
				2015	53.88292	-9.67493
				2018	53.79062	-9.61772
				2021	53.89140	-9.68717
41	Killala	Oysters	Trestles	2016	54.21140	-9.19207
				2019	54.21065	-9.19258

Area		Culture Species	Culture Method / Habitat Type	Year	Coordinates	
County Sligo						
42	Drumcliff	Oysters	Trestles	2016	54.33598	-8.55477
				2019	54.33992	-8.55830
				2022	54.33717	-8.55592
County Donegal						
43	Ardara	Oysters	Trestles	2016	54.76212	-8.47495
				2019	54.76338	-8.47423
				2022	54.76425	-8.47660
44	Donegal	n.a.	Floating dock	2021	54.65147	-8.11378
45		Oysters	Trestles	2018	54.62930	-8.17070
				2021	54.62190	-8.13700
46	Dungloe	Oysters	Trestles	2016	54.94275	-8.39882
				2019	54.94728	-8.40307
				2022	54.94370	-8.39793
47	Killybegs	n.a.	Dike	2021	54.62540	-8.47687
			Floating dock	2021	54.63263	-8.44472
48	Lough Foyle	Mussels	Bottom culture	2011	55.07752	-7.19678
				2014	55.14315	-7.11820
				2017	55.13888	-7.12017
49		Oysters	Bottom culture	2012	55.09783	-7.09445
				2015	55.14643	-7.15255
				2018	55.07530	-7.08720
				2020	55.13905	-7.07940

Area		Culture Species	Culture Method / Habitat Type	Year	Coordinates	
50	Lough Swilly	Mussels	Bottom culture	2014	55.04043	-7.52062
				2017	55.02538	-7.52955
51		Oysters	Bottom culture	2012	55.02300	-7.55673
				2015	54.99657	-7.59562
				2018	55.02620	-7.52985
				2021	55.00001	-7.57885
52	Mulroy Bay	Mussels	Rope culture	2013	55.15393	-7.68348
				2015	55.15393	-7.68348
				2018	55.15713	-7.67927
				2021	55.15363	-7.68890
53		Oysters	Trestles	2016	55.18240	-7.75068
				2019	55.18540	-7.78662
				2022	55.18543	-7.78568
54	Trawbreaga Bay	Oysters	Trestles	2012	55.28760	-7.31178
				2015	55.28703	-7.31377
				2018	55.28765	-7.31473
				2021	55.28865	-7.30988
55	Trawenagh Bay	Oysters	Trestles	2016	54.88208	-8.33830
				2019	54.88353	-8.34755
				2022	54.88208	-8.34310

cf. *Agardhiella subulata*

(C.Agardh) Kraft & M.J.Wynne
Algae (Rhodophyta)

Common name:
-

Origin:
NW Atlantic (Wolff, 2005).

First introduction in NW Europe:
<1973, UK (Stegenga, 1999a).

First introduction in Ireland:
2018, co. Waterford (This report).
N.B.Species is only scored as cf., indicating that it presence in Ireland still needs to be confirmed.

Distribution Ireland:
(based on surveys in Table 2)
The species was only recorded once, i.e., in 2018, in county Waterford (Fig. 4; Appendix).

Antithamnionella spirographidis

(Schiffner) E.M.Wollaston
Algae (Rhodophyta)

Common name:
-

Origin:
N Pacific (Maggs & Stegenga, 1999).

First introduction in NW Europe:
1906, Britain (Eno et al., 1997).

First introduction in Ireland:
1969 (NBDC, 2014).

Distribution in Ireland:
(based on surveys in Table 2)
This seaweeds species was found widespread along the north, east and south coasts of Ireland (Fig. 5; Appendix).

Figure 4: The locations where cf. *Agardhiella subulata* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.
* Species is only scored here as cf. *(conforma)*

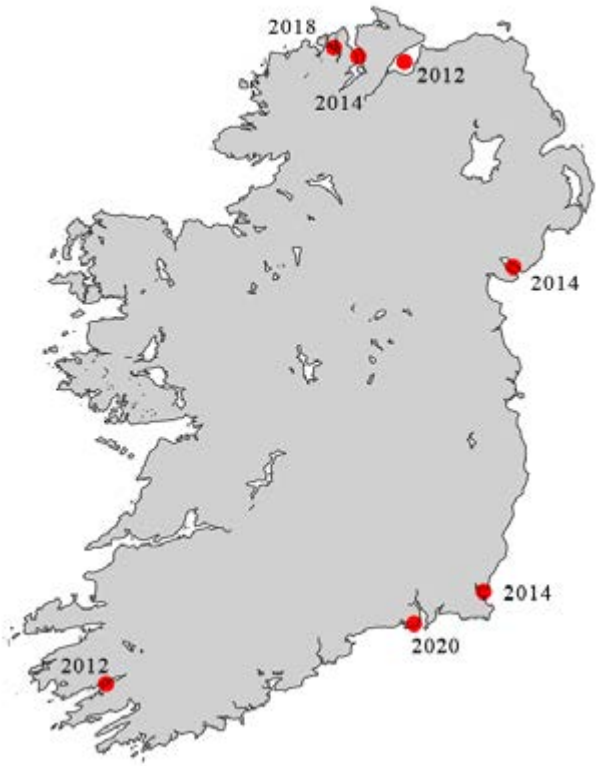

Figure 5: The locations where *Antithamnionella spirographidis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Antithamnionella ternifolia

(J.D.Hooker & Harvey) Lyle
Algae (Rhodophyta)

Common name:
-

Origin:
S Pacific (Reise et al., 2002).

First introduction in NW Europe:
1926 North Sea coasts, (Reise et al., 2002).

First introduction in Ireland:
1930 (NBDC, 2014).

Distribution Ireland:
(based on surveys in Table 2)
The species was recorded mainly the southwest and north of Ireland (Fig. 6; Appendix).

Asparagopsis armata

Harvey
Algae (Rhodophyta)

Common name:
Harpoon Weed

Origin:
S Pacific (Reise et al., 2002).

First introduction in NW Europe:
1925, France (Maggs & Stegenga 1999).

First introduction in Ireland:
1941, co. Galway (NBDC, 2014).

Distribution in Ireland:
(based on surveys in Table 2)
The distribution of this species appears to be restricted to the east coast of Ireland (Fig. 7; Appendix).

Figure 6: The locations where *Antithamnionella ternifolia* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location. * Species is only scored here as cf. *(conforma)*

Figure 7: The locations where *Asparagopsis armata* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Bonnemaisonia hamifera

Hariot
Algae (Rhodophyta)

Common name:
Bonnemaison's Hook Weed

Origin:
N Pacific (Reise et al., 2002).

First introduction in NW Europe:
1890, England (Maggs & Stegenga 1999).

First introduction in Ireland:
1911 (NBDC, 2014).

Distribution Ireland:
(based on surveys in Table 2)
The species is found widespread all around the island of Ireland (Fig. 8; Appendix).

Codium fragile

(Suringar) Hariot
Algae (Chlorophyta)

Common name:
Green Sponge Fingers

Origin:
NW Pacific (Chapman, 1999).

First introduction in NW Europe:
<1900, Netherlands (Van Goor, 1923).

First introduction in Ireland:
1845 (Nunes et al., 2014).

Distribution in Ireland:
(based on surveys in Table 2)
The species was found mainly on the north, south and west coast of Ireland (Fig. 9; Appendix).

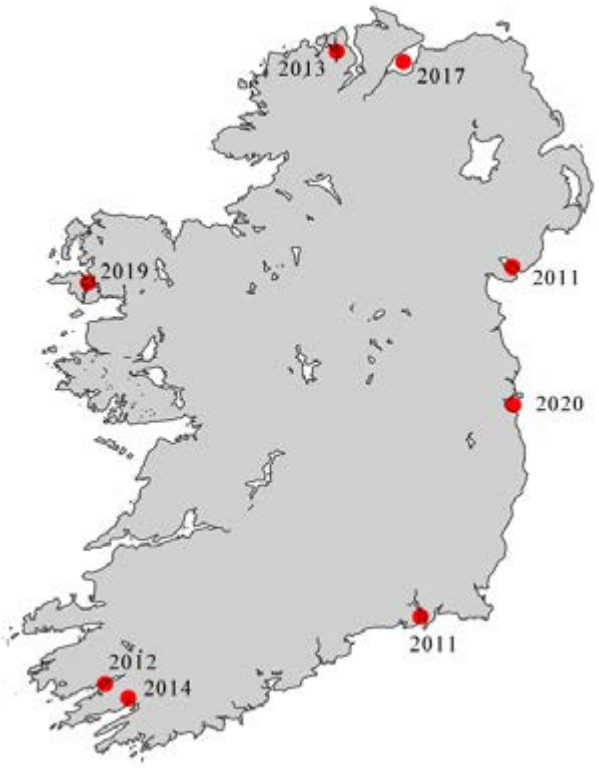

Figure 8: The locations where *Bonnemaisonia hamifera* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

