Revitalising Our Seas

Identifying Areas of Interest for Marine Protected Area Designation in Irish Waters

FAIR SEAS

Myrtleville Beach,
Co. Cork

Revitalising Our Seas

Identifying Areas of Interest for Marine Protected Area Designation in Irish Waters

The Fair Seas campaign is led by a coalition of Ireland's leading environmental non-governmental organisations and networks.

- **BirdWatch Ireland**
- **Coastwatch**
- **Coomhola Salmon Trust**
- **Friends of the Irish Environment**
- **Irish Environmental Network**
- **Irish Whale and Dolphin Group**
- **Irish Wildlife Trust**
- **SWAN–Sustainable Water Network**

At Fair Seas, we seek to protect, conserve and restore Ireland's unique marine environment. Our ambition is to see Ireland become a world leader in marine protection, giving our species, habitats and coastal communities the opportunity to thrive.

Fair Seas aims to build a movement of ocean stewardship across Ireland that energises and empowers people, to advocate for ambitious and robust legislation, provide impartial scientific data and research, and propose a network of effective well-managed marine protected areas.

Revitalising Our Seas, Identifying Areas of Interest for MPA Designation in Irish Waters is authored by Regina Classen, Marine Policy and Research Officer, Irish Wildlife Trust; Sarah Hegarty, Seabird MPA Researcher, BirdWatch Ireland; Hannah Keogh, Marine Mammal Ecologist, Irish Whale and Dolphin Group and Sibéal Regan, Education and Outreach Officer, Irish Whale and Dolphin Group.

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Co. Galway

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Foreword

Furthering the conversation about where and how to have Marine Protected Areas in Ireland

This study provides information on where to best protect marine species in Ireland, based on the geographic distributions of 15 species of whales and dolphins, 38 species of seabirds, 16 species of sharks, skates, rays, 7 commercially exploited species, and 11 habitat indicator species.

It follows a government report that outlined the shortcomings of Ireland's present marine conservation strategy and how it needed to catch up to meet legal obligations and sustainable management of marine resources (Marine Protected Area Advisory Group 2020). A public survey found 92% of respondents wanted more Marine Protected Areas (MPAs) in Ireland, indicating that national marine planning was also behind public opinion (French and McDonough 2020). The legal context to expand MPAs in Ireland has also been reviewed (Enright 2021), noting where improvements are possible, and that some MPAs, such as Lough Hyne, can already be created under the Wildlife Act in territorial seas. Thus, there is no reason to delay creating more MPAs due to legislative constraints.

This study complements the BioMar-LIFE project, which used standard field survey methods to survey subtidal and intertidal habitats and species during the 1990s (Picton et al. 2017). It led to the government proposing a network of marine Special Areas of Conservation to comply with the European Union Habitats Directive (Costello and Emblow 1997). The present study notes the increased availability of environmental and seabed habitat data for Ireland since BioMar. In addition, the National Biodiversity Data Centre has been compiling data from scientists and citizens leading to unprecedented availability of standardised data online, including in the Global Biodiversity Information Facility and Ocean Biodiversity Information System. Thus, the stage is set for more detailed mapping of marine species, habitats and ecosystems that could optimise where and how to best protect and restore marine biodiversity in Ireland's Exclusive Economic Zone (EEZ) to ensure MPAs are representative of all biodiversity, as well as selected species. However, the opportunity to improve the scientific context for MPA planning does not mean that there is any need to delay discussions with the public and commercial interests on how to best manage the marine environment. Indeed, this study, like BioMar, can be a catalyst to start such discussions, and consequent feedback can prioritise what information is needed to help marine spatial planning.

We do not know what Ireland's marine biodiversity would be naturally. Centuries of hunting and fishing have repeatedly removed the top predators and larger animals and thus altered food webs and ecosystems. However, few marine species have gone extinct globally so by having some safe havens from these effects biodiversity can self-restore.

It took 20 years after establishment of the first Marine Reserve (a no fishing MPA) in New Zealand in 1975 before the food web effects of fishing were understood (Leleu et al. 2012). The fishing out of large fish and crayfish enabled sea urchins to become larger and more abundant and graze down the kelp forest and other seaweeds to bare rock. These seaweed habitats are where young fish find refuge from predation and are thus critical habitat for fisheries. The loss of kelp and seaweed forests due to the food-web effects of fishing is likely a global trend; having been observed in the Mediterranean, north-east Pacific, Tasmania, and western Australia (Leleu et al. 2012). Thus, MPAs can be the reference areas by which to judge the direct and indirect effects of fishing. These effects may be acceptable, depending on how society values different aspects of biodiversity, but can only be understood when there are some (even small but replicated) MPAs whose environment is otherwise representative of the fished areas.

Another benefit of fully protected MPAs is that they enable the effects of fishing to be distinguished from the effects of climate change; e.g., if a fish population declines both inside and outside a fully protected MPA then this may be part of a climate driven population decline.

New Zealand now has 44 MPAs because of popular demand, from communities to schools and scuba clubs, and the increasing need to reverse long-term declines of fish and shellfish populations. Not only is there no evidence of negative impacts of these MPAs on fisheries, but local communities and fishermen support them because of the boosts to fish stocks which then spread into adjacent areas (see videos on YouTube) (Costello 2014). In addition, the modern availability of buoyant wet suits means children and adults can safely snorkel and witness rich marine life, including fish which lose their fear of people inside fully protected MPAs. The "Experiencing Marine Reserves" programme has taken over 180,000 local children and adults snorkelling and kayaking in New Zealand Marine Reserves. We get a new appreciation of life underwater when a fish bigger than a child and older than its parents cruises over and examines us. Ireland, without any areas in which fishing is prohibited, is thus about 50 years behind New Zealand in creating MPAs. We do not know what we are missing.

It may seem counter intuitive, but there is no evidence of any MPA anywhere in the world reducing fishery catch. But there are many examples of MPAs restoring fished populations and these restored stocks consequently repopulating adjacent areas where they contribute to fisheries (e.g., Costello 2014, Qu et al. 2021). Thus, fishing communities could take the lead in creating some MPAs to maximise their benefits. They could use MPAs to safeguard breeding populations, like farmers take special care of their breeding animals. Instead of nature conservation being viewed as in conflict with fisheries, MPAs may provide a simpler, cheaper, fairer, and more effective way to sustain inshore fisheries.

If properly planned, MPAs can lead to more stable and sustainable coastal fisheries, with added benefits of increased tourism and public enjoyment of marine life. This is why many Pacific Island nations have embraced MPAs, protecting most of their EEZs, some larger than Ireland's EEZ (https://mpatlas.org/zones). So called industrialised countries have much to learn from such communities who are more in tune with and respectful of their marine environment.

This report suggests that 36% of the sea should be in a MPA. However, what protection means in practice varies. There is a range of management measures from permitting commercial fishing to no fishing, and different kinds of recreation and aquaculture. In contrast to the range of private (e.g., marinas), commercial (e.g., harbours, cable zones, fishfarms, windfarms) and military activities that already exclude the public, MPAs generally facilitate increased public access to marine areas. Thus, informed management requires data comparing where species live, the distribution of habitats and understanding the effects of, and where necessary limiting, human extraction of resources. Only in special situations may it be necessary to restrict non-extractive activities, such as shipping and boating (e.g., for public safety, and/or to avoid collisions with whales).

What should be avoided is any pretence that all MPAs aim to protect biodiversity in a natural condition. In fact, globally 94% allow fishing (Costello and Ballantine 2015). The independent MPAtlas (mpatlas.org) can only verify 2.6% of the ocean is in a real MPA (i.e., a MPA that aims to exclude all harmful activities), not the 8% one hears UN agencies and governments declaring.

Ireland needs a core of fully protected MPA representative of its species and habitats that can be a reference for human effects elsewhere. Another set of MPAs may allow some uses, for example low footprint finfish, shellfish, and/or seaweed aquaculture, fishing that does not damage habitats, and energy generation; using the fully protected MPA to gauge their effects. These MPAs should be nested within a comprehensive strategy for sustainable use, based on the precautionary principle, for all of Ireland's seas.

MPAs are a form of marine spatial planning and do not necessarily increase management costs, (except where there was no management previously). They can simplify management, enabling more effective enforcement, self-policing and build community support for what activities are acceptable in different places and why. By Ireland stepping up its investment in its marine environmental management, including MPAs, it will benefit biodiversity, people and make for a more sustainable economy.

While a majority of the public in Ireland support the need to have MPAs in principle (French and McDonough 2020), there will be objections to exactly where they are located, their boundaries, and rules. This is normal whenever society decides to designate areas for the public good, including schools, hospitals, museums, interpretative centres and sports facilities, including valid concerns about issues including increased traffic, toilet facilities, and disturbance of the status quo. That is why discussions with local communities need to start as soon as possible within the context of wider regional land and marine planning about what MPA can be, with political support to implement what is best for Ireland in the long term. May the conversation begin.

Mark John Costello

The author (BSc Galway, PhD Cork) did his PhD in Ireland's first MPA, Lough Hyne Marine Reserve; spent 16 years teaching a graduate course on MPA in New Zealand; manages and posts daily news about MPA to facebook.com/marinereserves; and has over 250 peer-reviewed scientific papers. He is currently a Professor in Marine Ecology at Nord University, Norway and received a National University of Ireland Galway Alumni Award in 2021.

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Executive Summary

The Irish government has supported the EU Biodiversity Strategy target to protect at least 30% of the Irish Maritime Area by 2030. However, current nature protection designations cover only 2.1% of the Irish Maritime Area.[1] Commitments under the UN Sustainable Development Goals and the Convention on Biological Diversity, as well as several national and European legal obligations, require Ireland to protect and restore marine biodiversity.

In this report, Fair Seas presents 16 Areas of Interest for marine protected area (MPA) designation in Irish waters. The network of Areas of Interest for MPA designation covers just under 36% of Ireland's Maritime Area. An Area of Interest is defined as a key biodiversity hotspot for one or more species of conservation interest.

Methods used
The Areas of Interest (AOIs) were developed by conducting spatial analyses of species of conservation interest.

Five species groups were considered in this study: (1) cetaceans (marine mammals in the order Cetacea, e.g. whales and dolphins); (2) seabirds; (3) elasmobranchs (sharks, skates and rays and chimaeras); (4) commercially exploited species; and (5) seabed features.

> "In this report, Fair Seas presents 16 Areas of Interest for marine protected area (MPA) designation in Irish waters."

Different analyses were conducted for species groups depending on available data. Survey data for cetaceans, seabirds and elasmobranchs were used to identify areas with high population density and species richness in the Irish Maritime Area. For seabed features, occurrence maps were created; for commercially exploited species, existing locations of spawning grounds were considered as evidence that an area is of high importance for the species in question.

Additionally for seabirds, a scoring system was developed to identify potential hotspots, taking account of the species' conservation status and age of the recorded sighting.

Why do we need MPAs?
An ecologically coherent, representative, connected and resilient network of MPAs is necessary for the many reasons set out in the Irish government's MPA Advisory Group report published in 2020. In summary:

- MPAs, if managed effectively, restore ocean life.
- This restoration is necessary, because biodiversity has declined significantly in recent decades due to human impacts such as over-exploitation, habitat loss, pollution, and climate change.
- Conserving and restoring biodiversity is vital for human society because we depend on a healthy environment and the ecosystem services it provides, including carbon sequestration, food provision, storm protection, pollution control and recreation.
- Nature also has an intrinsic value and should be protected and restored regardless of its value to us.
- People want MPAs: out of 2,311 responses to the public consultation on the Government's MPA Advisory Group Report (2020), 99% supported MPAs. Respondents also showed strong support for the Irish government's 30% by 2030 target.

Ireland's current nature conservation designations, which are Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), collectively termed the Natura 2000 Network, are not sufficient to provide the necessary levels of protection and restoration, because of their low spatial coverage and because they are limited to the protection of habitats and species listed in the EU Habitats and Birds Directives. In addition, SACs and SPAs are not managed effectively and the health of habitats and species within these designations is declining.

Purpose of this report
The purpose of this report is to identify Areas of Interest (AOIs), which warrant consideration in the future MPA network. This report and proposed Areas of Interest aim to accelerate the Irish government's efforts to designate an MPA network in Irish waters. Our proposed AOIs should serve to further the conversation in order to engage all stakeholders in a constructive discussion around the meaning of the 30% by 2030 target.

While there are many data gaps and much is still unknown about marine life in Ireland, Fair Seas is satisfied that sufficient evidence exists to begin the MPA designation process, using the precautionary approach, best available data, and other information derived from peer-review and grey-literature sources, in strong consultation with all stakeholders.

1 As defined by the National Marine Planning Framework

Bull Island,
Co. Dublin

1 Introduction

At 488,762km^2, Ireland's Maritime Area is seven times the size of its land mass. Ireland has a responsibility to protect and restore this highly productive part of the north-east Atlantic Ocean.

Ireland's commitment to the EU Biodiversity Strategy for 2030
The Irish government wants to act on its international responsibility to protect its waters, and has committed in its Programme for Government to support the 'principles and ambition' of the EU Biodiversity Strategy for 2030, which includes a target of legally protecting a **minimum of 30% land and sea area by 2030**.[2] The current figure of Ireland's protected marine area stands at just 2.1%, meaning a 15-fold increase in protected area coverage is required to meet the 2030 commitment – in under eight years (see Figure 1.1)[3].

The Biodiversity Strategy also includes a goal of 'strictly protecting' a third of all protected areas, or 10% of all land and sea area and to 'effectively manage all protected areas, defining clear conservation objectives and measures, and monitoring them appropriately'.