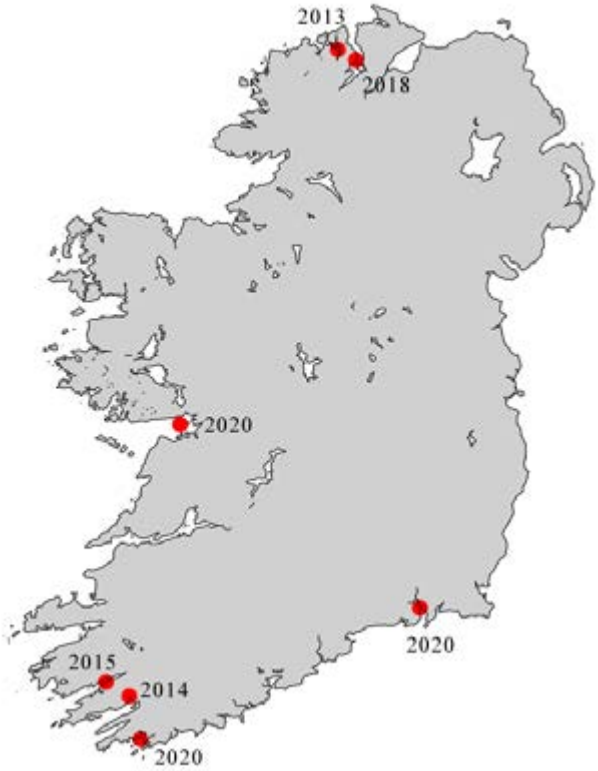

Figure 9: The locations where *Codium fragile* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Colpomenia peregrina

Sauvageau
Algae (Ochrophyta)

Common name:
Oyster Thief

Origin:
NW Atlantic (Wolff, 2005)

First introduction in NW Europe:
Unknown , Spain (Goulletquer Bachelet Sauriau & Noel 2002).

First introduction in Ireland:
1935 (NBDC, 2014).

Distribution Ireland:
(based on surveys in Table 2)
The species was reported widespread throughout Ireland, but mainly in the southwest of the island (Fig. 10; Appendix).

Cryptonemia hibernica

Guiry & L.M.Irvine, 1974
Algae (Rhodophyta)

Common name:
-

Origin:
SE Atlantic (Guiry & Irvine, 1974).

First introduction in NW Europe:
1971, Ireland (Guiry & Irvine, 1974).

First introduction in Ireland:
1971, Co. Cork (Guiry & Irvine, 1974).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only reported once in 2015, in Bantry Bay, co. Cork (Fig. 11; Appendix).

Figure 10: The locations where *Colpomenia peregrina* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Figure 11: The locations where *Cryptonemia hibernica* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Dasysiphonia japonica

(Yendo) H.-S.Kim
Algae (Rhodophyta)

Common name:
Siphoned Japan Weed

Origin:
NW pacific (Sjøtun et al., 2008).

First introduction in NW Europe:
1997, Netherlands (Maggs & Stegenga 1999).

First introduction in Ireland:
2002, co. Clare (Sjøtun et al., 2008).

Distribution Ireland:
(based on surveys in Table 2)
The species has its main distribution on the north, west and east coasts (Fig. 12; Appendix).

Gracilaria vermiculophylla

(Ohmi) Papenfuss
Algae (Rhodophyta)

Common name:
Wart Weed

Origin:
Pacific (Gollasch & Nehring, 2006).

First introduction in NW Europe:
1996, France (Rueness, 2005).

First introduction in Ireland:
2012, co. Louth (Minchin & Nunn, 2013).

Distribution in Ireland:
(based on surveys in Table 2)
The species was found localised on the north and south coasts of Ireland (Fig. 13; Appendix).

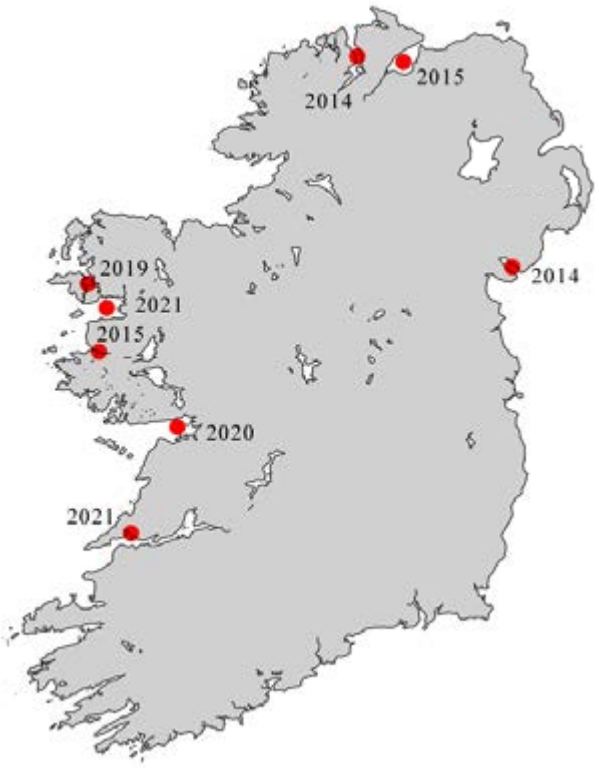

Figure 12: The locations where *Dasysiphonia japonica* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Figure 13: The locations where *Gracilaria vermiculophylla* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Grateloupia turuturu

Yamada
Algae (Rhodophyta)

Common name:
Devil's Tongue Weed

Origin:
NW pacific (Reise et al., 2002).

First introduction in NW Europe:
1969, England (Maggs & Stegenga 1999).

First introduction in Ireland:
2015, co. Cork (Gittenberger et al., 2023).

Distribution Ireland:
(based on surveys in Table 2)
The species was to be widespread on the south west to south east coasts of Ireland (Fig. 14; Appendix).

Lomentaria hakodatensis

Yendo
Algae (Rhodophyta)

Common name:
-

Origin:
Pacific (Loos et al., 2021).

First introduction in NW Europe:
1987, France (Cabioch & Magne, 1987).

First introduction in Ireland:
2015, co. Cork (Gittenberger et al., 2023).

Distribution in Ireland:
(based on surveys in Table 2)
The species was found at two locations in County Cork, i.e. in Bantry Bay (2015) and Kenmare River (2018) (Fig. 15; Appendix).

Figure 14: The locations where *Grateloupia turuturu* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.
* Species is only scored here as cf. *(conforma)*

Figure 15: The locations where *Lomentaria hakodatensis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Melanothamnus harveyi

(Bailey) Díaz-Tapia & Maggs
Algae (Rhodophyta)

Common name:
Harvey's Siphon Weed

Origin:
N Pacific (Maggs & Stegenga, 1999).

First introduction in NW Europe:
1832, France (Maggs & Stegenga 1999).

First introduction in Ireland:
1979, Aquanis.

Distribution Ireland:
(based on surveys in Table 2)
The species is found widespread on most of the coasts of Ireland (Fig. 16; Appendix).

Sargassum muticum

(Yendo) Fensholt
Algae (Ochrophyta)

Common name:
Wireweed

Origin:
NW Pacific (Wallentinus, 1999).

First introduction in NW Europe:
1966, France (Eno & Clarke, 1997).

First introduction in Ireland:
2001, co. Waterford (Kraan, 2008).

Distribution in Ireland:
(based on surveys in Table 2)
The species is found widespread on most of the coasts of Ireland (Fig. 17; Appendix).

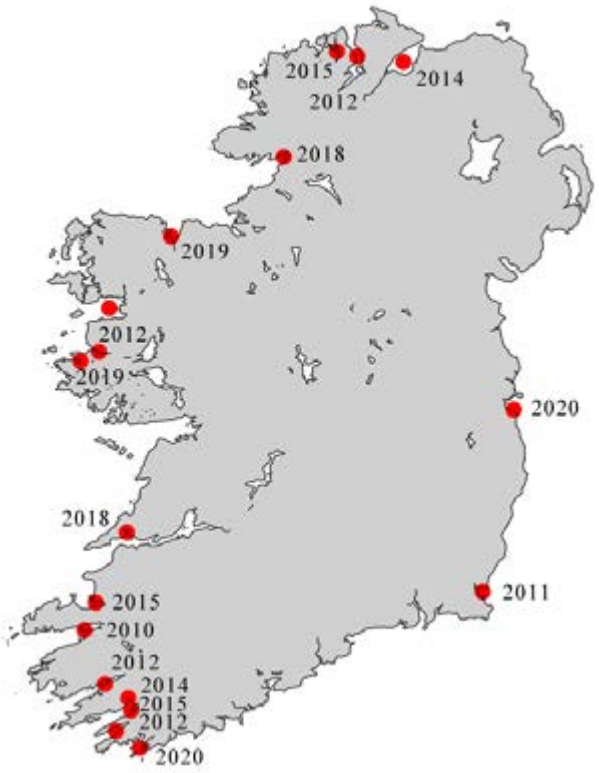

Figure 16: The locations where *Melanothamnus harveyi* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