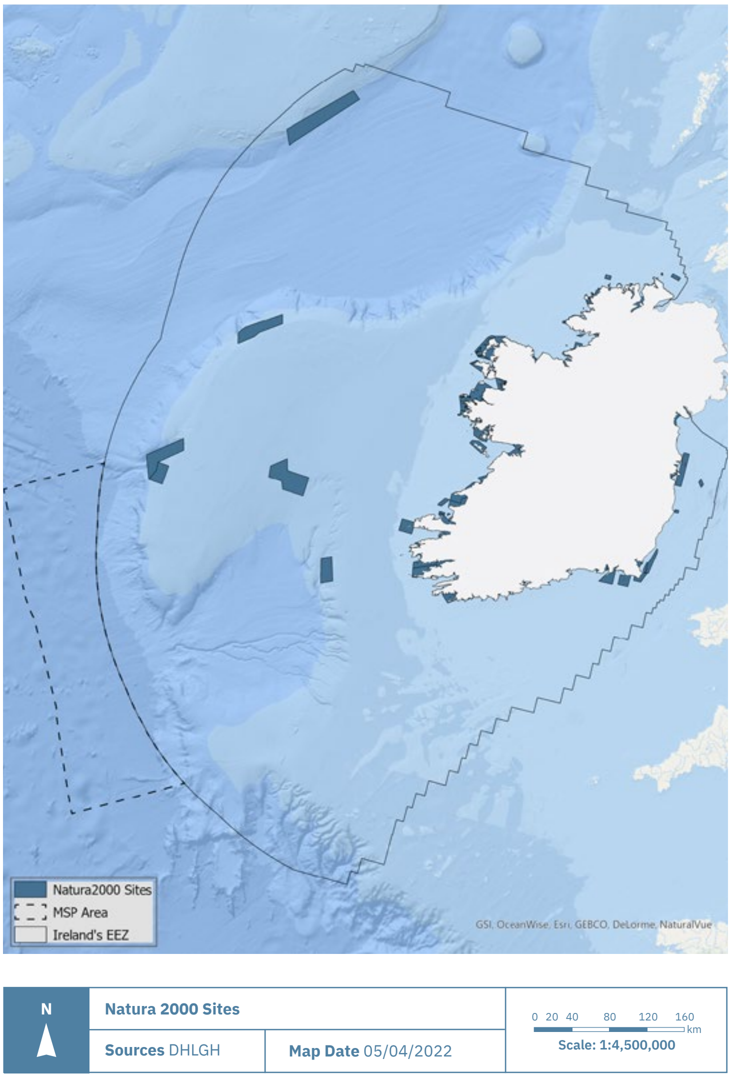
Why marine protected areas?

Importance of a healthy marine environment for proper ecosystem functioning
The main reason why the preservation and restoration of biodiversity is necessary is due to increasing human impacts interfering with the ways in which ecosystems function (IPBES, 2019). An 'ecosystem' is defined as 'a natural unit consisting of all the plants, animals and microorganisms in a given area, interacting with the non-living physical and chemical factors of this environment' (Levin et al., 2012). The loss or population decline of one species inevitably affects other species in the ecosystem. Equally, changes to physical or chemical factors also impact on the species living in the ecosystem. While changes within ecosystems are natural, severe impacts can cause irreversible changes such as localised or global-level species extinctions (Pimm et al., 2014).

A diverse ecosystem, which has a wide variety of animals, plants and microorganisms living in it, is more resilient to environmental changes (Tett et al., 2013). Therefore, high biodiversity means the ecosystem is healthier and better equipped to recover from impacts such as disease outbreaks, high temperatures or physical disturbance (Sheehan et al., 2021; Howarth et al., 2013).

Importance of a healthy marine environment to help us mitigate and adapt to climate change
At a global level, the ocean has an important role to play in climate stabilisation, having absorbed nearly

Figure 1.1
Map of Ireland's current MPAs (in the form of SACs and SPAs)



2 https://assets.gov.ie/130911/fe93e24e-dfe0-40ff-9934-def2b44b7b52.pdf
3 Current marine protected areas are in the form of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated under EU nature laws.

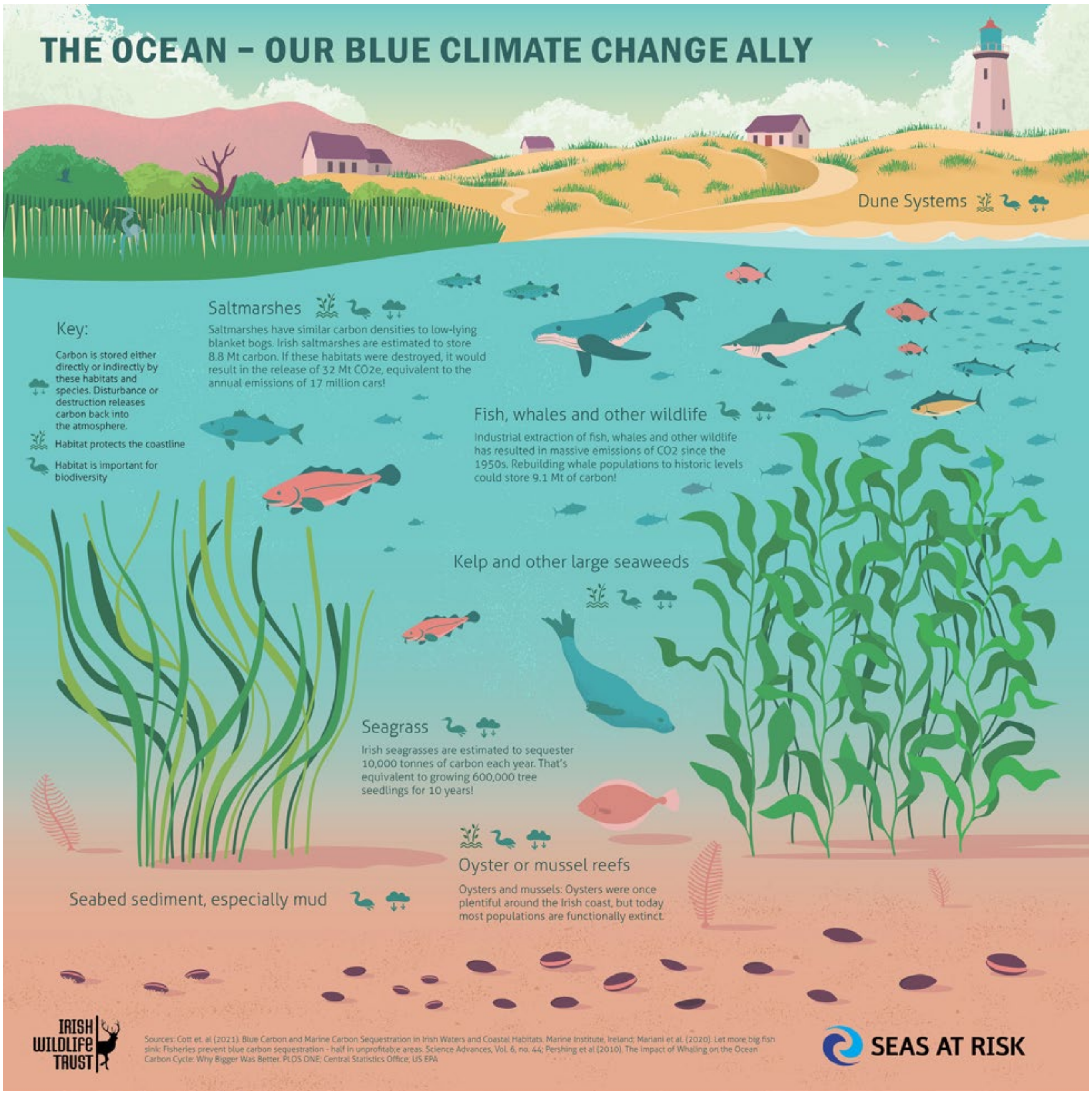


Figure 1.2
The many ways in which our ocean helps us to mitigate and adapt to climate change.

90% of the excess heat between 1971 and 2010 and over 30% of the carbon dioxide (CO_2) released into the atmosphere (Zanna et. al, 2019). The ocean has thereby helped to significantly slow global warming.

Many marine species and habitats, when intact, are highly effective at sequestering and storing carbon in the ocean – this carbon is called 'blue carbon' (see Figure 1.2). Saltmarshes, for example, have similar carbon densities to low-lying blanket bogs (Cott et al., 2021). Irish saltmarshes are estimated to store 8.8 Mt of carbon (Cott et al., 2021). However, when coastal wetlands are degraded (e.g. drained of water), the carbon stored in the soils can be released back into the atmosphere as CO_2 (Cott et al., 2021). Therefore, if Ireland's saltmarshes were destroyed, it would result in the release of 32 Mt CO_2e, equivalent to the annual emissions of 17 million cars.[4] Similarly, Irish seagrasses, which cover a relatively small area, are estimated to store 0.6 Mt of carbon (Cott et al., 2021). Seagrasses are currently on the decline in Ireland despite being protected in a network of Special Areas of Conservation (SACs)(NPWS, 2019).

The largest amount of carbon is absorbed by single-celled organisms, called phytoplankton, which grow at the surface of the ocean when conditions are right. It is estimated that phytoplankton in Irish waters sequester 7.1 Mt of carbon annually (Cott et al., 2021). Phytoplankton depend on nutrients to reproduce, just like plants on land. In the ocean, these nutrients are provided in part by whale excrements. By migrating over large distances and depths, whales act as pumps, or conveyor belts, that transport nutrients from nutrient-rich feeding grounds to nutrient-poor areas (Roman et al., 2014). Whales themselves are also rich in carbon due to their large size. It has been suggested that by rebuilding whale populations to their global historic levels, an additional 9.1 Mt of carbon would be stored globally (Pershing et al., 2010). Similarly, fish also store carbon in their bodies throughout their lifespan. In

4 Calculation based on US EPA Greenhouse Gas Equivalencies Calculator https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

the absence of fishing, much of this carbon would be sequestered in sediment once fish die and sink to the seafloor (Mariani et al., 2020). It is estimated that the extraction of fish biomass from commercial fisheries has prevented sequestration of around 21 Mt of carbon globally since 1950 (Mariani et al., 2020). Rebuilding ocean life to its former abundance within MPAs therefore has human, biodiversity and climate benefits.

Status of Ireland's Marine Environment and Legal Obligations

The MPA Advisory Group Report (2020) discusses in detail the international, EU and national legislation and agreements that require Ireland to introduce MPAs. Below is a summary of the most important legal requirements under EU laws along with an outline of Ireland's progress towards achieving these obligations.

> **"Even knowing the scale of this change, it is difficult to imagine quite how rich the seas were"**
> Ireland's MPA Advisory Group Report 2020

Under the EU's Marine Strategy Framework Directive (MSFD), Ireland was obligated to bring its marine waters to Good Environmental Status (GES) by 2020. This was not achieved (DHPLG, 2020). GES is described as 'the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations'. One of the tools through which GES should be achieved is the designation of an ecologically coherent and representative network of MPAs, adequately covering the diversity of the constituent ecosystems, at a (sub) regional level. The extension of Ireland's MPA network is one of the measures listed under the MSFD Programme of Measures in 2016 (Department of Environment, Community and Local Government, 2016).

The most recent assessment of the health of our seas under the MSFD has shown that only six out of 11 indicators for GES have been met. For example, the majority of commercial and non-commercial fish populations are either in a poor or unknown status (DHPLG, 2020). In 2019, 44 out of 177 commercial fish and shellfish populations were incompatible with GES, while the status of 99 stocks is unknown, despite a 2020 deadline to end overfishing under the Common Fisheries Policy (CFP)(DHPLG, 2020).

There is a continued downward trend of some large predatory fish species such as sharks, skates and rays (Clarke et al., 2016). An IUCN Red List status report of cartilaginous fish in Ireland showed that out of 58 species assessed, 6 were Critically Endangered, 5 were Endangered, 6 were Vulnerable, and 19 were Near Threatened (Clarke et al., 2016). The main cause of this decline is over-exploitation in commercial fisheries, where these species are caught as either target or non-target (bycatch) species (Clarke et al., 2016). Iconic species such as porbeagles and angel sharks have undergone a 90% decline in abundance, while the Portuguese dogfish and spurdog have declined by more than 80% (Clarke et al., 2016). The long-term abundance and reproduction of large predators forms an important part of achieving GES for the MSFD Foodwebs descriptor.

Physical loss and disturbance of seafloor habitats is also reported under the MSFD assessments. Physical loss is defined as a permanent change to the seabed that has lasted or is expected to last for a period of two reporting cycles (12 years) or more, while physical disturbance is a change to the seabed from which it can recover if the activity causing the disturbance pressure ceases (DHPLG, 2020). In Ireland, it is estimated that 586km^2 of seafloor habitat has been lost, however, if taking into account the impact of damaging fishing activities over the last century, it could be much higher.[5] Physical disturbance from fishing pressure has occurred over a minimum of 64,860km^2, an area almost as large as Ireland's entire landmass (DHPLG, 2020).[6] Many benthic habitats, including reefs, have been severely damaged by bottom trawling (DHPLG, 2020), and on average 53% of the Celtic Sea is bottom-trawled each year (ICES, 2021).

Existing protected areas in Ireland include those designated under the EU Habitats and Birds directives called Special Areas of Conservation (SACs) or Special Protection Areas (SPAs), or collectively Natura 2000 sites. These Natura 2000 sites cover 2.1% of the Irish Maritime Area, and Ireland is legally obligated to bring certain habitats and species within, or associated with these areas to a Favourable Conservation Status.

Most of these designations have not had a positive effect on biodiversity, however. Recent assessments indicate that 65% of Ireland's coastal habitat types are considered to be in an unfavourable condition (NPWS, 2019). Several marine habitat types have significantly deteriorated in recent years (e.g. large shallow inlets and bays and estuaries) despite falling within SACs (Scally et al., 2020). The problem in these cases is not lack of designation, but lack of management and enforcement (Classen, 2020). The entire Natura 2000 network across Irish land and sea lacks the legally required conservation measures, meaning many harmful human activities are allowed to continue within the protected sites.[7]

Ireland is also a member of the Regional Seas Convention for the Northeast Atlantic (OSPAR), under which it has committed to establishing an ecologically

5 See 'sliding baselines syndrome' discussed in the MPA Advisory Group Report (2020)

6 This assessment is limited to Irish waters in OSPAR Region III and does not cover all of the Irish marine region.

7 https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1235

coherent network of MPAs. Given at the moment there is no national legislation for Ireland to legally underpin these commitments, Ireland has had to designate existing SACs as OSPAR MPAs. SACs and SPAs are limited to the protection of habitats and species listed in the Birds and Habitats Directives, which are more than 25 years old and focused on protecting vulnerable, rare and/or endemic habitats and species. Not all of the habitats and species listed for protection under OSPAR appear in the Birds and Habitats Directives. Therefore, significant aspects of the Irish marine environment are excluded from protection under the current legal framework (Enright, 2021).

Why fully or highly protected marine areas?

In scaling up Ireland's MPA network, it is clear that a more ambitious approach is urgently needed to ensure the health of marine biodiversity is restored. The most significant pressure on marine biodiversity in Ireland is the extraction of fish and shellfish biomass and associated disturbance by human fishing activity (DHLGH, 2022). Fair Seas is therefore calling for fully or highly protected marine areas as defined by 'The MPA Guide: A framework to achieve global goals for the ocean' (Grorud Colvert et al., 2021). According to the Guide, fully protected areas do not allow any kind of extraction through fisheries or aquaculture, while highly protected areas allow only small-scale, low-impact extraction of fish or shellfish. Neither protected area category allows dredging or dumping, and only minimal to low-impact, small-scale infrastructure is permitted.

Globally, 94% of all MPAs allow fishing (Costello and Ballantine, 2015). In a direct comparison of partially protected MPAs and fully protected areas, it was found that fully protected areas had higher biomass, organism density, species richness and organism size (Lester and Halpern 2008). A meta-analysis of different studies found that the biomass of fish assemblage is 343% greater within fully protected areas compared to partially protected MPAs (Sala & Giakoumi, 2017). As the animals within the fully protected area grow larger over time, they also produce more eggs, are more successful at reproduction and produce fitter young (Roberts, 2012). Furthermore, Edgar et. al (2014) argue that conservation benefits of MPAs increase exponentially with the accumulation of five key features: no-take, well enforced, old (>10 years), large (>100 km^2), and isolated by deep water or sand. No Irish protected area currently achieves these objectives.

The primary objective of a protected area according to the IUCN is 'to conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/or geodiversity features: these attributes will have been formed mostly or entirely by non-human forces and will be degraded or destroyed when subjected to all but very light human impact' (Dudley, 2008). Any industrial activities and infrastructural developments (e.g. mining, industrial fishing, oil and gas extraction) are not compatible with MPAs and should be excluded.[8]

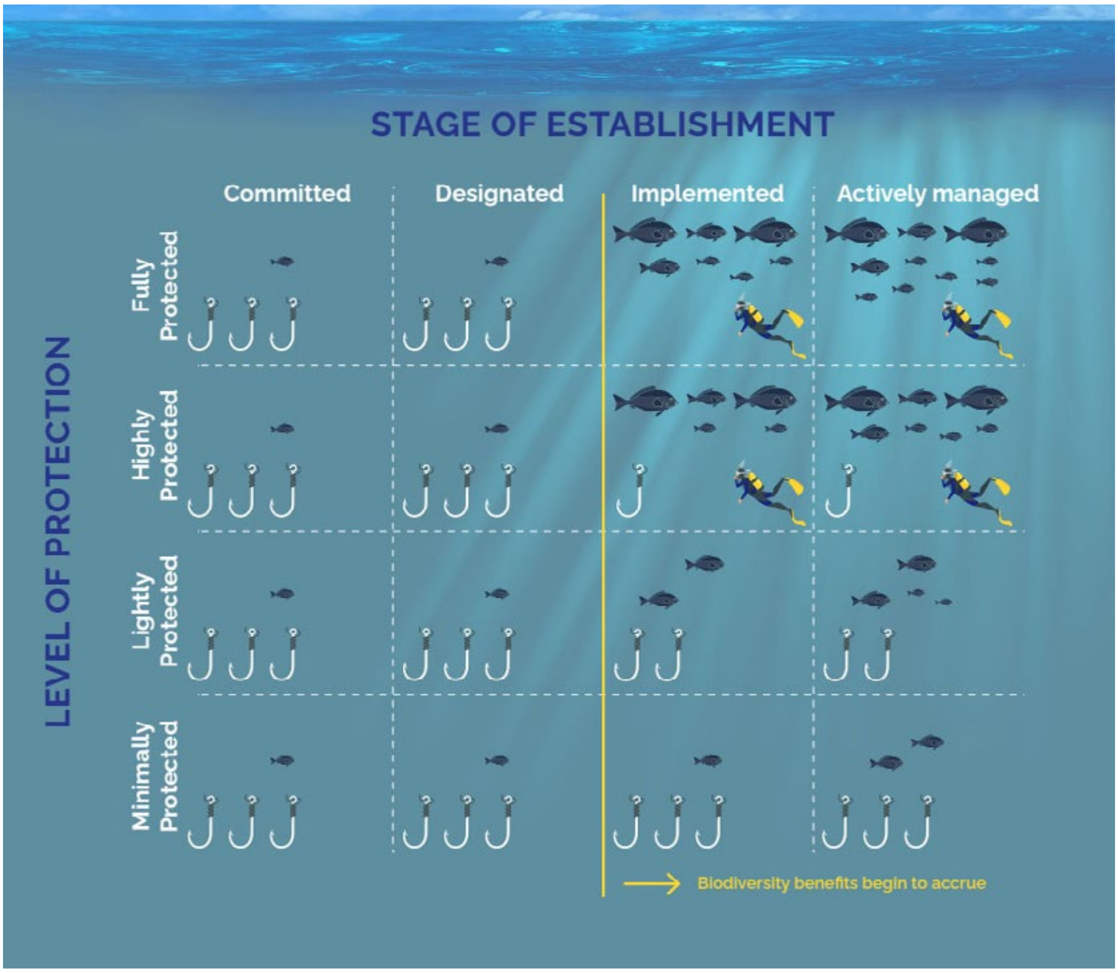


Figure 1.3
How level of protection and stage of MPA establishment influence biodiversity benefits – graphic from the MPA Guide (Grorud-Colvert et al., 2021) showing that with increasing levels of protection and implementation, the potential of MPAs to protect and restore biodiversity and the benefits they provide to people also increase

8 'Industrial fishing' is defined by the IUCN as '(>12m long x 6m wide) motorised vessels, with a capacity of >50kg catch/voyage, requiring substantial sums for their construction, maintenance, and operation and mostly sold commercially, and all fishing using trawling gears that are dragged or towed across the seafloor or through the water column, and fishing using purse seines and large longlines.'

“Humans are not separate from the natural environment, but a part of it. Therefore, the approach to the designation and management of MPAs must be participatory.”

The current form of solely having multi-use MPAs in Ireland (i.e. SACs and SPAs) is therefore incompatible with IUCN guidelines.

Existing MPAs, i.e. Natura 2000 sites, are feature-based, whereby protection of certain species and habitats listed under EU legislation is prioritised. An SAC or SPA is therefore designated to bring some habitats and/or species to a favourable conservation status, rather than protecting the whole site and all the ecosystems within its boundaries (Pikesley et al., 2021). This can be problematic, if exact boundaries of certain habitat features are unknown or shift, or the baseline condition of a feature is unknown (Sheehan et al., 2013a). Studies from the UK have shown that excluding bottom-towed fishing gear not just from known reef features but also from the sedimentary areas nearby could result in positive conservation benefits (Pikesley et al., 2021; Sheehan et al., 2013a). For example, untrawled sediments had a greater abundance of sessile and slow-growing species such as corals and seapens, indicating an expansion of the reef features onto the sediment had occurred after bottom trawls and dredges were excluded. Without this gear exclusion, the reef expansion could not have occurred. The study concluded that ‘feature-based MPA management may not adequately protect targeted features, whereas site-based management allows for shifting baselines and will be more effective at delivering ecosystem goods and services’ (Sheehan et al., 2013a). Fully or highly protected marine areas, which by default apply a whole-site approach, are therefore the best tools we have to regenerate life in the ocean (see Figure 1.3, Grorud-Colvert et al., 2021; Lester and Halpern, 2008; Sala et al., 2018).

The importance of public participation in MPA network design and management

Humans are not separate from the natural environment, but a part of it. Therefore, the approach to the designation and management of MPAs must be participatory. The MPA Advisory Group Report (2020) entails some excellent recommendations regarding stakeholder engagement which Fair Seas supports. A good model for effective inshore fisheries engagement is, for example, the Lyme Bay MPA in England.[9] The Lyme Bay model showed that MPAs that allow low levels of low-impact extraction can be a good compromise to allow rich biodiversity and human livelihoods to coexist in inshore areas. By excluding bottom-towed fishing gears coupled with good management and strong collaboration with the low-impact potting fleet, the reef ecosystem was able to recover (Sheehan et al., 2013b). However, even pot fishing should be regulated to avoid overfishing and allow all ecosystem processes to function properly (Rees et al., 2021).

From laggards to leaders during the UN Decade on Ecosystem Restoration

The UN Decade on Ecosystem Restoration aims to prevent, halt and reverse the degradation of ecosystems on every continent and in every ocean. The challenge of increasing MPA coverage from 2.1% to 30% by 2030 during this important decade should be seen as an opportunity rather than an obligation. We will be able to offer sanctuary and restoration to the habitats and species in our seas that need it most by designating an ecologically coherent network of MPAs that lets marine life not only survive, but thrive. With the right MPAs in the right places, appropriate management and political leadership, Ireland’s MPA network can be exemplary. Scaling up to 30% effective protection would turn Ireland from a laggard to a leader in ocean conservation globally, and bring benefits to the fishing industry and wider society.

Purpose of this report

The purpose of this report is to identify Areas of Interest (AOIs), which warrant consideration in the future MPA network. Several Irish NGOs working together under the Fair Seas campaign have compiled an initial assessment based on available data which supports the designation of Areas of Interest based on occurrence, density and richness of certain species and habitats. The proposed Areas of Interest cover just under 36% of the Irish marine region, and their designation would contribute to meeting international and EU legal obligations including the EU Biodiversity Strategy and the UN Convention on Biological Diversity and international political commitments such as the UN Sustainable Development Goals.

This report and the proposed Areas of Interest should serve to further the conversation in order to engage all stakeholders in a constructive discussion around the meaning of the minimum target of protecting 30% of Ireland’s Maritime Area by 2030. Our proposed AOIs are a starting point towards a network of MPAs that covers a representative amount of marine biodiversity found in Irish waters and fills some of the gaps of the Natura 2000 network outlined in the government’s MPA Advisory Group Report (2020), thereby enabling the government to meet its 2030 commitments with the best possible outcomes for nature, climate and people.

9 See https://www.lymebayreserve.co.uk/

Murder Hole Beach,
Co. Donegal

2 Development of Areas of Interest for MPA Designation

2.1 Methods

There are many possible ways to design an MPA network (e.g. Swedish Agency for Marine and Water Management, 2021; Joint Nature Conservation Committee (JNCC), 2010). The JNCC report (2010) defines seven main MPA network design principles, namely (1) Representativity (ensuring that a range of habitats and species representative of the regional environment are protected); (2) Replication (ensuring that several examples of the representative habitats and species distributions are protected); (3) Adequacy (ensuring a certain proportion of each representative habitat and species' distributions are protected); (4) Viability (ensuring adequate size of the MPAs to achieve conservation objectives); (5) Connectivity (ensuring good distribution of MPAs that are not located too far apart from each other); (6) Protection (ensuring protection levels are high enough to achieve conservation objectives) and (7) Best available evidence (ensuring best available scientific evidence is used and lack of scientific certainty is not used to delay the network design and planning process). The MPA Advisory Group Report (2020) recommends the use of a systematic conservation planning approach. Systematic conservation planning is now commonly used for the design of efficient MPA networks, and identifying these priority areas often involves using specific conservation-planning software, such as Marxan or Zonation. These tools allow the input of the best available socio-economic and ecological data, identifying trade-offs between conservation and socio-economic objectives (Delavenne et al. 2012). Addressing socio-economic objectives, costs and engaging stakeholders and communities in MPA network planning is crucial for a successful outcome (Ardron et al. 2008). The current report represents the first step towards building Ireland's MPA network by analysing existing ecological data. From there, social and economic principles should be applied as a secondary filter (Benyon et al., 2020).

2.1.1 List of species of conservation importance

One of the main tasks when selecting the Areas of Interest was to create a list of species of conservation importance, the locations of which would give rise to potential biodiversity hotspots in the Irish Maritime Area. The list of species of conservation importance is intentionally non-exhaustive and represents only a small subset of key indicators of Irish marine biodiversity. Our analysis therefore serves as a proxy for capturing a range of Irish marine wildlife, the protection of which would contribute to international obligations under EU environmental laws and OSPAR. To create the list of species of conservation importance we followed the first steps outlined in the Swedish approach to MPA Network Design & Management (Swedish Agency for Marine and Water Management (SwAM), 2021). The Swedish model is a very easy to follow step-by-step guide to creating a framework for MPA network design and management, and its method of choosing target features (i.e. our species of conservation importance) suited this project well. Our final list includes OSPAR listed species, Habitats and Birds Directive Annex species, commercially exploited species where one or more stocks are currently fished above maximum sustainable yield (MSY, i.e. the largest average catch or yield that can continuously be taken from a stock under existing environmental conditions), as well as all seabird species that occur in Irish waters.. The species in this initial list were then scored based on their conservation status, strength of available data and the population's relevance to Ireland. A full list of the species assessed as part of this report is shown in Table 1, and all occurrence, density and richness maps of the species groups can be found in the annexes of this report.

> "The current report represents the first step towards building Ireland's MPA network by analysing existing ecological data."

Some species that are not listed were nevertheless considered when reference to them was made in association with a particular habitat in the scientific literature. For example, while orange roughy is not listed in Table 1, the species is still considered as important in coral communities. Any unlisted species that occur in the same habitat as listed species are therefore still considered protected within our chosen Areas of Interest through the recommended application of a whole site approach and the precautionary principle.