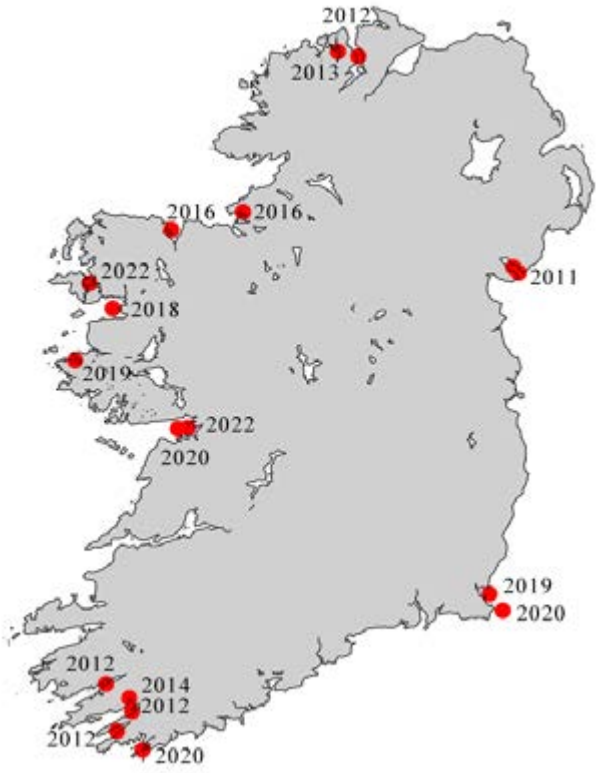

Figure 17: The locations where *Sargassum muticum* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Ulva australis

Areschoug
Algae (Chlorophyta)

Common name:
Lacy Sea Lettuce

Origin:
N Pacific (Stegenga & Mol, 2002).

First introduction in NW Europe:
1993, Netherlands (Stegenga, & Mol, 2002).

First introduction in Ireland:
2011, co. Wexford (Gittenberger et al., 2023).

Distribution Ireland:
(based on surveys in Table 2)
The species was reported widespread throughout Ireland, but mainly in the southwest of the island (Fig. 18; Appendix).

Ulva rhacodes

(Holmes) Papenfuss
Algae (Chlorophyta)

Common name:
Sea Lettuce

Origin:
SE Atlantic (Hoek & Donze, 1966).

First introduction in NW Europe:
1963, Spain (Hoek & Donze, 1966).

First introduction in Ireland:
2011, co. Cork (Gittenberger et al., 2023).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only found once in 2011 in Youghal Bay in the south of Ireland (Fig. 19; Appendix).

Figure 18: The locations where *Ulva australis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location. * Species is only scored here as cf. *(conforma)*

Figure 19: The locations where *Ulva rhacodes* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Undaria pinnatifida

(Harvey) Suringar
Algae (Ochrophyta)

Common name:
Wakame

Origin:
NW Pacific (Stegenga, 1999b).

First introduction in NW Europe:
1971, France (Leliaert et al., 2000).

First introduction in Ireland:
2015, co. Kerry (Gittenberger et al., 2023).

Distribution Ireland:
(based on surveys in Table 2)
Wakame was recorded from various locations around Ireland (Fig. 20; Appendix).

cf. *Neodexiospira brasiliensis*

(Grube, 1872)
Annelida

Common name:
Brazilian Spiral Tubeworm

Origin:
SW Atlantic (Eno et al., 1997).

First introduction in NW Europe:
1974, UK (Eno et al., 1997).

First introduction in Ireland:
2019, co. Dublin, 2019 (This report)
N.B.Species is only scored as cf., indicating that it presence in Ireland still needs to be confirmed.

Distribution in Ireland:
(based on surveys in Table 2)
The species was recorded on the west coast and on the east coast of Ireland (Fig. 21; Appendix).

Figure 20: The locations where *Undaria pinnatifida* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Figure 21: The locations where cf. *Neodexiospira brasiliensis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Aplidium glabrum

(Verrill, 1871)
Ascidiacea

Common name:
-

Origin:
Cryptogenic, possibly native to NE Atlantic (Wolff, 2005).

First introduction in NW Europe:
unclear, possibly a European species (Wolff, 2005).

First introduction in Ireland:
2010 (Nunn & Minchin, 2013).

Distribution Ireland:
(based on surveys in Table 2)
(Fig. 22; Appendix).

Asterocarpa humilis

(Heller, 1878)
Ascidiacea

Common name:
-

Origin:
S Indo - Pacific (Bishop et al, 2013).

First introduction in NW Europe:
2009, UK (www.gbif.org/species/2332123).

First introduction in Ireland:
2019, Co. Dublin (Gittenberger et al., 2023).

Distribution in Ireland:
(based on surveys in Table 2)
A single report in 2019, in Dún Laoghaire Harbour, Co. Dublin (Fig. 23; Appendix).

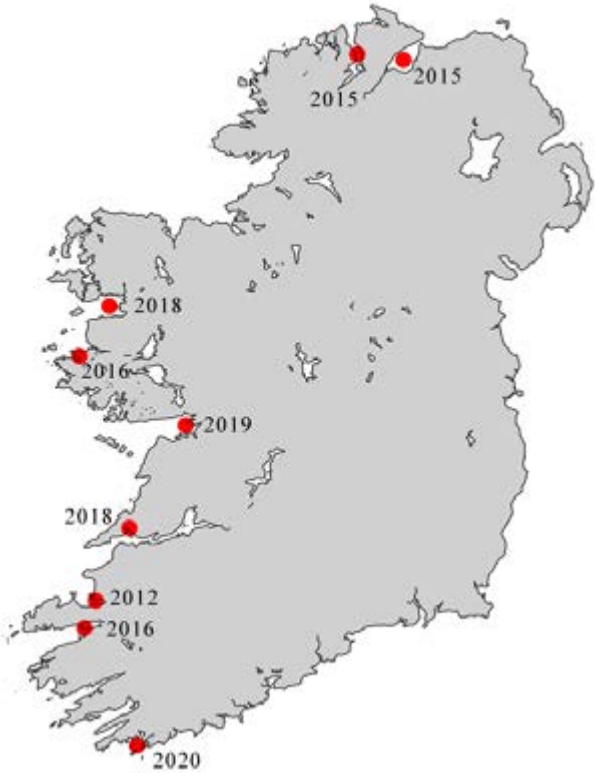

Figure 22: The locations where *Aplidium glabrum* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Figure 23: The locations where *Asterocarpa humilis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Botrylloides violaceus

Oka, 1927
Ascidiacea

Common name:
Violet Tunicate

Origin:
NW Pacific (Minchin, 2007).

First introduction in NW Europe:
1999, Netherlands (Gittenberger & Schrieken 2000).

First introduction in Ireland:
2005, co. Dublin (NBDC, 2014).

Distribution Ireland:
(based on surveys in Table 2)
The species is found widespread on most of the coasts of Ireland (Fig. 24; Appendix).

Didemnum vexillum

Kott, 2002
Ascidiacea

Common name:
Compound Sea Squirt

Origin:
NW Pacific (Stefaniak et al., 2009).

First introduction in NW Europe:
1991, The Netherlands (Gittenberger, 2006).

First introduction in Ireland:
2005, Co. Dublin (NBDC, 2014).

Distribution in Ireland:
(based on surveys in Table 2)
(Fig. 25; Appendix).

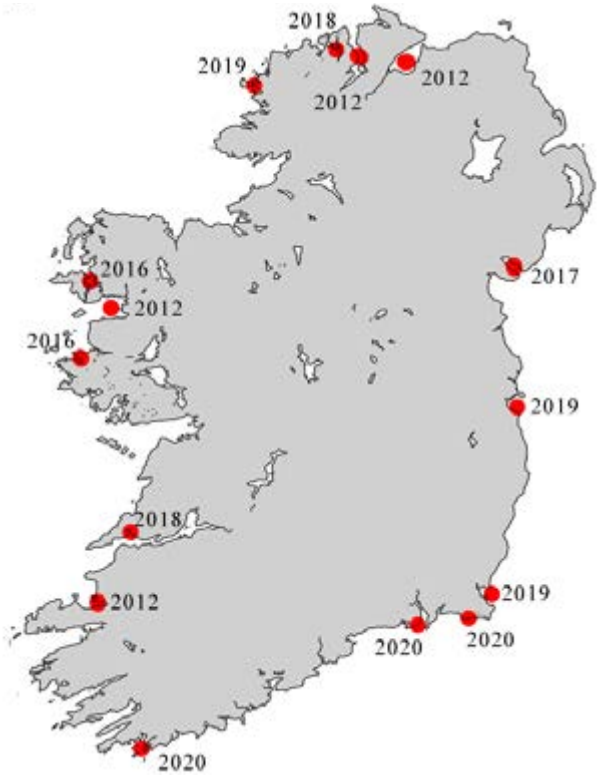

Figure 24: The locations where *Botrylloides violaceus* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