Table 1: List of species of conservation importance which were spatially analysed to select potential Areas of Interest

Seabed Habitats	Commercially Exploited Species	Cetaceans	Elasmobranchs	Birds (Breeding)	Birds (Non-breeding)
1. Corals	1. Blue whiting (*Micromesistius poutassou*)	1. Harbour porpoise (*Phocoena phocoena*)	1. Angel shark (*Squatina squatina*)	1. Black-legged kittiwake (*Rissa tridactyla*)	1. Arctic skua (Stercorarius parasiticus)
2. Deep-sea sponges	2. Cod (*Gadus morhua*)	2. Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	2. Flapper skate (prev: common skate) (*Dipturus intermedius*)	2. Lesser black-backed gull (*Larus fuscus*)	2. Long-tailed skua (Stercorarius longicaudus)
3. Seapen and burrowing megafauna communities	3. Haddock (*Melanogrammus aeglefinus*)	3. White-beaked dolphin (*Lagenorhynchus albirostris*)	3. Undulate skate (*Raja undulata*)	3. Black-headed gull (*Larus ribibundus*)	3. Pomarine skua (Stercorarius pomarinus)
4. Horse mussel (*Modiolus modiolus*)	4. Herring (*Clupea harengus*)	4. Bottlenose dolphin (*Tursiops truncatus*)	4. White skate (*Rostroraja alba*)**	4. Mediterranean gull (*Larus melanocephalus*)	4. Balearic shearwater (Puffinus mauretanicus)
5. Ross worm (*Sabellaria spinulosa*)	5. Nephrops (*Nephrops norvegicus*)	5. Risso's dolphin (*Grampus griseus*)	5. Basking shark (*Cetorhinus maximus*)	5. Common gull (*Larus canus*)	5. Cory's shearwater (Calonectris borealis)
6. Red tubeworm (*Serpula vermicularis*)	6. Whiting (*Merlangius merlangius*)	6. Blue whale (*Balaenoptera musculus*)	6. Kitefin shark (*Dalatias licha*)	6. Great black-backed gull (*Larus marinus*)	6. Sooty shearwater (Ardenna grisea)
7. Kelp (*Laminaria spp.*.)	7. Horse Mackerel (*Trachurus trachurus*)	7. Cuvier's beaked whale (*Ziphius cavirostris*)	7. Leafscale gulper shark (*Centrophorus squamosus*)	7. European herring gull (*Larus argentatus*)	7. Great shearwater (Ardenna gravis)
8. Maerl beds		8. Sowerby's beaked whale (*Mesoplodon bidens*)	8. Porbeagle (*Lamna nasus*)**	8. Roseate tern (*Sterna dougallii*)	8. Wilson's storm-petrel (Oceanites oceanicus)
9. Seagrass (*Zostera* spp.) beds		9. Beaked whale spp.	9. Spurdog (*Squalus acanthias*)	9. Common tern (*Sterna hirundo*)	9. Little gull (Hydrocoloeus minutus)
10. Native oyster (*Ostrea edulis*)*		10. Fin whale (*Balaenoptera physalus*)	10. Longnosed skate (*Dipturus oxyrinchus*)	10. Arctic tern (*Sterna paradisaea*)	10. Yellow-legged gull (Larus michahellis)
11. Blue mussel (*Mytilus edulis*)		11. Humpback whale (*Megaptera novaeangliae*)	11. Blue skate (prev: common skate) (*Dipturus batis*)	11. Sandwich tern (*Thalasseus sandvicensis*)	11. Iceland gull (Larus glaucoides)
		12. Killer whale (*Orcinus orca*)	12. Common stingray (*Dasyatis pastinaca*)	12. Little tern (*Sternula albifrons*)	12. Black tern (Chlidonias niger)
		13. Long-finned pilot whale (*Globicephala melas*)	13. Portuguese dogfish (*Centroscymnus coelolepis*)	13. Razorbill (*Alca torda*)	13. Sabine's gull (Xema sabini)
		14. Minke whale (*Balaenoptera acutorostrata*)	14. Shagreen ray (*Leucoraja fullonica*)	14. Atlantic puffin (*Fratercula arctica*)	14. Little auk (Alle alle)
		15. Sperm whale (*Physeter macrocephalus*)	15. Thornback skate (*Raja clavata*)	15. Common guillemot (*Uria aalge*)	
			16. Tope (*Galeorhinus galeus*)	16. Black guillemot (*Cepphus grylle*)	
			17. Longnose velvet dogfish (*Centroselachus crepidater*)	17. Manx shearwater (*Puffinus puffinus*)	
			18. Cuckoo ray (*Leucoraja naevus*)	18. Northern fulmar (*Fulmarus glacialis*)	
				19. European storm-petrel (*Hydrobates pelagicus*)	
				20. Leach's storm-petrel (*Hydrobates leucorhous*)	
				21. Northern gannet (*Morus bassanus*)	
				22. European shag (*Gulosus aristotelis*)	
				23. Great cormorant (*Phalacrocorax carbo*)	
				24. Great skua (*Catharacta skua*)	

The coverage of EUNIS Level 3 habitat types was also considered, as described in section 2.2.2

***_Ostrea edulis_ reefs are currently very rare and confined to inshore bays within existing SACs on Ireland's west coast. Future efforts should focus on restoration of this species, e.g. on the east coast, where historical reefs have disappeared due to overexploitation.**

****Not enough available data. This species was omitted from final analysis.**

> "The primary consideration to identify Areas of Interest was whether or not a species or habitat of interest was present and, if available data allowed, whether it was present in high densities."

2.1.2 Selection of Areas of Interest

The second step towards identifying the Areas of Interest was to source all relevant data, which would define the type of analyses that could be conducted. All data sources are given in the Annex of this report. Following the sourcing of data, a set of criteria were developed that would give rise to the Areas of Interest. The criteria presented in this section therefore represent the best possible method given the data available. Each of the criteria are discussed in detail in the individual Area of Interest descriptions in Section 2.2. and are supported by the maps and data analysis shown in the Annex of this report. Data from scientific and grey literature was consulted in addition to our analyses whenever relevant.

Criterion a) Occurrence and/or density of a species or habitat of interest

The primary consideration to identify Areas of Interest was whether or not a species or habitat of interest was present and, if available data allowed, whether it was present in high densities. All occurrence and density maps are shown in the annexes. In the case of commercially exploited species, the primary consideration was the location of fish spawning grounds produced by ICES (2009).

Criterion b) Species richness of certain taxa groups

The secondary consideration to identify Areas of Interest was species richness of certain taxa groups, e.g. birds, cetaceans, and elasmobranchs. Survey hauls from trawl surveys were also analysed to calculate total species richness to further build the evidence base for biodiversity hotspots on Ireland's shelf sediments. All species richness maps are shown in the annex.

Criterion c) New index to identify bird hotspots

A record-scoring system was used to aid the identification of potential hotspots for seabirds in offshore waters. This method was derived from a similar method designed for application to farmland bird data by BirdWatch Ireland (Kennedy et al., 2022), where hotspots were identified for 28 individual terrestrial bird species. The method used information about age of record, season, breeding evidence and conservation status, and created a scoring system for each criterion. The present-study uses information largely based on the Bird of Conservation Concern in Ireland 2020-2026 (Gilbert et al., 2021), applying an adapted scoring index to three groups of seabirds – Group 1: BoCCI red-listed species (n=5); Group 2: BoCCI amber-listed terns (n=6); and Group 3: BoCCI amber-listed gulls (n=6). Conservation status, trends in population and range, and age of record were assessed for species within each group. A breakdown of the scoring system is outlined in the annex. Scores for each group were expressed as a percentile and a threshold was applied to each group (70%, 50% and 50% respectively), and they were mapped within the 10km x 10km fishnet used to divide the study area.

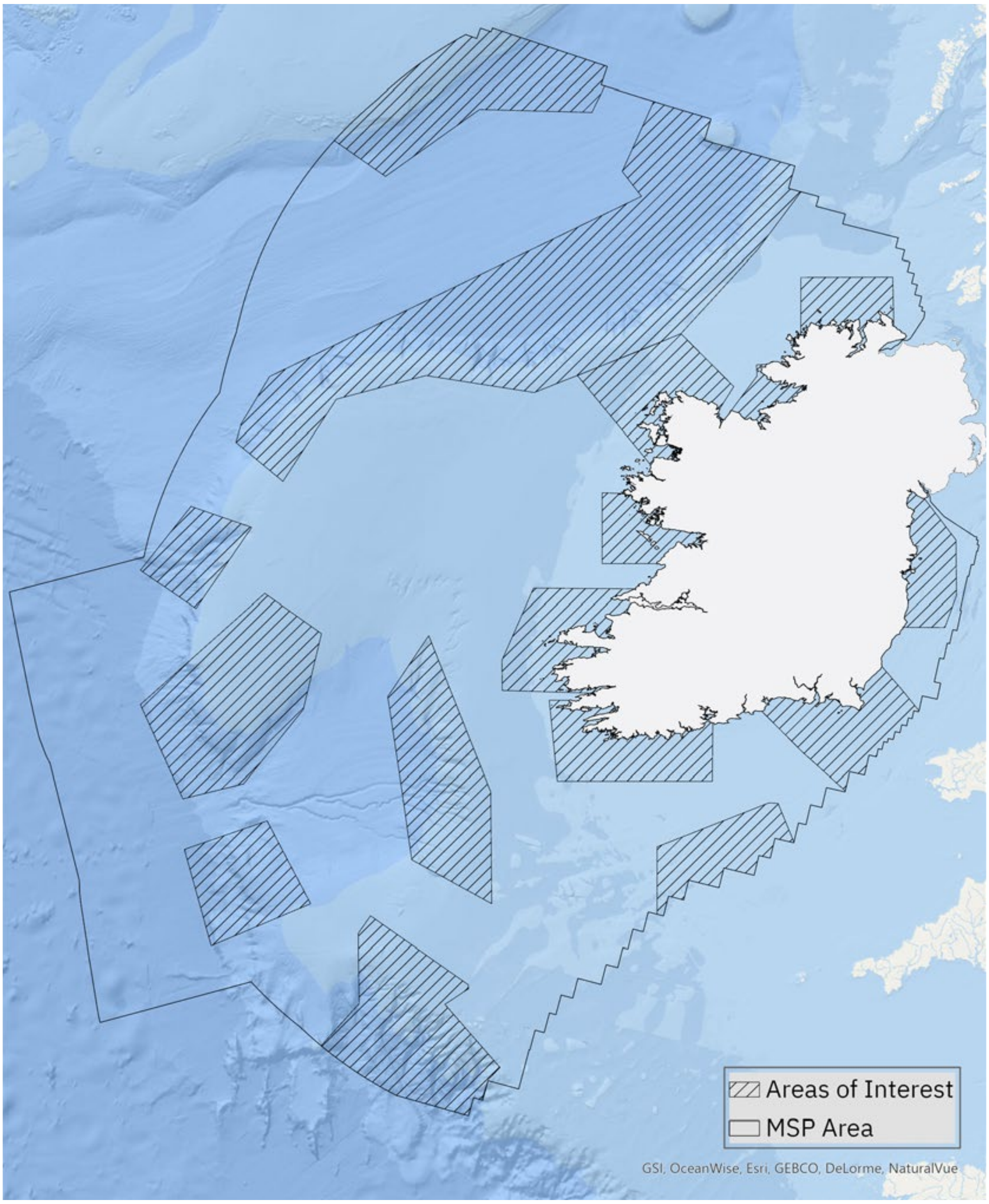
This is the first time a scoring system of this design has been applied exclusively to seabirds, although a similar hotspot index method for waterbirds included four gull species in its analysis (Lauder & Lauder, 2020). The current index identified very few hotspots in offshore areas where a greater focus and novel approaches to assessments are needed, and are in development. While not the only tool for determining important bird areas in the present study, it may have the potential in the future of being an efficient means of analysis concerning existing data for large areas. In addition, with continued analysis and further refinement of the methodology, a wider number of species may be incorporated into the scoring system, thereby working towards hotspot identification that represents the full diversity of Irish marine waters.

Criterion d) Seabird colonies of both national and international importance

Population estimates for breeding seabirds at their colonies were compiled, with most recent counts taken between 2014 and 2018 (Leach's storm-petrel estimates from presently unpublished 2019 count). The total estimates for Ireland's seabird populations were obtained from the online BirdLife International DataZone (BirdLife International, 2015). The count for each colony, or in some cases combined colonies such as islands, was expressed as a percentage of the total population. A colony is considered to be important if it contains 1% or more of a geographic population (Ramsar, Criterion 6.) However, only colonies with 5% of the national population or higher were mapped in this report.

Polygons for the five taxa groups (cetaceans, birds, commercially exploited species, seabed features, elasmobranchs) were created based on criteria a, b, c and d. Following the creation of these polygons, the spatial overlap of the groups was assessed. An Area of Interest was selected when the area was identified as important for two or more groups. A full description of these methods can be found in the annexes.

Figure 2.2.1
Map of full network of Areas of Interest within Ireland's Maritime Area / Marine Spatial Planning (MSP) Assessment Area



N FAIR SEAS	**Network of Areas of Interest**	**Map Date** 08/04/2022	175504km² 35.91%	0 20 40 80 120 160 km
	Sources Fair Seas	Projected Coordinate Systems: ETRS 1989 LAEA		**Scale: 1:4,500,000**

2.2 Areas of Interest for MPA Designation

2.2.1 Size of the Areas of Interest
Given the scale of the task to identify Areas of Interest for the entire Irish Maritime Area, the sites chosen are relatively large. This is due to the uncertainty involved in drawing MPA boundaries based on interpretation of best available data and using the precautionary approach. The size of the areas is further justified based on evidence of species foraging and acoustic detection radii and information from available literature.

In the case of corals along the continental slope, Areas of Interest were drawn to encompass parts of the shelf sediment above the slope. This is because evidence from the literature shows that corals need protection from trawling not only where they occur, but also on nearby sediments, as sediment plumes can settle on the corals and smother them (Wilson et al., 2015).

2.2.2 Protection of EUNIS (European Nature Information System) Level 3 broad-scale habitat types by the chosen network of AOIs
The EUNIS Level 3 broad-scale habitats reasonably reflect the variation in biological character of the marine environment, due to the classification according to biologically meaningful characteristic (e.g. water depth, substrata, and energy levels)(OSPAR, 2006). In order to test our network of AOIs against the representativity principle laid out by JNCC (2010), spatial analysis was carried out to assess the percentage of EUNIS Level 3 broad-scale habitat covered by our chosen AOIs.

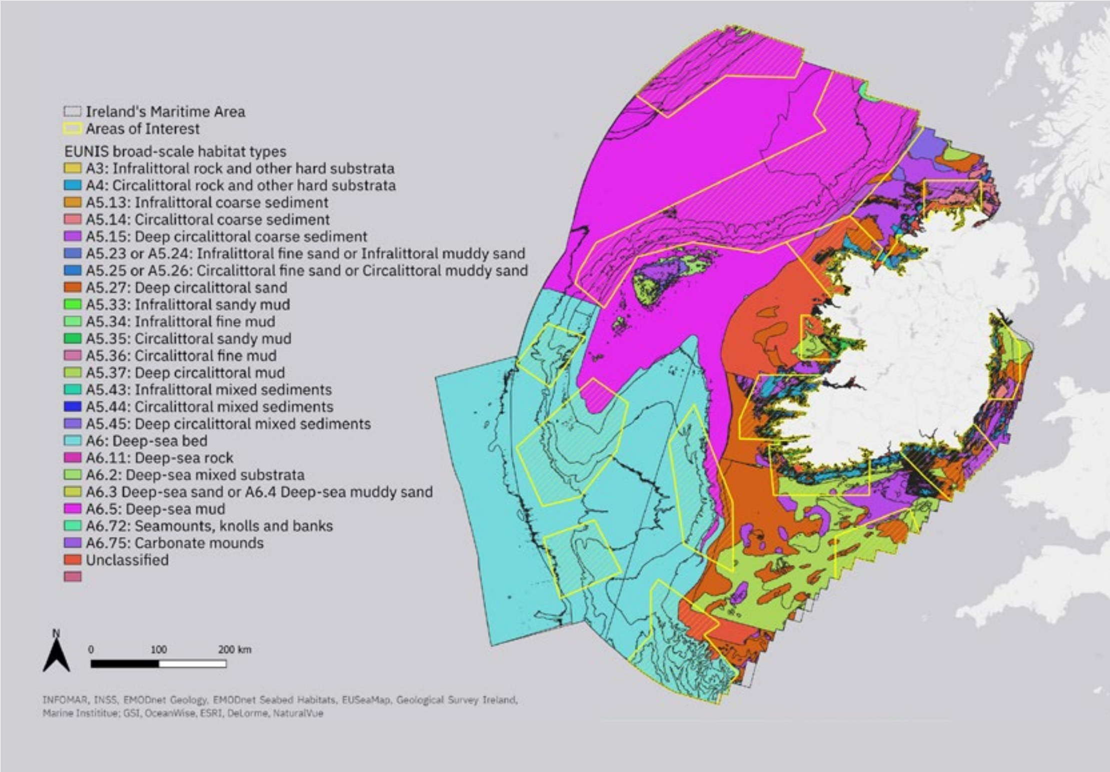


Figure 2.2.1.1 EUNIS Level 3 seabed habitat types with chosen Areas of Interest. An online interactive version of this map can be viewed at https://atlas.marine.ie/ under 'Themes' > 'Biodiversity' > 'Benthic Habitats' > 'Broad Benthic Habitat Type'