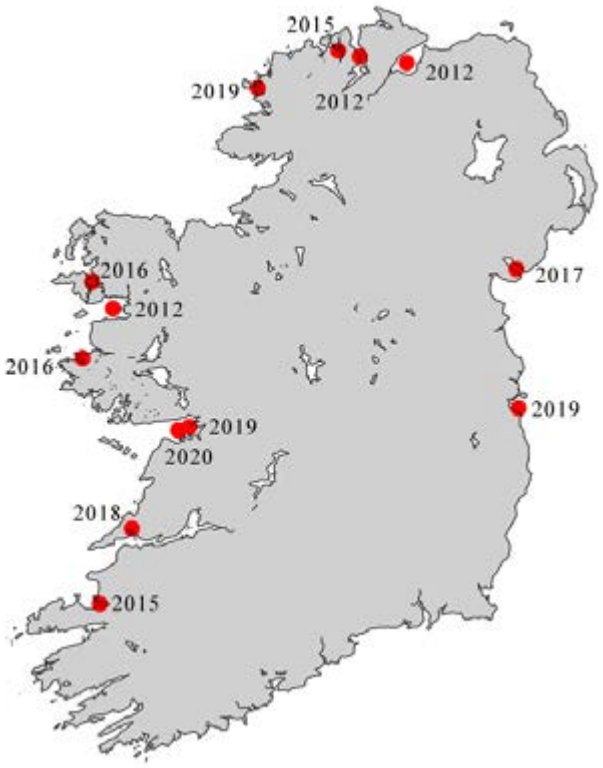

Figure 25: The locations where *Didemnum vexillum* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Molgula manhattensis

(De Kay, 1843)
Ascidiacea

Common name:
Sea Grape

Origin:
NW Atlantic (Haydar et al., 2011).

First introduction in NW Europe:
1762, Netherlands (Baster 1762).

First introduction in Ireland:
1998, co. Wexford (Minchin, 2007).

Distribution Ireland:
(based on surveys in Table 2)
The species was recorded widespread in Ireland (Fig. 26; Appendix).

Perophora japonica

Oka, 1927
Ascidiacea

Common name:
-

Origin:
NW Pacific (Gittenberger et al., 2021).

First introduction in NW Europe:
1982, France (Nishikawa et al., 2000).

First introduction in Ireland:
2012, co. Louth (Nunn & Minchin, 2013).

Distribution in Ireland:
(based on surveys in Table 2)
The species was mainly recorded on the west and east coasts of Ireland (Fig. 27; Appendix).

Figure 26: The locations where *Molgula manhattensis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

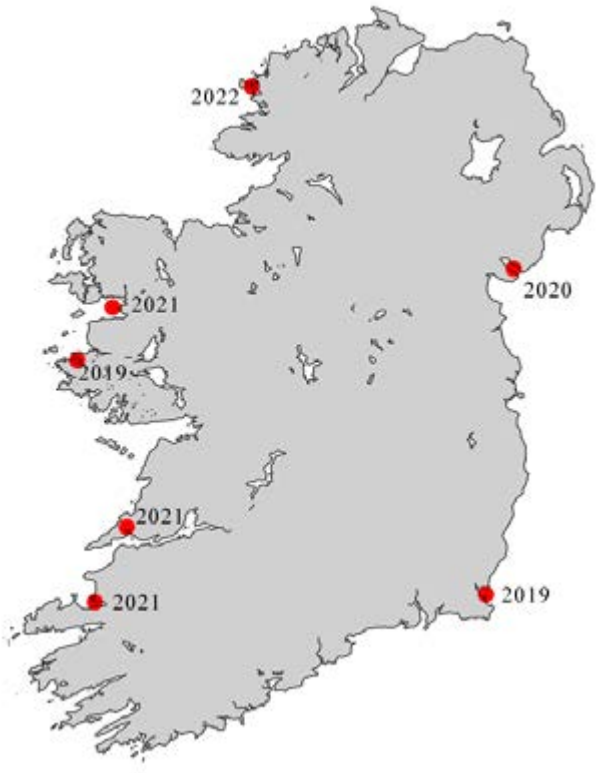

Figure 27: The locations where *Perophora japonica* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Phallusia mammillata

(Cuvier, 1815)
Ascidiacea

Common name:
White Warty Seasquirt

Origin:
NE Atlantic (Stokes et al., 2004).

First introduction in NW Europe:
1967, France (www.gbif.org/species/2330609).

First introduction in Ireland:
1890, co.Cork (Stokes et al., 2004).

Distribution Ireland:
(based on surveys in Table 2)
Species is only recorded in county Cork (Fig. 28; Appendix).

Styela clava

Herdman, 1881
Ascidiacea

Common name:
Rough Sea Squirt, Leathery Sea Squirt, Folded Sea Squirt

Origin:
NW Pacific (Lützen, 1999).

First introduction in NW Europe:
1952, United Kingdom (Lützen 1999).

First introduction in Ireland:
1971, co. Cork (Nunn & Minchin, 2009).

Distribution in Ireland:
(based on surveys in Table 2)
The species is found widespread on most of the coasts of Ireland (Fig. 29; Appendix).

Figure 28: The locations where *Phallusia mammillata* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

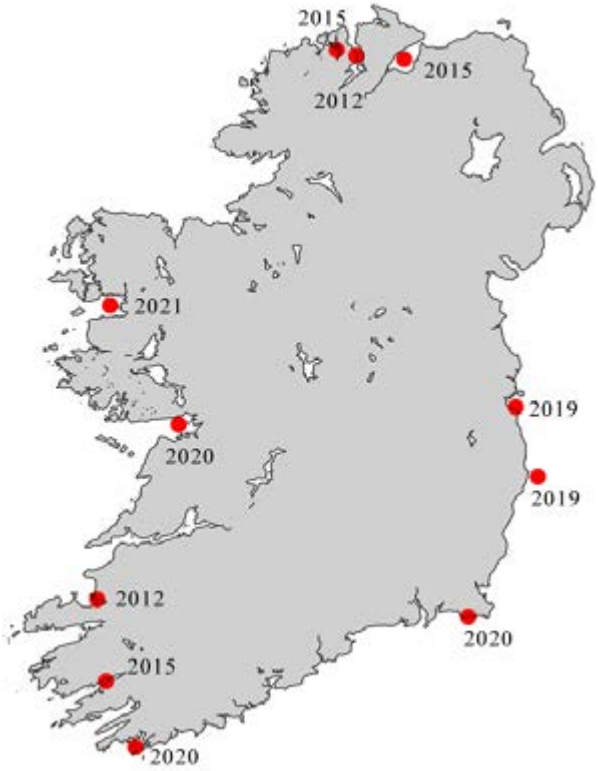

Figure 29: The locations where *Styela clava* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Bugula neritina

(Linnaeus, 1758)
Bryozoa

Common name:
Brown Bryozoan

Origin:
Cryptogenic (Faasse, 2007).

First introduction in NW Europe:
2007, The Netherlands (Faasse, 2007).

First introduction in Ireland:
2006, Co. Dublin (Porter et al., 2017).

Distribution Ireland:
(based on surveys in Table 2)
Species is only recorded in marina's (Fig. 30; Appendix).

Bugulina simplex

(Hincks, 1886)
Bryozoa

Common name:
-

Origin:
Mediterranean (Ryland 1958).

First introduction in NW Europe:
1957, UK (Ryland 1958).

First introduction in Ireland:
2020, Co. Wexford (Gittenberger et al., 2023).

Distribution in Ireland:
(based on surveys in Table 2)
Species recorded only in marina's in county Wexford and Waterford (Fig. 31; Appendix).

Figure 30: The locations where *Bugula neritina* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.
* Species is only scored here as cf. *(conforma)*

Figure 31: The locations where *Bugula simplex* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Bugulina stolonifera

(Ryland, 1960)
Bryozoa

Common name:
-

Origin:
NW Atlantic (Cohen & Carlton, 1995).

First introduction in NW Europe:
1960, United Kingdom (Ryland 1960).

First introduction in Ireland:
1950s (Gittenberger et al., 2023).

Distribution Ireland:
(based on surveys in Table 2)
The species was found both in the north and in the south of Ireland (Fig. 32; Appendix).

cf. *Fenestrulina delicia*

Hayward & Craig, 2000xxx
Bryozoa

Common name:
-

Origin:
NW Atlantic (De Blauwe, 2009).

First introduction in NW Europe:
2009, Belgium (De Blauwe, 2009).

First introduction in Ireland:
2012, co. Donegal (This report).
* Species is only scored here as cf. *(conforma)*.

Distribution in Ireland:
(based on surveys in Table 2)
A single report in 2018, in Lough Swilly, county Donegal, only scored as cf. (Fig. 33; Appendix).

Figure 32: The locations where *Bugulina stolonifera* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Figure 33: The locations where cf. *Fenestrulina delicia* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.
* Species is only scored here as cf. *(conforma)*

Smittoidea prolifica

Osburn, 1952
Bryozoa

Common name:
-

Origin:
Pacific coast of north America (Faasse et al., 2013).

First introduction in NW Europe:
1995, The Netherlands (Faasse et al., 2013).

First introduction in Ireland:
2017, Co. Wexford (Gittenberger et al., 2023).

Distribution Ireland:
(based on surveys in Table 2)
The species was only recorded in the south of Ireland (Fig. 34; Appendix).

Tricellaria inopinata

d'Hondt & Occhipinti Ambrogi, 1985
Bryozoa

Common name:
-

Origin:
Probably NE Pacific (Cook et al., 2013).

First introduction in NW Europe:
1998, United Kingdom (Dyrynda et al., 2000).

First introduction in Ireland:
2005, Co. Dublin & Co. Cork.
(Kelso & Wyse-Jackson, 2012).

Distribution in Ireland:
(based on surveys in Table 2)
The species was mainly recorded in the south of Ireland (Fig. 35; Appendix).

Figure 34: locations where *Smittoidea prolifica* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Figure 35: The locations where *Tricellaria inopinata* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Watersipora subatra

(Ortmann, 1890)
Bryozoa

Common name:
-

Origin:
Gulf of Mexico (Kelso & Wyse-Jackson, 2012).

First introduction in NW Europe:
2006, France (www.gbif.org/species/8155634).

First introduction in Ireland:
2011, Co. Dublin (Kelso & Wyse-Jackson, 2012).

Distribution Ireland:
(based on surveys in Table 2)
The species was only found in Dún Laoghaire Harbour on the east coast of Ireland (Fig. 36; Appendix).

Cordylophora caspia

(Pallas, 1771)
Cnidaria

Common name:
Ponto-Caspian Freshwater Hydroid

Origin:
Ponto-Caspian (Nehring & Leuchs, 1999).

First introduction in NW Europe:
1810 Sweden (www.gbif.org/species/2266009).

First introduction in Ireland:
1842 (Allman, 1844).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only found in Waterford Marina on the southeast coast of Ireland (Fig. 37; Appendix).

Figure 36: The locations where *Watersipora subatra* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Figure 37: The locations where *Cordylophora caspia* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Diadumene lineata

(Verrill, 1869)
Cnidaria

Common name:
Striped Sea Anemone

Origin:
NW Pacific (Gollasch &Riemann-Zürneck, 1996).

First introduction in NW Europe:
-

First introduction in Ireland:
1974 (Nunes et al., 2014).

Distribution Ireland:
(based on surveys in Table 2)
The distribution of this species appears to be restricted to the east coast of Ireland, where it was only found once (Fig. 38; Appendix).

Amphibalanus improvisus

(Darwin, 1854)
Crustacea

Common name:
Bay Barnacle, Acorn Barnacle

Origin:
Crytogenic, probably native for NE Atlantic (Gollasch, 2002).

First introduction in NW Europe:
Unknown, 1600-1700 (Kerckhof & Cattrijsse, 2001).

First introduction in Ireland:
1950, probably co. Wexford (NBDC, 2014).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only found in the south of Ireland (Fig. 39; Appendix).

Figure 38: The locations where *Diadumene lineata* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Figure 39: The locations where *Amphibalanus improvisus* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Austrominius modestus

(Darwin, 1854)
Crustacea

Common name:
New-Zealand Barnacle

Origin:
SW Pacific (Harms, 1999).

First introduction in NW Europe:
1945, United Kingdom (Bishop 1947).

First introduction in Ireland:
1957, Co. Cork (Allen et al., 2006).

Distribution Ireland:
(based on surveys in Table 2)
The species is found widespread on most of the coasts of Ireland (Fig. 40; Appendix).

Caprella mutica

Schurin, 1935
Crustacea

Common name:
Japanese Skeleton Shrimp

Origin:
Pacific (Schrey & Buschbaum, 2006).

First introduction in NW Europe:
1993, Netherlands (Faasse 1996).

First introduction in Ireland:
2003, Co. Galway (Thieltges et al. 2013).

Distribution in Ireland:
(based on surveys in Table 2)
The species is found widespread on most of the coasts of Ireland (Fig. 41; Appendix).

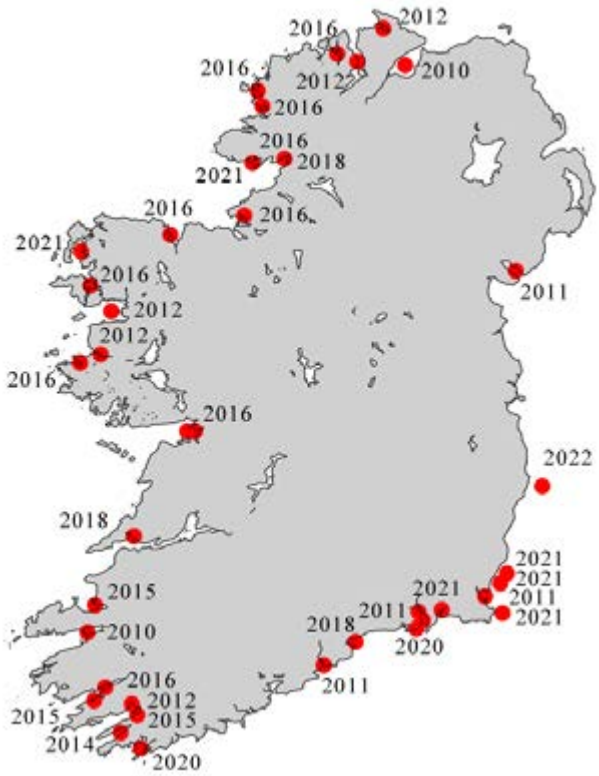

Figure 40: The locations where *Austrominius modestus* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

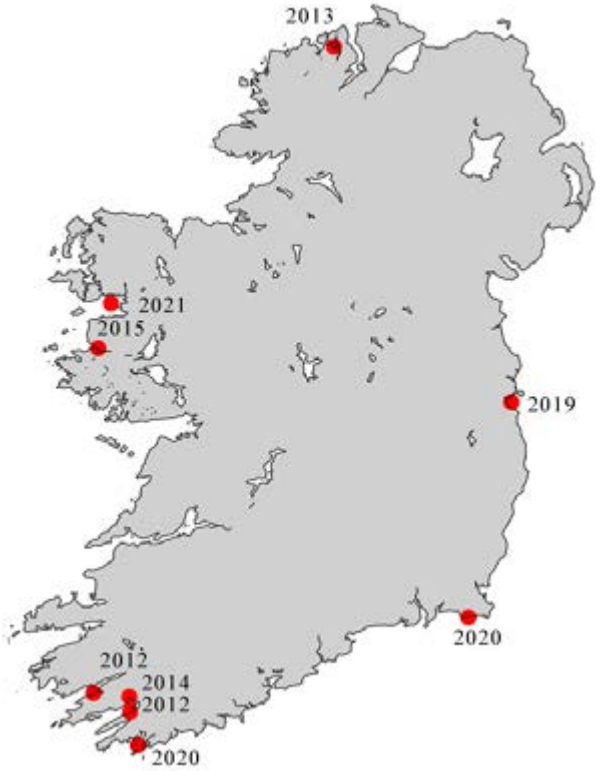

Figure 41: The locations where *Caprella mutica* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Jassa marmorata

Holmes, 1905
Crustacea

Common name:
-

Origin:
NW Atlantic (Gittenberger *et al.*, 2019).

First introduction in NW Europe:
Unknown (Gittenberger et al., 2019).

First introduction in Ireland:
1983 (Aquanis).

Distribution Ireland:
(based on surveys in Table 2)
The species was reported widespread throughout Ireland, but mainly in the southwest of the island (Fig. 42; Appendix).

Monocorophium acherusicum

(A. Costa, 1853)
Crustacea

Common name:
-

Origin:
Cryptogenic (Minchin & Nunn, 2013).

First introduction in NW Europe:
-

First introduction in Ireland:
2007, Co. Dublin (Daniels et al., 2009).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only found once in Dún Laoghaire Harbour on the east coast of Ireland (Fig. 46; Appendix). (Fig. 43; Appendix).

Figure 42: The locations where *Jassa marmorata* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

Figure 43: The locations where *Monocorophium acherusicum* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Calyptraea chinensis

(Linnaeus, 1758)
Mollusca

Common name:
Chinese Cupand-Saucer Limpet

Origin:
Cryptogenic (Minchin & Nunn, 2013).

First introduction in NW Europe:
-

First introduction in Ireland:
1946, Co. Mayo (NBDC, 2014).

Distribution Ireland:
(based on surveys in Table 2)
The distribution of this species appears to be restricted to the east coast of Ireland where it was only found once (Fig. 44; Appendix).

Crepidula fornicata

(Linnaeus, 1758)
Mollusca

Common name:
Common Slipper Limpet

Origin:
NW Atlantic (Nehring & Leuchs, 1999).

First introduction in NW Europe:
1872, United Kingdom (Van Benthem Jutting 1933).

First introduction in Ireland:
1893, Co. Galway (McNeill et al., 2010).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only found in Lough Swilly (Fig. 45; Appendix).

Figure 44: The locations where *Calyptraea chinensis* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Figure 45: The locations where *Crepidula fornicata* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Magallana gigas

(Thunberg, 1793)
Mollusca

Common name:
Pacific Oyster, Japanese Oyster

Origin:
NW Pacific (Eno et al., 1997).

First introduction in NW Europe:
1819, Portugal (Wolff, 2005).