EUNIS Habitat Type	Total area of EUNIS habitat type within Ireland's Maritime Area (km²)	EUNIS habitat area within Areas of Interest (in km²)	EUNIS habitat area within proposed MPA network(in % of full habitat)
A3: Infralittoral rock and other hard substrata	392.18	313.77	80.0%
A4: Circalittoral rock and other hard substrata	7,640.69	5,509.38	72.1%
A5.13: Infralittoral coarse sediment	207.49	186.95	90.1%
A5.14: Circalittoral coarse sediment	4,163.34	2,486.49	59.7%
A5.15: Deep circalittoral coarse sediment	27,861.86	8,733.30	31.3%
A5.23 or A5.24: Infralittoral fine sand or Infralittoral muddy sand	408.42	364.64	89.3%
A5.25 or A5.26: Circalittoral fine sand or Circalittoral muddy sand	2,466.77	1,929.59	78.2%
A5.27: Deep circalittoral sand	39,880.70	12,236.02	30.7%
A5.33: Infralittoral sandy mud	139.55	116.38	83.4%
A5.34: Infralittoral fine mud	25.09	21.93	87.4%
A5.35: Circalittoral sandy mud	1,071.70	1,025.62	95.7%
A5.36: Circalittoral fine mud	17.03	17.03	100.0%
A5.37: Deep circalittoral mud	32,846.41	10,602.95	32.3%
A5.43: Infralittoral mixed sediments	76.35	53.34	69.9%
A5.44: Circalittoral mixed sediments	195.36	84.01	43.0%
A5.45: Deep circalittoral mixed sediments	4,086.76	550.49	13.5%
A6.11: Deep-sea rock	76.12	66.33	87.1%
A6.2: Deep-sea mixed substrata	1,846.01	223.17	12.1%
A6.3 Deep-sea sand or A6.4 Deep-sea muddy sand	91.53	33.36	36.4%
A6.5: Deep-sea mud	158,218.28	69,319.54	43.8%
A6.72: Seamounts, knolls and banks	332.86	332.86	100.0%
A6.75: Carbonate mounds	248.02	171.77	69.3%
A6: Deep-sea bed	156,925.32	50,686.25	32.3%
Unclassified	25,471.12	8,461.54	33.2%
TOTAL	**464,688.97**	**173,526.71**	**37.3%**

Table 2: EUNIS Level 3 habitat types protected by the chosen network of AOIs

Depending on the EUNIS habitat type, the Joint Nature Conservation Committee (2010) recommends protection of between 15% and 42% of each habitat type per regional project area. The Areas of Interest shown in figure 2.2.1. achieve this for all but 'deep circalittoral mixed sediments' and 'deep-sea mixed substrata'. This is because the AOIs were chosen to cover a high amount of shallow inshore habitats due to the importance of inshore areas to seabirds, cetaceans and as breeding habitat for commercial fish and sharks, skates and rays.

2.2.3 Proximity to UK MPAs

Another consideration when choosing our Areas of Interest was the potential for cross-border protection of certain habitats and species. Several very large MPAs are designated in UK waters that could be expanded by the Irish network to ensure species that move between the UK and Ireland in these areas are protected. Examples where our Areas of Interest border MPAs in the UK are the Whittard Canyon, the South-East Rockall Bank and the North-West Continental Shelf.

2.2.4 Future Analyses

The AOIs identified in the present report are taking a biodiversity-focused approach to identify areas of interest for possible MPA designation. Further analyses will be required to refine the site selection, such as climate resilience assessments, assessing the proposed network for ecological connectivity and assessing representativity of the network using more detailed seabed habitat types than the EUNIS level 3

Figure 2.2.3 Marine Protected Areas in UK and Ireland

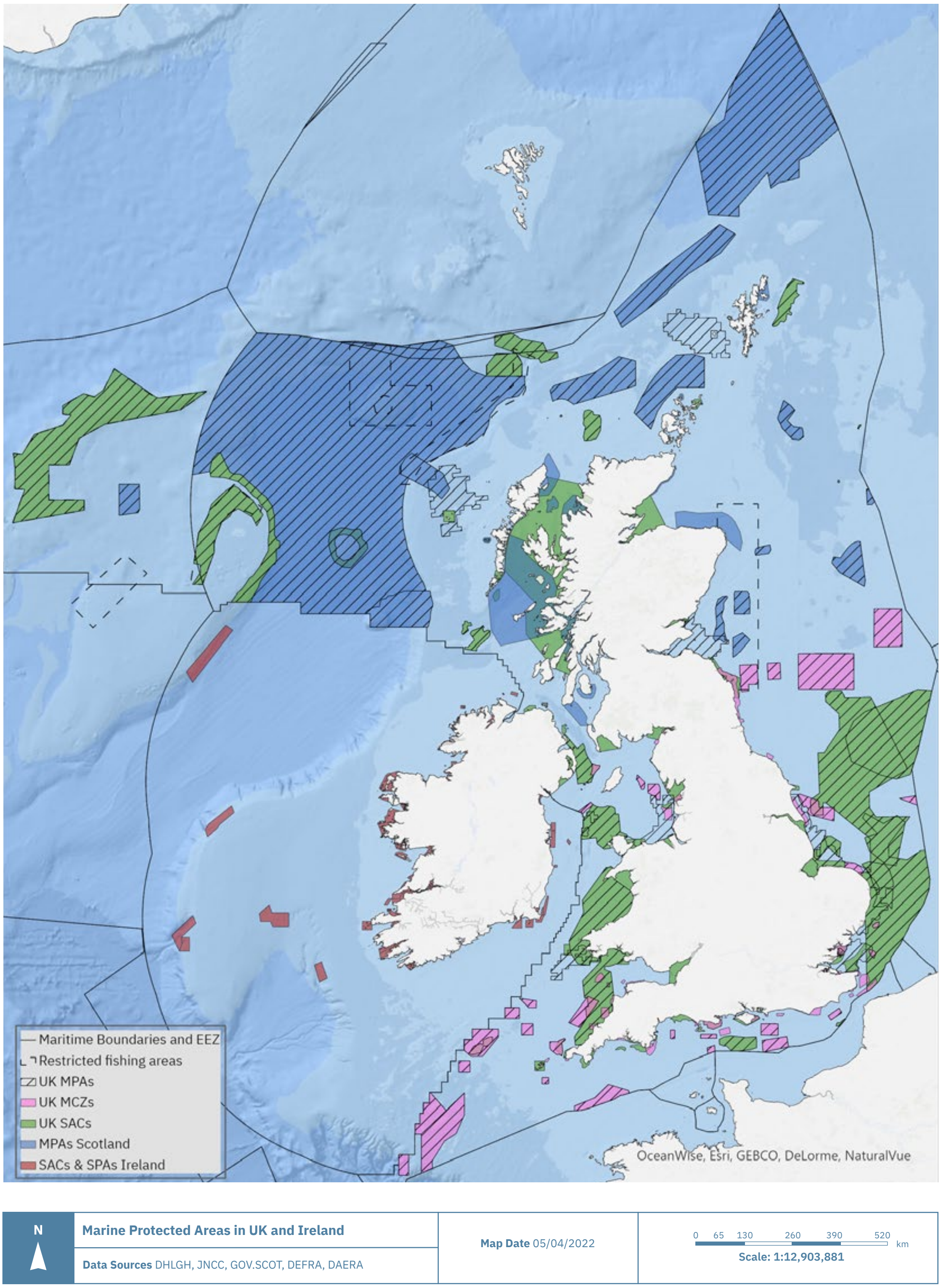
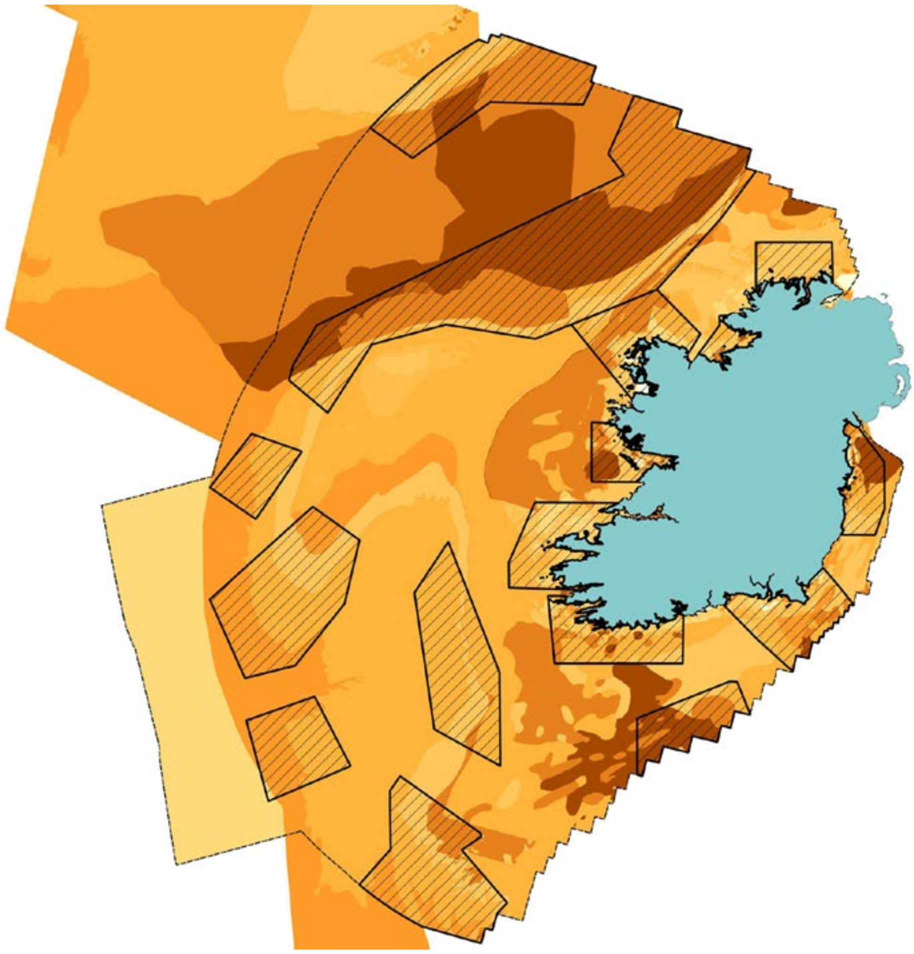


Figure 2.2.4.1
Chosen Areas of Interest shown in relation to carbon sequestration potential of seabed sediments. Darker areas show high carbon sequestration potential of the seabed. Carbon sequestration spatial data was taken from Parker et. al (2016) and downloaded via Ireland's Marine Atlas. Carbon sequestration potential was mapped by Parker et. al (2016) using known locations of seabed substrate, where circalittoral mud was considered to store more carbon and coarse sediment and sand likely to store less carbon.



classifications used here. Socio-economic factors were also not considered in this report. Furthermore, the list of species of conservation importance may be expanded on as more data becomes available.

Taking account of carbon storage in marine ecosystems during the MPA network design stage will be crucial. Research on 'blue carbon' storage in Irish seabed sediments is already underway, which would allow future analyses to incorporate blue carbon into MPA network design.

For the moment, precise data on carbon stored in Irish continental shelf sediments is not available. Nevertheless, modelling studies have shown which areas have higher carbon sequestration potential (see figure 2.2.4.1)(Parker et al., 2016). While blue carbon was not considered fully in the analysis of this report, the chosen Areas of Interest cover 32.3% of deep circalittoral mud, which has a high carbon sequestration potential. Deep muddy sediments are currently not listed under the Annexes of the Habitats Directive, which means several seabed sediment types cannot be protected under current legislation.

Ecological coherence is very difficult to assess and was therefore not considered in the present study, nevertheless some of the OSPAR principles outlined below are likely to have been achieved by our chosen network. According to OSPAR, an 'ecologically coherent network' of MPAs (OSPAR, 2007):

(i) interacts and supports the wider environment;

(ii) maintains the processes, functions, and structures of the intended protected features across their natural range;

(iii) functions synergistically as a whole, such that the individual protected sites benefit from each other to achieve the two objectives above; and

(iv) (additionally) may be designed to be resilient to changing conditions.

The MPA Advisory Group Report (2020) has several great recommendations on MPA network design which should be considered in future analyses. The present report should therefore be seen as the first stage towards highlighting important areas for MPA designation, not the end product.

2.2.5 Guidance on interpreting the Areas of Interest
Each Area of Interest is described in detail in the following sections. The site descriptions are best appreciated in conjunction with the species occurrence, density and richness maps shown in Annexes B to F of this report.

"The present report should therefore be seen as the first stage towards highlighting important areas for MPA designation, not the end product."

Cliffs of Moher,
Co. Clare

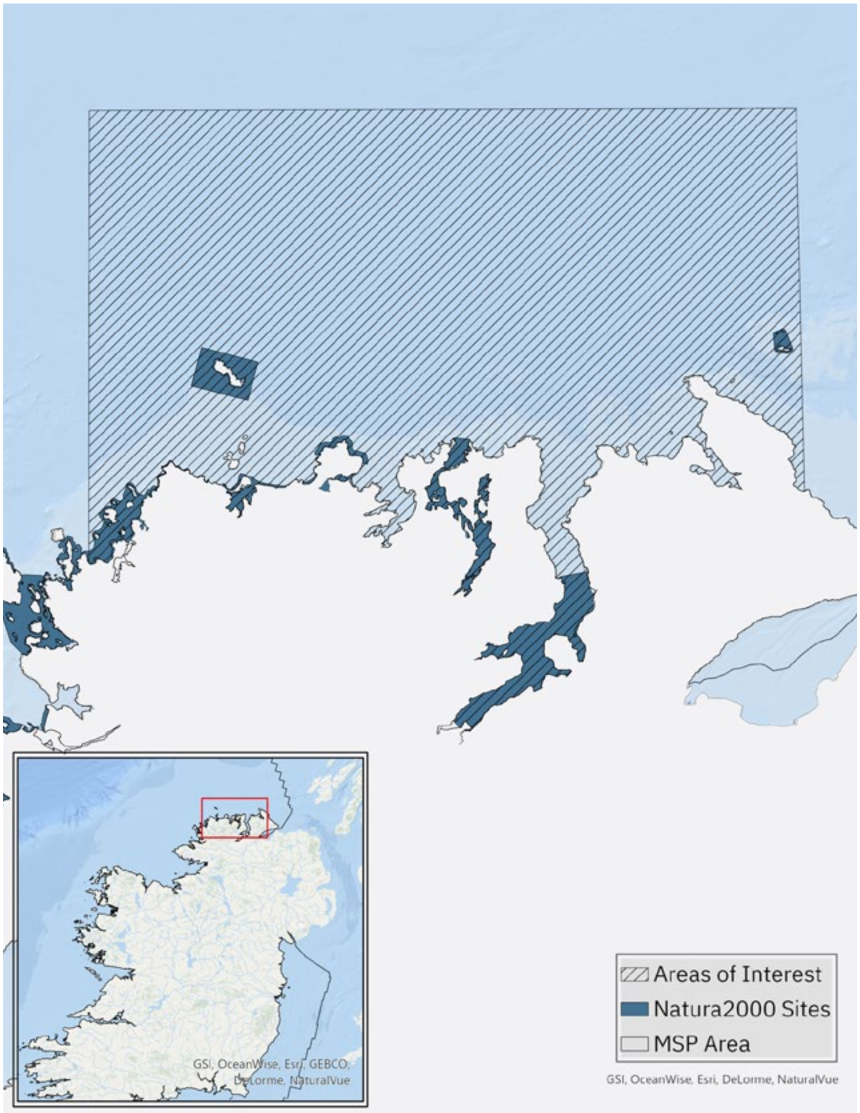
AREA OF INTEREST

North Coast 2.3

Qualifying Interests

- **Seabed features of conservation importance** *Modiolus modiolus*, maerl, *zostera*
- **Cetaceans** Bottlenose dolphin, harbour porpoise
- **Elasmobranchs** Basking Shark, tope shark, thornback skate, flapper skate
- **Commercially Exploited Species** Herring, whiting
- **Birds: Breeding** Arctic tern, sandwich tern, kittiwake, cormorant, shag, Manx shearwater, fulmar, puffin, guillemot, razorbill, black guillemot, gannet, black-headed gull, herring gull, lesser black-backed gull, great black-backed gull, common gull, Leach's storm-petrel, European storm-petrel, great skua
- **Birds: Frequent non-breeding** Sooty shearwater, Arctic skua
- **Birds: Infrequent non-breeding** Pomarine skua

Spatial Extent
3,744km² **0.77%**
of Maritime Area



N	North Coast / **Data Sources** Fair Seas, NPWS	**Map Date** 08/04/2022 Projected Coordinate Systems: ETRS 1989 LAEA	3744km² 0.77%	0 5 10 20 km Scale: 1:512,000

Figure 2.3.1
North Coast Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.3.1: Main broad-scale seabed habitat types covered within North Coast AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep circalittoral coarse sediment	43%
Circalittoral coarse sediment	33%
Deep circalittoral sand	3%
Circalittoral rock and other hard substrata	2%
Other	4%
Unclassified	15%

Boyeeghter Strand,
Co. Donegal

"Harbour porpoise and bottlenose dolphin are present year-round with high concentrations of both species at the mouth of Lough Swilly."

Primary Reasons for Site Importance

Harbour porpoise and bottlenose dolphin are present year-round with high concentrations of both species at the mouth of Lough Swilly. The area has very high densities of basking sharks especially around Malin Head. Lough Swilly is the site of several important seabird colonies, and the cliffs and islands within this site are vital in this region of Ireland.

Description of Features

Habitats
The dominant sediment type on the north coast of Donegal is coarse sediment with the exception of Lough Swilly, where fine sand dominates the seafloor. Several small SACs are already designated for reefs, large shallow inlets and bays, intertidal mudflats and sandflats, sea caves, estuaries and coastal lagoons in this area. This larger Area of Interest would create corridors between these SACs. Mulroy Bay, in particular, is a very important site for seabed habitats, with maerl, zostera and *Modiolus modiolus* all recorded here (see Annex B).

Seabirds
The coast of Donegal has a diverse and open geography suitable for a variety of breeding and non-breeding seabirds that frequent our shores annually. Long stretches of cliffs from Horn Head to Fanad Head are home to important colonies of three BoCCI red-listed species (kittiwake, razorbill and puffin) (Gilbert et al., 2021), and Lough Swilly provides sanctuary for breeding terns, black guillemots and black-headed gulls. Tory Island and Inishtrahull are rich in seabird diversity. Bloody Foreland has been identified as a major migration bottleneck, with cumulative abundance of >31,000 seabirds and 24 species recorded over a four-year period (Keogh et al, 2014). The waters in this area are also utilised by birds hailing from Scottish colonies.

Elasmobranchs
The area around Malin Head has been identified as a hotspot for basking sharks by the Irish Basking Shark Group.[10] Analysis of the IWDG database confirms high densities of basking sharks along the north coast, with 14% of total sightings recorded in this area – several records show between 60 and 75 individuals in a single sighting (see Annex F). The northeast corner of this Area of Interest has one of the highest average catches of tope shark per haul in groundfish survey catches from 2011-2020. The entire northwest coast is very important for thornback skate, with high densities occurring from the Mayo and Donegal coastlines out to the continental shelf edge. Within the Donegal Area of Interest, the mouth of Lough Swilly is most important for thornback skate, with an average of 26 individuals caught per groundfish survey haul (see Annex F). Clarke et al. (2016) identified Lough Swilly as a refuge for the critically endangered flapper skate.

Commercially exploited species
The largest herring spawning grounds of the country are located north of Donegal. Some of these grounds are located within this proposed MPA. Whiting spawning grounds also cover this entire AOI (see Annex E).

Cetaceans
High cetacean diversity was recorded, with seven cetacean species within the site between 2005 and 2021. Densities of bottlenose dolphin (*Tursiops truncatus*) varied throughout the site with higher densities (5.69/100km^2) and concentrations at the mouth of Lough Swilly and northeast of Innisfree Bay (9.9/100km^2) (see Annex C). Relatively high densities (2.69/100km^2) of harbour porpoise (*Phocoena phocoena*) compared to other selected sites, also exhibiting dense concentrations at the mouth of Lough Swilly. Presence of bottlenose dolphin and harbour porpoise were recorded year-round.

Killer whales (*Orcinus orca*) were observed on seven occasions throughout the site, most frequently at the mouth of Lough Swilly, while further offshore, closer to the shelf edge, groups of 75 individuals were recorded by the IWDG Sightings Scheme. Recent research on the North Atlantic killer whale population suggests foraging movements from the Norwegian Deeps to the northwest coast of Ireland around pelagic trawl fisheries targeting mackerel and horse mackerel (Pinfield et al., 2011), similar behaviour to that observed in north Scottish waters (Luque et al., 2006). Sightings of minke whales (*Balaenoptera acutorostrata*) occurred along the coast of North Donegal, with higher densities recorded off Bloody Foreland (1.4/100km^2).

Transient species within this site also include occasional sightings of humpback whales (*Megaptera novaeangliae*) (n=4), Risso's dolphins (*Grampus griseus*) (n=8) and common dolphins (*Delphinus delphis*) (n=20) (See Annex C for common dolphin distribution).

10 https://www.baskingshark.ie/downloads

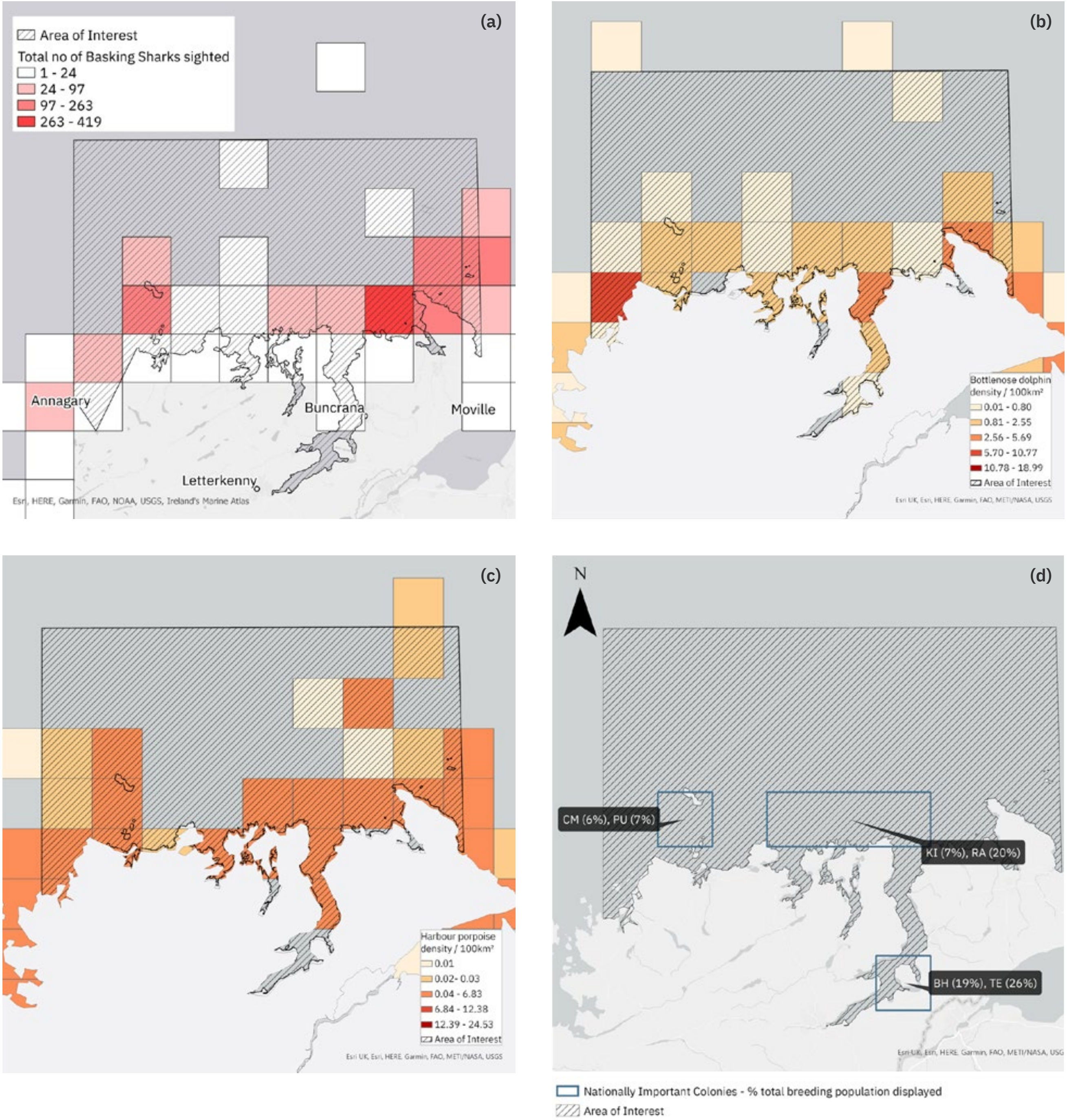


Figure 2.3.2
a) Basking shark counts; (b) Densities per 100km² of bottlenose dolphin (2005-2021); (c) Densities per 100km² of harbour porpoise (2005-2021); (d) Nationally important seabird colonies within the North Coast AOI with the proportion of the national total of breeding pairs (%) shown (BH – black-headed gull; CM – common gull; KI – kittiwake; PU – puffin; RA – razorbill; TE – sandwich tern)

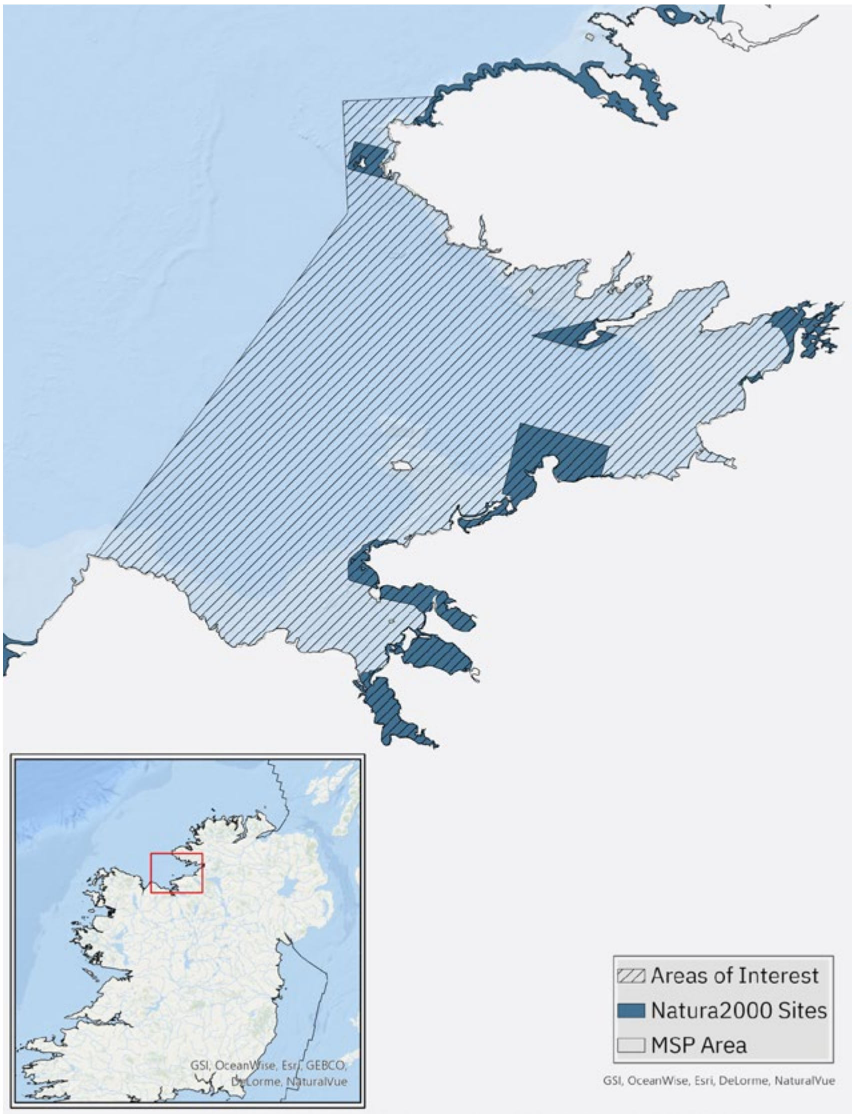
AREA OF INTEREST

Donegal to Sligo 2.4

Qualifying Interests

- **Seabed features of conservation importance** *Zostera*, maerl
- **Cetaceans** Bottlenose dolphin, harbour porpoise
- **Elasmobranchs** Spurdog, thornback skate
- **Commercially Exploited Species** Whiting, Herring
- **Birds: Breeding** Manx shearwater, fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, herring gull, lesser black-backed gull, great black-backed gull, common gull, European storm-petrel, great skua, common tern, gannet, cormorant, shag
- **Birds: Frequent non-breeding** Sooty shearwater, great shearwater, Arctic skua, pomarine skua

Spatial Extent
1,433km² **0.29%**
of Maritime Area



N	Donegal to Sligo	Map Date 08/04/2022	1433km² 0.29%	0 2 4 8 12 16 km
	Data Sources Fair Seas, NPWS	Projected Coordinate Systems: ETRS 1989 LAEA		Scale: 1:400,000

Figure 2.4.1: Donegal to Sligo Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.4.1 : Main broad-scale seabed habitat types covered within Donegal to Sligo AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Circalittoral fine sand or Circalittoral muddy sand	36%
Deep circalittoral sand	23%
Circalittoral rock and other hard substrata	20%
Infralittoral fine sand or Infralittoral muddy sand	6%
Circalittoral sandy mud	3%
Other	3%
Unclassified	9%

Slieve League,
Co. Donegal

"High densities of bottlenose dolphin occur in this area, which show a degree of site fidelity to Donegal Bay."