First introduction in Ireland:
1877, Co. Cork (NBDC, 2014).

Distribution Ireland:
(based on surveys in Table 2)
Locally "wild" Pacific oysters were recorded in the north, south and west of Ireland (Fig. 46; Appendix).

Mya arenaria

Linnaeus, 1758
Mollusca

Common name:
Steamer Clam, Softshell Clam, Softshell, Sand Gaper, Long Necked Clam

Origin:
NW Atlantic& N Pacific (Cohen & Carlton, 1995).

First introduction in NW Europe:
Unknown (Wolff, 2005).

First introduction in Ireland:
1844 (Aquanis).

Distribution in Ireland:
(based on surveys in Table 2)
The species was only found once off Kenmare in the southwest of Ireland (Fig. 46; Appendix). (Fig. 47; Appendix).

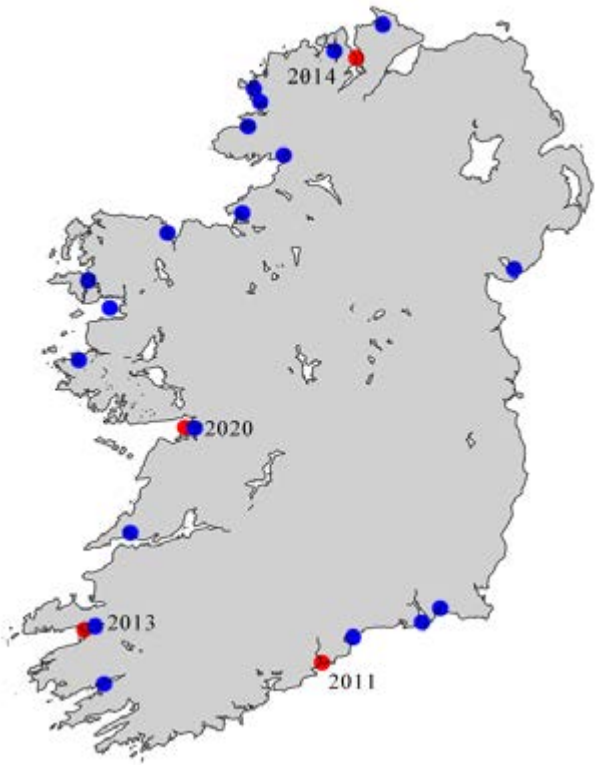

Figure 46: The locations and years where *Magallana gigas* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location. Red dots: *M. gigas* found in the wild; Blue dots: *M. gigas* only recorded in bags on trestles.

Figure 47: The locations where *Mya arenaria* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found during these SASIs is indicated per location.

Teredo navalis

Linnaeus, 1758
Mollusca

Common name:
Naval Shipworm, Great Shipworm

Origin:
Crytogenic (Wolff, 2005).

First introduction in NW Europe:
<1730, Netherlands (Van Benthem Jutting 1943).

First introduction in Ireland:
1845 (Minchin & Nunn, 2013).

Distribution Ireland:
(based on surveys in Table 2)
The species was only found once in Lough Foyle on the north coast of Ireland (Fig. 48; Appendix).

Figure 48: The locations where *Teredo navalis* was found during surveys in Ireland between 2010 and 2022. The year in which the species was first found during these SASIs is indicated per location.

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APPENDIX 1

The locations and years where cf. *Agardhiella subulata* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Waterford	16	Dungarvan	Oyster	Trestles	2018*

The locations and years where cf. *Agardhiella subulata* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2014, 2017
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2014, 2017, 2022
Waterford	17	Dunmore East	n.a.	Full marina	2020
Kerry	31	Tralee Bay	Oyster	Bottom culture	2012, 2015, 2018, 2021
Donegal	49	Lough Foyle	Oyster	Bottom culture	2012
	48		Mussel	Bottom culture	2017
	50	Lough Swilly	Mussel	Bottom culture	2014
	51		Oyster	Bottom culture	2015
	52	Mulroy Bay	Mussel	Rope culture	2018

The locations and years where cf. *Agardhiella subulata* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Cork	21	Bantry Bay	Mussel	Rope culture	2015
	22	Dunmanus Bay	Mussel	Rope culture	2012, 2015
	23	Glengariff	Mussel	Rope culture	2014
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2010*
	29	Kenmare River	Mussel	Rope culture	2012, 2018
	31	Tralee Bay	Oyster	Bottom culture	2018
Clare	32	Poulnasherry	Oyster	Trestles	2018
Galway	35	Connemara	Mussel	Rope culture	2015
Donegal	48	Lough Foyle	Mussel	Bottom culture	2017
	52	Mulroy Bay	Mussel	Rope culture	2018

The locations and years where *Asparagopsis armata* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Kerry	31	Tralee Bay	Oyster	Bottom culture	2012, 2015, 2021
Mayo	37	Achill	Oyster	Trestles	2019
	39	Clew Bay	Mussel	Rope culture	2021
	41	Killala	Oyster	Trestles	2019

The locations and years where *Bonnemaisonia hamifera* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2011, 2017
Dublin	3	Dún Laoghaire Harbour	n.a.	Floating dock	2020
Waterford	18	Waterford Harbour	Mussel	Bottom culture	2011
Cork	23	Glengariff	Mussel	Rope culture	2014
Kerry	29	Kenmare River	Mussel	Rope culture	2012, 2021
Mayo	37	Achill	Oyster	Trestles	2019
Donegal	48	Lough Foyle	Mussel	Bottom culture	2017
	52	Mulroy Bay	Mussel	Rope culture	2013, 2015, 2018

The locations and years where *Codium fragile* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Waterford	17	Dunmore East	n.a.	Marina	2020
Cork	23	Glengariff	Mussel	Rope culture	2014, 2020
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	29	Kenmare River	Mussel	Rope culture	2015, 2018
Galway	36	Georges Bank	n.a.	Bottom	2020
Donegal	51	Lough Swilly	Oyster	Bottom culture	2018, 2021
	52	Mulroy Bay	Mussel	Rope culture	2013, 2015, 2018, 2021

The locations and years where *Colpomenia peregrina* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Cork	21	Bantry Bay	Mussel	Rope culture	2012, 2015
	22	Dunmanus Bay	Mussel	Rope culture	2018
	23	Glengariff	Mussel	Rope culture	2017
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2016
	29	Kenmare River	Mussel	Rope culture	2012, 2015, 2018, 2021
Mayo	39	Clew Bay	Mussel	Rope culture	2021
Donegal	52	Mulroy Bay	Mussel	Rope culture	2013, 2015, 2021

The locations and years where *Cryptonemia hibernica* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Cork	21	Bantry Bay	Mussel	Rope culture	2015

The locations and years where *Dasysiphonia japonica* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2014, 2017
Clare	32	Poulnasherry	Oyster	Trestles	2021
Galway	35	Connemara	Mussel	Rope culture	2015
	36	Georges Bank	Oyster	Bottom culture	2020
Mayo	37	Achill	Oyster	Trestles	2019
	39	Clew Bay	Mussel	Rope culture	2021
Donegal	48	Lough Foyle	Mussel	Bottom culture	2017
	49		Oyster	Bottom culture	2015, 2018
	50	Lough Swilly	Mussel	Bottom culture	2014
	51		Oyster	Bottom culture	2018, 2021

The locations and years where *Gracilaria vermiculophylla* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2017
Waterford	16	Dungarvan	Oyster	Trestles	2018
Donegal	49	Lough Foyle	Oyster	Bottom culture	2018
	52	Mulroy Bay	Mussel	Rope culture	2018

The locations and years where *Grateloupia turuturu* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Floating dock	2020
Wexford	12	Off Rosselare	Mussel	Bottom culture	2017*
	13	Wexford Harbour	Mussel	Bottom culture	2017
Cork	21	Bantry Bay	Mussel	Rope culture	2015, 2020
Kerry	31	Tralee Bay	Oyster	Bottom culture	2018*

The locations and years where *Lomentaria hakodatensis* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Cork	21	Bantry Bay	Mussel	Rope culture	2015
Kerry	29	Kenmare River	Mussel	Rope culture	2018

The locations and years where *Melanothamnus harveyi* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Floating dock	2020
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2011, 2017
Cork	21	Bantry Bay	Mussel	Rope culture	2015, 2018, 2020
	22	Dunmanus Bay	Mussel	Rope culture	2012, 2015, 2018, 2020
	23	Glengariff	Mussel	Rope culture	2014, 2017, 2020
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2010, 2013, 2019, 2022
	29	Kenmare River	Mussel	Rope culture	2012, 2015, 2018, 2021
	31	Tralee Bay	Oyster	Bottom culture	2015, 2018, 2021
Clare	32	Poulnasherry	Oyster	Trestles	2018
Galway	33	Ballinakil	Oyster	Trestles	2019
	35	Connemara	Mussel	Rope culture	2012, 2015
Mayo	39	Clew Bay	Mussel	Rope culture	2021
	41	Killala	Oyster	Trestles	2019
Donegal	45	Donegal Harbour	Oyster	Trestles	2018
	48	Lough Foyle	Mussel	Bottom culture	2014
	50	Lough Swilly	Mussel	Bottom culture	2014
	51		Oyster	Bottom culture	2012, 2021
	52	Mulroy Bay	Mussel	Rope culture	2015, 2018, 2021

The locations and years where *Sargassum muticum* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2011, 2014, 2017, 2020
	2		Oyster	Trestles	2016, 2019
Wexford	12	Rosselare	Mussel	Seedbed	2020
	14	Wexford	Mussel	Seedbed	2019
Cork	21	Bantry Bay	Mussel	Rope culture	2012, 2015, 2018, 2020
	22	Dunmanus Bay	Mussel	Rope culture	2012, 2015, 2018, 2020
	23	Glengariff	Mussel	Rope culture	2014, 2017
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	29	Kenmare River	Mussel	Rope culture	2012, 2015, 2018, 2021
Galway	33	Ballinakil	Oyster	Trestles	2019
	34	Clarenbridge, Inner Galway Bay	Oyster	Trestles	2022
	36	Georges Bank	Oyster	Bottom culture	2020
Mayo	37	Achill	Oyster	Trestles	2022
	39	Clew Bay	Mussel	Rope culture	2021
	40		Oyster	Trestles	2018
	41	Killala	Oyster	Trestles	2016, 2019
Sligo	42	Drumcliff	Oyster	Trestles	2016, 2022
Donegal	51	Lough Swilly	Oyster	Bottom culture	2012
	52	Mulroy Bay	Mussel	Rope culture	2013, 2015, 2018, 2021

The locations and years where *Ulva australis* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2011
Cork	22	Dunmanus Bay	Mussel	Rope culture	2012*, 2018*
Kerry	29	Kenmare River	Mussel	Rope culture	2018
	30	Templenoe	Oyster	Trestles	2022
	31	Tralee Bay	Oyster	Bottom culture	2012
Donegal	52	Mulroy Bay	Mussel	Rope culture	2018

The locations and years where *Ulva rhacodes* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Cork	26	Youghal Bay	Mussel	Bottom culture	2011

The locations and years where *Undaria pinnatifida* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Floating dock	2019
Wexford	10	Kilmore Quay	n.a.	Full marina	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2016
	31	Tralee Bay	Oyster	Bottom culture	2015
Donegal	49	Lough Foyle	Oyster	Bottom culture	2015

The locations and years where cf. *Neodexiospira brasiliensis* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019*
Galway	36	Georges Bank	n.a.	Bottom culture	2020*

The locations and years where *Aplidium glabrum* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Cork	26	Roaringwater	Mussel	Rope culture	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2016, 2019
	31	Tralee Bay	Oyster	Bottom culture	2012, 2015, 2018, 2021
Clare	32	Poulnasherry	Oyster	Trestles	2018, 2021
Galway	33	Ballinakil	Oyster	Trestles	2016, 2019
	34	Clarenbridge, Inner Galway Bay	Oyster	Trestles	2019
Mayo	39	Clew Bay	Mussel	Rope culture	2021
	40		Oyster	Trestles	2018
Donegal	49	Lough Foyle	Oyster	Bottom culture	2015, 2020
	51	Lough Swilly	Oyster	Bottom culture	2015, 2018, 2021

The locations and years where *Asterocarpa humilis* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019

The locations and years where *Botrylloides violaceus* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2017
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Wexford	10	Kilmore Quay	n.a.	Marina	2020
	14	Wexford	Mussel	Seedbed	2019
Waterford	17	Dunmore East	n.a.	Marina	2020
Cork	25	Roaringwater	Mussel	Rope culture	2020
Kerry	31	Tralee Bay	Oyster	Bottom culture	2012, 2015, 2018, 2021
Clare	32	Poulnasherry	Oyster	Trestles	2018, 2021
Galway	33	Ballinakil	Oyster	Trestles	2016, 2019, 2022
Mayo	37	Achill	Oyster	Trestles	2016, 2019
	39	Clew Bay	Mussel	Rope culture	2021
	40		Oyster	Trestles	2012, 2018, 2021
Donegal	46	Dungloe	Oyster	Trestles	2019, 2022
	48	Lough Foyle	Mussel	Bottom culture	2014
	49		Oyster	Bottom culture	2012, 2020
	51	Lough Swilly	Oyster	Bottom culture	2012, 2015, 2021
	52	Mulroy Bay	Mussel	Rope culture	2018

The locations and years where *Didemnum vexillum* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2017
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Kerry	31	Tralee Bay	Oyster	Bottom culture	2015
Clare	32	Poulnasherry	Oyster	Trestles	2018
Galway	33	Ballinakil	Oyster	Trestles	2016, 2019
	34	Clarenbridge, Inner Galway Bay	Oyster	Trestles	2019
	36	Georges Bank	n.a.	Bottom	2020
Mayo	37	Achill	Oyster	Trestles	2016
	39	Clew Bay	Mussel	Rope culture	2021
	40		Oyster	Trestles	2012, 2018
Donegal	46	Dungloe	Oyster	Trestles	2019, 2022
	48	Lough Foyle	Mussel	Bottom culture	2014
	49		Oyster	Bottom culture	2012, 2015
	50	Lough Swilly	Mussel	Bottom culture	2017
	51		Oyster	Bottom culture	2012, 2015
	52	Mulroy Bay	Mussel	Rope culture	2015

The locations and years where *Molgula manhattensis* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Wexford	10	Kilmore Quay	n.a.	Marina	2020
	13	Wexford Harbour	Mussel	Bottom culture	2017, 2019, 2022
	14	Wexford	Mussel	Seedbed	2019
Cork	25	Roaringwater	Mussel	Rope culture	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2019
Donegal	52	Mulroy Bay	Mussel	Rope culture	2015, 2018, 2021

The locations and years where *Perophora japonica* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2020
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2019, 2022
	15	Wexford	n.a.	Bottom	2020
Kerry	31	Tralee Bay	Oyster	Bottom culture	2021
Clare	32	Poulnasherry	Oyster	Trestles	2021
Galway	33	Ballinakil	Oyster	Trestles	2019
Mayo	39	Clew Bay	Mussel	Rope culture	2021
Donegal	46	Dungloe	Oyster	Trestles	2022

The locations and years where *Phallusia mammillata* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Cork	21	Bantry Bay	Mussel	Rope culture	2012, 2015, 2018, 2020
	23	Glengariff	Mussel	Rope culture	2014

The locations and years where *Styela clava* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Wicklow	4	Wicklow	Mussel	Seedbed	2019
Wexford	10	Kilmore Quay	n.a.	Marina	2020
Cork	25	Roaringwater	Mussel	Rope culture	2020
Kerry	29	Kenmare River	Mussel	Rope culture	2015
	31	Tralee Bay	Oyster	Bottom culture	2012, 2015, 2018, 2021
Galway	36	Georges Bank	n.a.	Bottom	2020
Mayo	39	Clew Bay	Mussel	Rope culture	2021
Donegal	49	Lough Foyle	Oyster	Bottom culture	2015
	51	Lough Swilly	Oyster	Bottom culture	2012, 2021
	52	Mulroy Bay	Mussel	Rope culture	2015, 2018, 2021

The locations and years where *Bugula neritina* was found during surveys in Ireland between 2010 and 2022. * Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Waterford	17	Dunmore East	n.a.	Marina	2020
Cork	24	Roaringwater	n.a.	Floating dock	2020*

The locations and years where *Bugula simplex* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Wexford	10	Kilmore Quay	n.a.	Marina	2020
Waterford	17	Dunmore East	n.a.	Marina	2020

The locations and years where *Bugulina stolonifera* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Waterford	18	Waterford Harbour	Mussel	Bottom culture	2017
Donegal	48	Lough Foyle	Mussel	Bottom culture	2011
	51	Lough Swilly	Oyster	Bottom culture	2012
	52	Mulroy Bay	Mussel	Rope culture	2015

The locations and years where cf. *Fenestrulina delicia* was found during surveys in Ireland between 2010 and 2022.
* Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Donegal	51	Lough Swilly	Oyster	Bottom culture	2012*

The locations and years where *Smittoidea prolifica* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2017
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2019, 2022

The locations and years where *Tricellaria inopinata* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Waterford	17	Dunmore East	n.a.	Marina	2020
Cork	21	Bantry Bay	Mussel	Rope culture	2018, 2020
	22	Dunmanus Bay	Mussel	Rope culture	2018, 2020
	23	Glengariff	Mussel	Rope culture	2017
	25	Roaringwater	Mussel	Rope culture	2020

The locations and years where *Watersipora subatra* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019

The locations and years where *Bugulina stolonifera* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Waterford	19	Waterford Marina	n.a.	Marina	2020

The locations and years where cf. *Fenestrulina delicia* was found during surveys in Ireland between 2010 and 2022.
* Species is only scored here as cf. *(conforma)*

County	Location		Shellfish species	Habitat	Year
Galway	34	Clarenbridge, Inner Galway Bay	Oyster	Trestles	2019