Primary Reasons for Site Importance

High densities of bottlenose dolphin occur in this area, which show a degree of site fidelity to Donegal Bay. Six percent of all bottlenose dolphin sightings from 2005 to the present date across the analysed data within Ireland's EEZ occur within this site, accounting for 11% of the overall total number of individuals (n=41,888). Harbour porpoise are present year-round within this AOI. Important seabird colonies found within this site are Inishmurray, especially for European shag and lesser black-backed gull, Aughris Head, Ardboline and Horse Island, and along the Slieve League Peninsula.

Description of Features

Seabirds
This area supports several important colony areas including Inishmurray (shag – 8% of Ireland's breeding population; lesser black-backed gull – 5%; greater black-backed gull –3.5%) and Ardboline and Horse Island (cormorant – 4%), with many other species occupying areas all along the sheltered coastline including kittiwake (~500 breeding pairs), razorbill (~90 pairs) and European storm-petrel (~280 pairs) (see Annex D).

Habitats
This AOI is home to the EUNIS seabed habitat types infralittoral and circalittoral 'rock and other hard substrata', especially around Inishmurray Island, with the areas surrounding these hard substrates being dominated by fine sand or muddy sand. One of the largest marine SACs in this area, 'Bunduff Lough and Machair/ Trawalua/Mullaghmore SAC' is designated for mudflats and sandflats not covered by seawater at low tide, large shallow inlets and bays and reefs. Other marine SACs of note are Ballysadare Bay, Sligo Bay and Donegal Bay. Seagrass and maerl communities are located within this Area of Interest (see Annex B).

Elasmobranchs
The bay shows high elasmobranch species richness, with eight species recorded in one area in the inner bay. Threatened species that occur within Donegal Bay include spurdog, thornback ray, tope and flapper skate. While this is not the most important area for spurdog in Ireland, there are on average 17 individuals caught per groundfish survey haul in one area of Donegal Bay. Similarly, on average four individuals of thornback skate are caught per survey haul in this area (see Annex F).

Commercially exploited species
Whiting spawn in this area from the northern coast of Mayo all the way to Donegal. A small herring spawning ground is located near Killybegs, and larger nursery grounds are located north of Sligo Bay and west of Donegal town (see Annex E). While there is currently no evidence of spawning site fidelity for sprat, high catches of juveniles are observed in groundfish surveys in this area (Marine Institute, 2021). A large proportion of sprat landings come from Donegal Bay (Marine Institute, 2021). The protection of sprat is important, as it is a primary food source for many seabirds and cetaceans.

Cetaceans
Eight different species of cetaceans were recorded within the site between 2005 and 2021; however not all species are regularly occurring. Concentrations of bottlenose dolphin were recorded along the coast within the site, with high densities (8.61/100km^2) recorded off St. Johns Point and Mullaghmore (6.57/100km^2), and lower densities (3.95/100km^2) in Sligo Bay. The highest counts were from June to August. Donegal Bay is well known for the presence of bottlenose dolphins. A number of studies have identified this area as having a high encounter rate with this species, and photo identification has shown the same individuals use this bay on a regular basis. Nykänen et al. (2015) estimated that in 2014 189 individuals (CV=0.11, 95% CI=162-23) used the waters between Connemara, Mullet Peninsula and Donegal Bay, with 23 individuals only seen in Donegal Bay. Nykänen et al. (2015) also stated that while calves were encountered on most occasions, six were observed in Donegal Bay – the highest number recorded throughout the study. Inter-annual re-sightings indicate that a degree of site fidelity occurs in the west/ northwest of Ireland.

Although lower densities of harbour porpoise were recorded across the site (0.04 to 0.93/100km^2), sightings occurred throughout the year. High densities (0.61/100km^2) and concentrations of minke whales were recorded off St. John's Point, compared to lower densities throughout the site (see Annex C).

Transient species include recent sightings of humpback whales (n=6), with three sightings outside the site boundary; and sporadic sightings of killer whales (n=5) from June to September and of Risso's dolphins (n=4) from May to September. Common dolphin sightings were abundant (n=38) throughout the site (see Annex C).

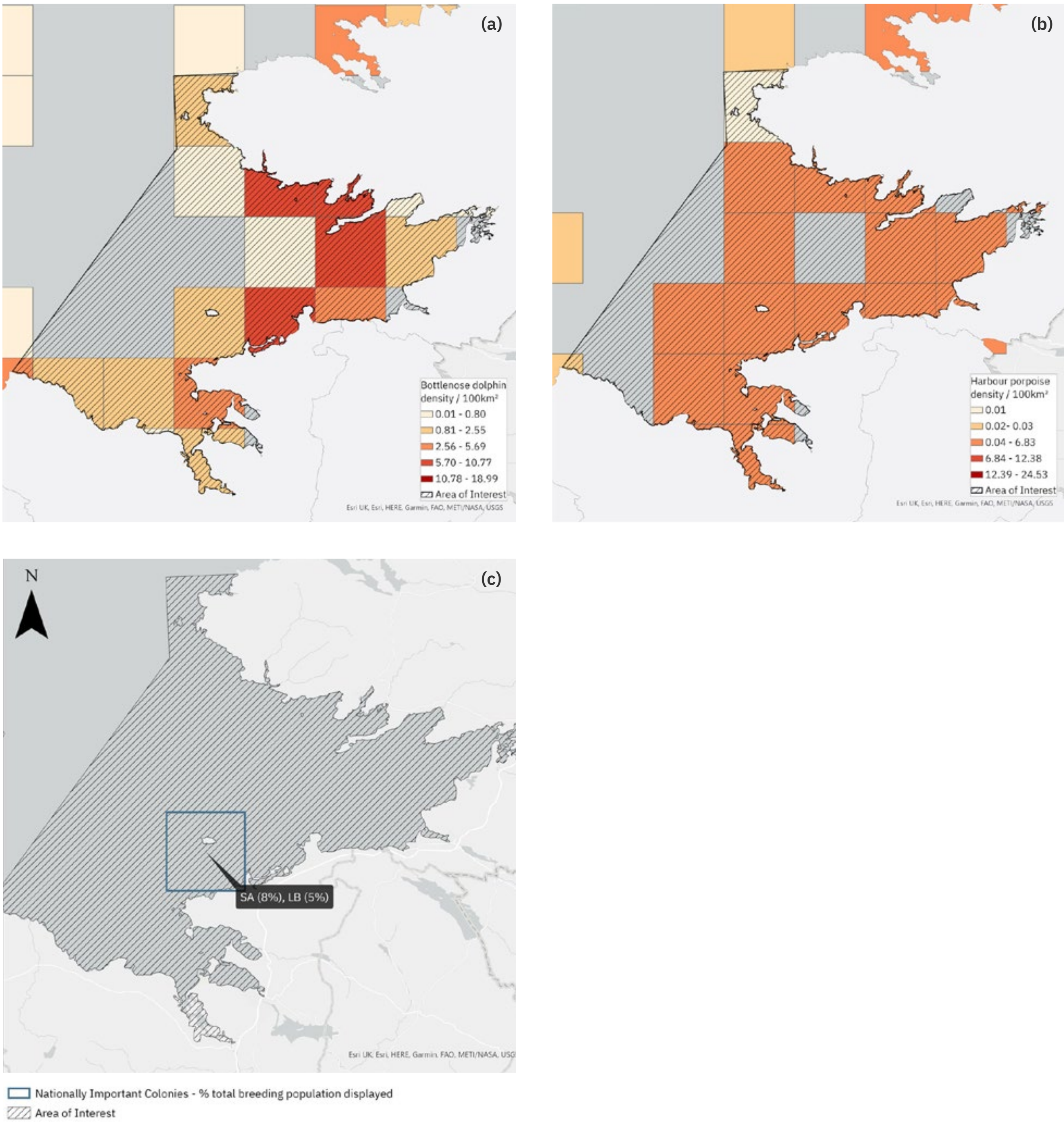


Figure 2.4.2
(a) Densities per 100km² of bottlenose dolphin (2005-2021); (b) Densities per 100km² of harbour porpoise (2005-2021); (c) Nationally important seabird colonies within the Donegal to Sligo AOI with the proportion of the national total of breeding pairs (%) shown (SA – shag; LB – lesser black-backed gull)

AREA OF INTEREST

Mayo to Shelf Edge 2.5

Qualifying Interests

- **Seabed features of conservation importance** *Ostrea edulis, Mytilus edulis, Serpula vermicularis*
- **Cetaceans** Bottlenose dolphin, harbour porpoise
- **Elasmobranchs** Flapper skate, angel shark
- **Commercially Exploited Species** Herring, whiting
- **Birds: Breeding** Manx shearwater, fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, black-headed gull, herring gull, lesser black-backed gull, great black-backed gull, common gull, European storm-petrel, great skua, Arctic tern, common tern, gannet, cormorant, shag
- **Birds: Frequent non-breeding** Great shearwater, sooty shearwater, Arctic skua
- **Birds: Infrequent non-breeding** Cory's shearwater, Sabine's gull, Wilson's storm-petrel, black tern, pomarine skua

Spatial Extent

7,210km² **1.48%** of Maritime Area

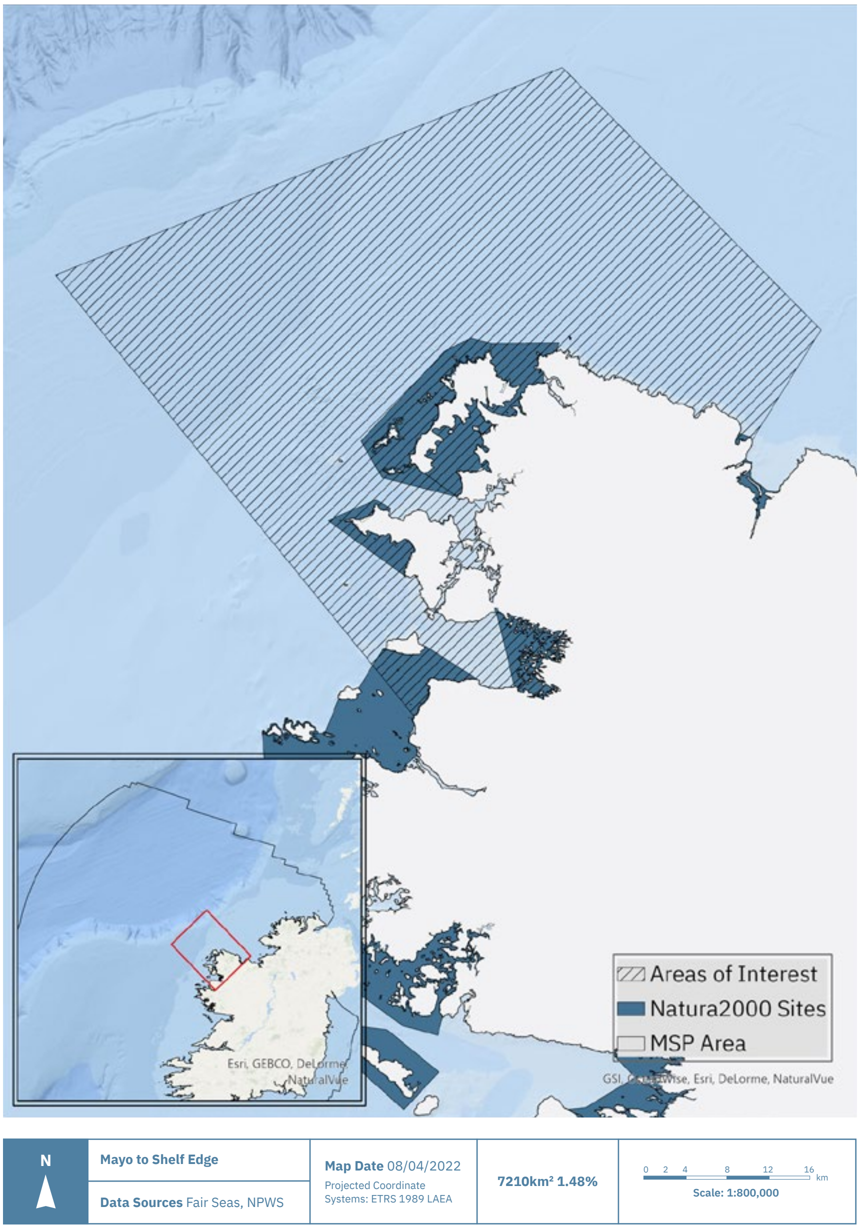


Figure 2.5.1: Mayo to Shelf Edge Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.5.1: Main broad-scale seabed habitat types covered within Mayo to Shelf Edge AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep circalittoral sand	17%
Deep-sea Mud	12%
Circalittoral rock and other hard substrata	11%
Deep circalittoral coarse sediment	7%
Circalittoral fine sand or Circalittoral muddy sand	2%
Other	2%
Unclassified	49%

Westport,
Co. Mayo

"The coastline of this area has a number of highly significant colonies. It is the only part of the country where Leach's storm-petrel breeds each year"

Primary Reasons for Site Importance

This area has high densities of bottlenose dolphins with presence year-round. Clew Bay is one of a few Irish bays in which Critically Endangered angel shark (*Squatina squatina*) and flapper skate are still found (Clarke et al., 2016). The rare-breeding BoCCI red-listed Leach's storm-petrel, *Hydrobates leucorhous*, only breeds within this site (Gilbert et al., 2021).