The locations and years where *Tricellaria inopinata* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Wexford	13	Wexford Harbour	Mussel	Bottom culture	2019
Waterford	19	Waterford Marina	n.a.	Marina	2020
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2013

The locations and years where *Austrominius modestus* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Louth	1	Carlingford Lough	Mussel	Bottom culture	2011, 2014, 2017, 2020
	2		Oyster	Trestles	2016, 2019, 2022
Wicklow	4	Wicklow	Mussel	Seedbed	2022
Wexford	5	Bannow Bay	Oyster	Trestles	2021, 2022
	6	Blackwater	Mussel	Seedbed	2021
	7	Cahore	Mussel	Seedbed	2021, 2022
	12	Rosselare	Mussel	Seedbed	2021
	13	Wexford Harbour	Mussel	Bottom culture	2011, 2014, 2017, 2019, 2022
Waterford	16	Dungarvan	Oyster	Trestles	2018, 2021
	17	Dunmore East	n.a.	Marina	2020
	18	Waterford Harbour	Mussel	Bottom culture	2011, 2014, 2017
	19	Waterford Marina	n.a.	Marina	2020
	20	Woodstown	Oyster	Trestles	2017, 2019, 2022
Cork	21	Bantry Bay	Mussel	Rope culture	2012, 2015, 2018, 2020
	22	Dunmanus Bay	Mussel	Rope culture	2015, 2018, 2020
	23	Glengariff	Mussel	Rope culture	2014, 2017, 2020
	24	Roaringwater	n.a.	Floating dock	2020
	25		Mussel	Rope culture	2020
	26	Youghal Bay	Mussel	Bottom culture	2011, 2017
Kerry	27	Castlemaine Harbour	Mussel	Bottom culture	2010, 2013, 2016, 2019, 2022
	28		Oyster	Trestles	2018, 2021
	29	Kenmare River	Mussel	Rope culture	2015, 2018, 2021
	30	Templenoe	Oyster	Trestles	2016, 2019, 2022
	31	Tralee Bay	Oyster	Bottom culture	2015, 2018, 2021

The locations and years where *Austrominius modestus* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Clare	32	Poulnasherry	Oyster	Trestles	2018, 2021
Galway	33	Ballinakil	Oyster	Trestles	2016, 2019, 2022
	34	Clarenbridge, Inner Galway Bay	Oyster	Trestles	2016, 2019, 2022
	35	Connemara	Mussel	Rope culture	2012
	36	Georges Bank	n.a.	Bottom	2020
Mayo	37	Achill	Oyster	Trestles	2016, 2019, 2022
	38	Blacksod Bay	Littorina	Bottom culture	2021
	40	Clew Bay	Oyster	Trestles	2012, 2015, 2018, 2021
	41	Killala	Oyster	Trestles	2016, 2019
Sligo	42	Drumcliff	Oyster	Trestles	2016, 2019, 2022
Donegal	43	Ardara	Oyster	Trestles	2016, 2019, 2022
	44	Donegal	n.a.	Floating dock	2021
	45	Donegal Harbour	Oyster	Trestles	2018, 2021
	46	Dungloe	Oyster	Trestles	2016, 2019, 2022
	47	Killybegs	n.a.	Floating dock	2021
	48	Lough Foyle	Mussel	Bottom culture	2011, 2014, 2017
	49		Oyster	Bottom culture	2012, 2015, 2018, 2020
	50	Lough Swilly	Mussel	Bottom culture	2014, 2017
	51		Oyster	Bottom culture	2012, 2015, 2018, 2021
	53	Mulroy Bay	Oyster	Trestles	2016, 2022
	54	Trawbreaga Bay	Oyster	Trestles	2012, 2015, 218, 2021
	55	Trawenagh Bay	Oyster	Trestles	2016, 2019, 2022

The locations and years where *Caprella mutica* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Wexford	10	Kilmore Quay	n.a.	Marina	2020
Cork	21	Bantry Bay	Mussel	Rope culture	2012, 2015, 2108, 2020
	23	Glengariff	Mussel	Rope culture	2014, 2017, 2020
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	29	Kenmare River	Mussel	Rope culture	2012, 2105, 2018, 2021
Galway	35	Connemara	Mussel	Rope culture	2015
Mayo	39	Clew Bay	Mussel	Rope culture	2021
Donegal	52	Mulroy Bay	Mussel	Rope culture	2013, 2015, 2018, 2021

The locations and years where *Jassa marmorata* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019
Cork	21	Bantry Bay	Mussel	Rope culture	2012
	22	Dunmanus Bay	Mussel	Rope culture	2012, 2015, 2018
	23	Glengariff	Mussel	Rope culture	2014, 2017, 2020
	25	Roaringwater	Mussel	Rope culture	2020
Kerry	29	Kenmare River	Mussel	Rope culture	2015, 2018, 2021
Mayo	39	Clew Bay	Mussel	Rope culture	2021
Donegal	52	Mulroy Bay	Mussel	Rope culture	2015, 2018, 2021

The locations and years where *Monocorophium acherusicum* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Dublin	3	Dún Laoghaire Harbour	n.a.	Marina	2019

The locations and years where *Calyptraea chinensis* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Galway	36	Georges Bank	n.a.	Bottom	2020

The locations and years where *Crepidula fornicata* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Donegal	51	Lough Swilly	Oyster	Bottom culture	2018, 2021

The locations where *Magallana gigas* was found during surveys in Ireland between 2010 and 2022.The year in which the species was first found is indicated per location. * *M. gigas* only recorded in bags on trestles.

County	Location		Shellfish species	Habitat	Year
Louth	2*	Carlingford Lough	Oyster	Trestles	2016, 2019, 2022
Wexford	5*	Bannow Bay	Oyster	Trestles	2021
Waterford	16*	Dungarvan	Oyster	Trestles	2018, 2021
	20*	Woodstown	Oyster	Trestles	2017, 2019, 2022
Cork	26*	Youghal Bay	Mussel	Bottom culture	2011
Kerry	27*	Castlemaine Harbour	Mussel	Bottom culture	2013
	28*		Oyster	Trestles	2018, 2021
	30*	Templenoe	Oyster	Trestles	2016, 2019, 2022
Clare	32*	Poulnasherry	Oyster	Trestles	2018, 2021
Galway	33*	Ballinakil	Oyster	Trestles	2016, 2019, 2022
	34*	Clarenbridge, Inner Galway Bay	Oyster	Trestles	2016, 2019, 2022
Mayo	37*	Achill	Oyster	Trestles	2016, 2019, 2022
	40*	Clew Bay	Oyster	Trestles	2012, 2015, 2018, 2021
	41*	Killala	Oyster	Trestles	2016, 2019
Sligo	42*	Drumcliff	Oyster	Trestles	2016, 2019, 2022
Donegal	43*	Ardara	Oyster	Trestles	2016, 2019, 2022
	45*	Donegal	Oyster	Trestles	2018, 2021
	46*	Dungloe	Oyster	Trestles	2016, 2019, 2022
	50	Lough Swilly	Mussel	Bottom culture	2014, 2017
	51		Oyster	Bottom culture	2012, 2015, 2018, 2021
	53*	Mulroy Bay	Oyster	Trestles	2016, 2019, 2022
	54*	Trawbreaga Bay	Oyster	Trestles	2012, 2015, 2018, 2021
	55*	Trawenagh Bay	Oyster	Trestles	2016, 2019, 2022

The locations and years where *Mya arenaria* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Kerry	29	Kenmare River	Mussel	Rope culture	2012

The locations and years where *Teredo navalis* was found during surveys in Ireland between 2010 and 2022.

County	Location		Shellfish species	Habitat	Year
Donegal	49	Lough Foyle	Oyster	Bottom culture	2015

APPENDIX 2

Term	Definition	Context
Alien Species	Means any live specimen of a species, subspecies or lower taxon of animals, plants, fungi or micro-organisms introduced outside its natural range; it includes any part, gametes, seeds, eggs or propagules of such species, as well as any hybrids, varieties or breeds that might survive and subsequently reproduce.	IAS Regulation
	(a) a species or subspecies of an aquatic organism occurring outside its known natural range and the area of its natural dispersal potential; (b) polyploid organisms, and fertile artificially hybridised species irrespective of their natural range or dispersal potential.	Alien and Locally Absent species in Aquaculture Regulation
Invasive Alien Species (IAS)	An alien species whose introduction or spread has been found to threaten or adversely impact upon biodiversity and related ecosystem services.	EU IAS Regulation
Non-indigenous species (NIS)	Species whose introduction or spread threaten biodiversity.	OSPAR MSFD
Non-native species	A species, subspecies or lower taxon, introduced (i.e. by human action) outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce.	*Used more in a GB context.*
Locally absent species	Species or subspecies of an aquatic organism which is locally absent from a zone within its natural range of distribution for biogeographical reasons.	Alien and Locally Absent Species in Aquaculture Regulation
Pathway	The routes and mechanisms of the introduction and spread of invasive alien species. The route by which alien species enters a new area.	EU IAS Regulation
Vector	The way an alien species travels to a new area.	
Introduction	The movement, as a consequence of human intervention, of a species outside its natural range.	EU IAS Regulation