Description of Features

Cetaceans
Proximity close to the shelf edge results in high species diversity. Historically this was the site of Ireland's most recent whaling stations, which hunted fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), sei (*Balaenoptera borealis*) and sperm whales (*Physeter macrocephalus*) along the shelf edge. Compared with other sites, densities for bottlenose dolphins are relatively high (4.24/100km^2), distributed close to the coast and within the West Connacht Coast SAC (for which this species is the sole qualifying interest), and further south around Achill Island (3.87/100km^2). Presence occurs year-round with higher sightings recorded during the summer months. Lower densities of harbour porpoises exist within the site; however sightings were recorded year-round with higher recordings during the summer months.

Lower densities (0.01-0.09/100km^2) of minke whales are recorded inshore as well as out to the shelf edge (see Annex C). Small numbers of long-finned pilot whales (*Globicephala melas*) were recorded within the site, with higher densities (0.71/100km^2) observed closer to the shelf edge and further offshore. SCANS II surveys demonstrated that Atlantic-white sided dolphins (*Lagenorhynchus acutus*) also occur and use the AOI. Occasional sightings (n=17) of killer whales were recorded close to the coast with higher counts during the summer months. White-beaked dolphins (*Lagenorhynchus albirostris*) occurred on occasion within the site, with one encounter of 35 animals off Clare Island. There were a small number of sightings of Risso's dolphin (n=15), and small numbers of humpback whale sightings close to the coast (n=6). Common dolphins were distributed throughout the site and occurred year-round. Juveniles and calves accounted for 0.4% of 3,001 individuals recorded within this site between 2005 and 2021.

Seabirds
As the closest land point to the drop-off of the continental shelf, this area is a hive of seabird activity. Sightings of 27 species of seabirds are represented in this area, including 19 of the 24 species that breed in Ireland annually. The coastline of this area has a number of highly significant colonies. It is the only part of the country where Leach's storm-petrel breeds each year, one of Ireland's five BoCCI red-listed seabird species (Gilbert et al., 2021). Important sites are Stags of Broadhaven and Bills Rocks. Numerous other inhabited and uninhabited islands and islets are attractive breeding sites for terns, auks, and fulmar.

Elasmobranchs
Clew Bay has been identified as a hotspot for the Critically Endangered angel shark (*Squatina squatina*) and a refuge for the flapper skate *Dipturus intermedius* (Clarke et al., 2016).

Analysis of the IWDG database and ObSERVE survey data indicate high basking shark (*Cetorhinus maximus*) densities around Achill Island (see Annex F). While the area is not the highest in terms of sightings (6% of total basking shark sightings reported from this Area of Interest), there are three sightings of between 10 and 20 individuals from the south coast of Achill Island and one sighting of 30 individuals in Broadhaven Bay.

Habitats
Reefs of the native oyster *Ostrea edulis* occur in Clew Bay. These have become extremely rare in Irish waters and only occur in a few bays on the west coast.

Blacksod Bay, which is already an SAC, once had a large (855 ha) *Serpula vermicularis* reef, which has been completely destroyed by benthic dredging (Scally et al., 2020; NPWS, 2014b). Many species lived within this reef, either between or on the reef structures (NPWS, 2014b). The tube-forming worm reef was described as being encrusted with coralline algae and sponges, with red algae and anemones also growing on the reef (NPWS, 2014b). The *S. vermicularis* reef was considered to be a keystone community that was of considerable importance to the overall ecology and biodiversity of the habitat by virtue of its physical complexity (NPWS, 2014b). Stricter protection of the area may allow this reef to recover.

Large seagrass and maerl beds also occur in Blacksod Bay, as well as the horse mussel *Modiolus modiolus*. The area has a high variation in seabed substrate, from fine sand to rock, however large parts of seabed substrate have not yet been classified.

Commercially exploited species
The area features herring spawning and nursery grounds and part of a whiting spawning ground on the north Mayo coastline.

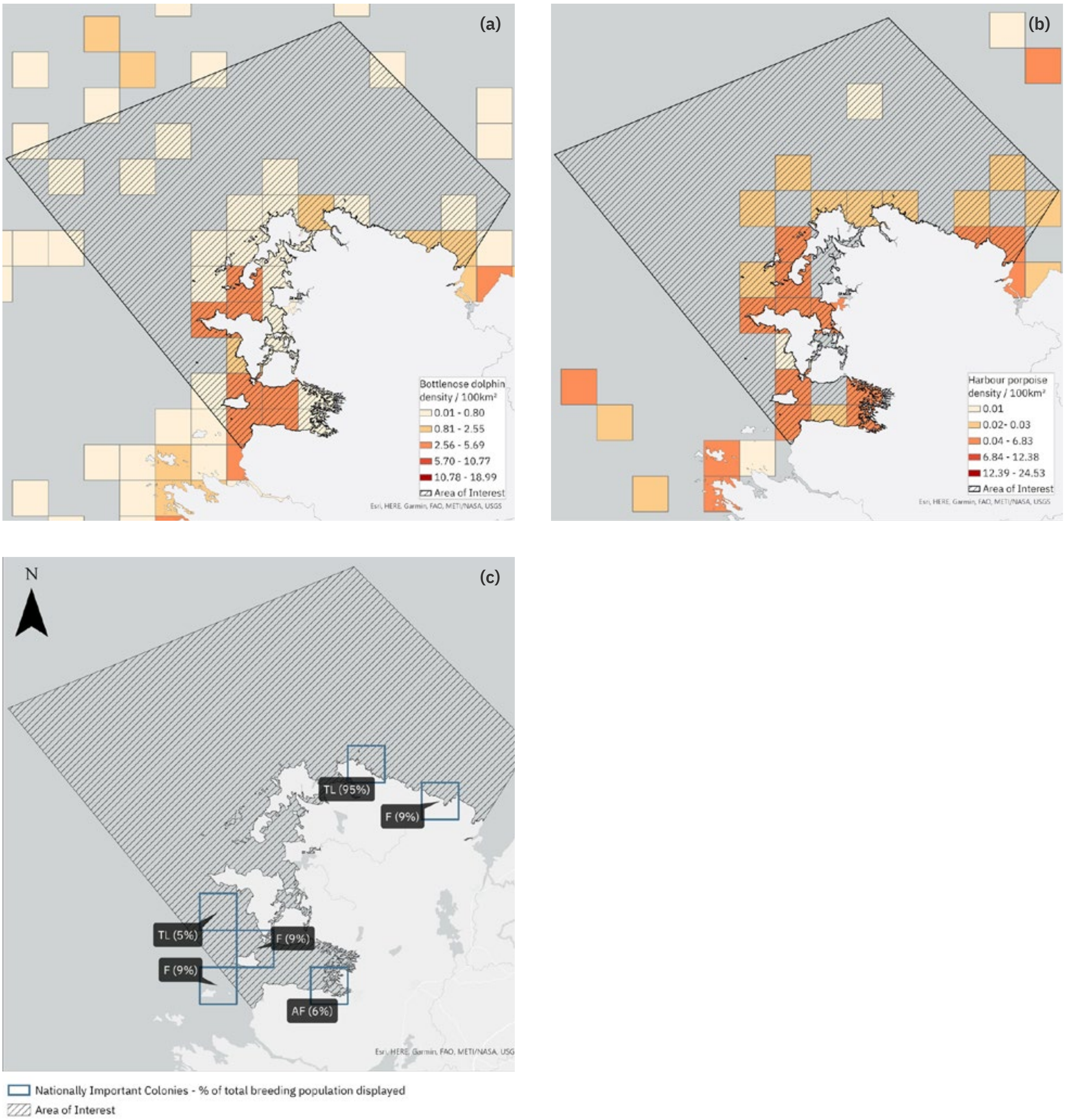


Figure 2.5.2
(a) Densities per 100km² of bottlenose dolphin (2005-2021); (b) Densities per 100km² of harbour porpoise (2005-2021) within the Mayo to Shelf Edge AOI c) Nationally important seabird colonies with the proportion of the national total of breeding pairs (%) shown (AF – little tern; F – fulmar; TL – Leach's storm-petrel)

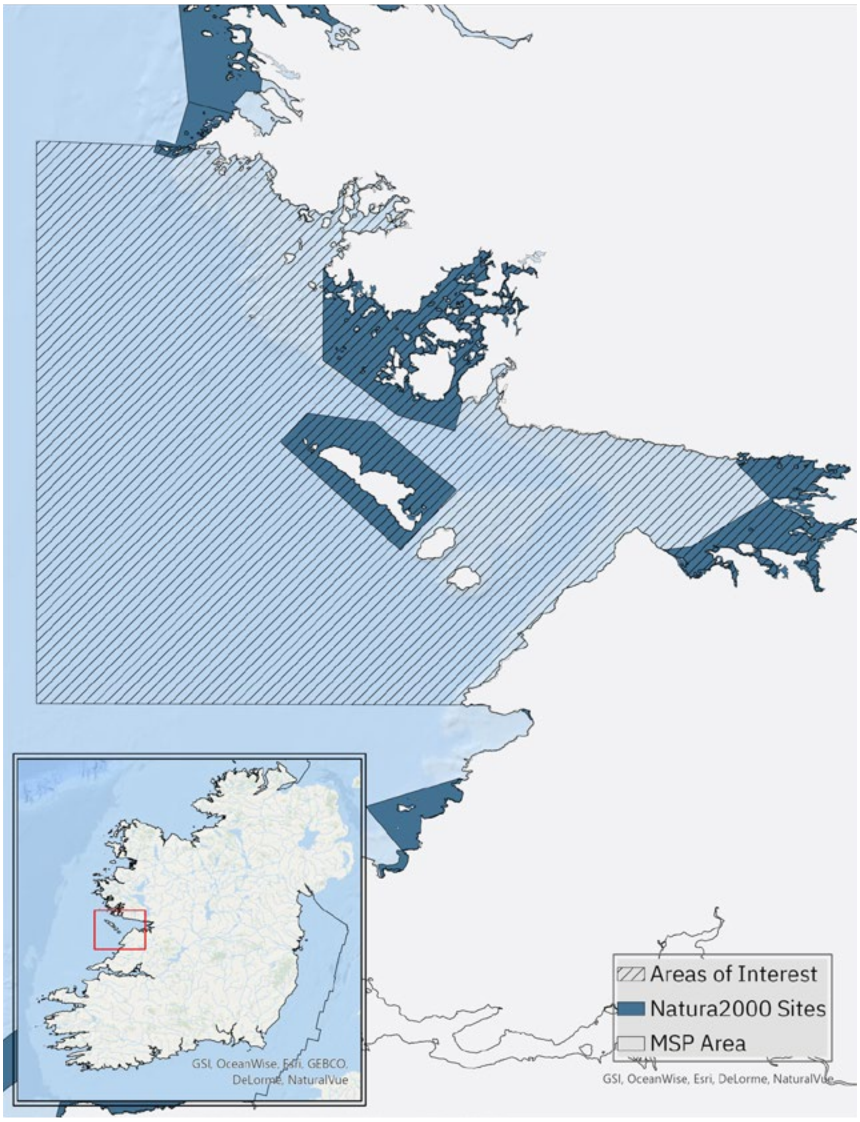
AREA OF INTEREST

Galway Bay and Islands 2.6

Qualifying Interests

- **Seabed features of conservation importance** *Modiolus modiolus,* maerl*, Laminaria spp.., Zostera*
- **Cetaceans** Bottlenose dolphin, harbour porpoise
- **Elasmobranchs** Spurdog (*Squalus acanthias*), flapper skate (*Dipturus intermedius*), angel shark (*Squatina squatina*)
- **Commercial Fish** Haddock, herring, whiting, Nephrops
- **Birds: Breeding** Manx shearwater, fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, black-headed gull, herring gull, lesser black-backed gull, great black-backed gull, common gull, little gull, European storm-petrel, great skua, Arctic tern, common tern, Sandwich tern, gannet, cormorant, shag
- **Birds: Frequent non-breeding** Great shearwater, sooty shearwater, Arctic skua
- **Birds: Infrequent non-breeding** Sabine's gull, Wilson's storm-petrel, pomarine skua

Spatial Extent
3,470km² **0.71%**
of Maritime Area



N	Galway Bay and Islands / **Data Sources** Fair Seas, NPWS	**Map Date** 08/04/2022 Projected Coordinate Systems: ETRS 1989 LAEA	3470km² 0.71%	0 3.5 7 14 21 km Scale: 1:500,000

Figure 2.6.1: Galway Bay and Islands Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.6.1: Main broad-scale seabed habitat types covered within Galway Bay and Islands AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep circalittoral mud	33%
Circalittoral sandy mud	13%
Deep circalittoral sand	7%
Circalittoral rock and other hard substrata	6%
Circalittoral coarse sediment	3%
Infraalittoral rock and other hard substrata	3%
Other	7%
Unclassified	27%

Inishmore,
Co. Galway

> "The area between the Aran Islands and Galway is a herring nursery ground and there are several small herring spawning grounds in this area."

Primary Reasons for Site Importance

The Area of Interest encompasses several highly important habitat types, including seagrass and maerl beds. The area is very important for several elasmobranch species. It has high densities of bottlenose dolphins and harbour porpoises with presence year-round. This is one of the most important coastal AOIs for seabirds in terms of diversity and volume, with roughly 65,000 birds breeding here (estimate based on the sum of the most recent counts for each seabird species present).

Description of Features

Habitats
The proposed MPA covers several important inshore bays and estuaries, including ones that are already designated SACs or SPAs, e.g. Galway Bay, Aran Islands and Kilkieran Bay and Islands. Proper management of these sites would already contribute substantially to the protection of habitats within them, however SACs and SPAs only afford protection to a small subset of listed habitats and species. An extension of these sites into one larger MPA would allow movement between core areas of species and their habitats and – crucially –protect some species that might not currently be afforded protection within existing SACs.

The main species of interest outside of the current SAC network is maerl in outer Galway Bay, *Laminaria spp.* along the coastline and the *Zostera spp* in Galway Bay. The seabed habitat types around the Aran Islands are highly varied, from shallow rock to gravel, fine sand and sandy mud to deep mud. According to GIS data from GBIF and OSPAR, the horse mussel *Modiolus modiolus* occurs in Galway Bay (see Annex B).

Seabirds
This area incorporates the Cliffs of Moher, which annually hosts some of the largest aggregations of kittiwake, guillemot (breeding population of international importance), razorbill, puffin and fulmar in the country. It is the most visited natural tourism attraction in the country, with more than one million visitors annually, coming to experience the cliffs' impressive height and trying to get a glimpse of the iconic puffins. Not far from shore are the Aran Islands, with important colonies for kittiwake, species of auk (guillemot, black guillemot and razorbill), as well as great black-backed gull and fulmar. Starting in Galway Bay and running along the Connemara coastline, several tern colonies are present along the way.

Elasmobranchs
The area shows high elasmobranch species richness with 5-8 species recorded throughout the site. Analysis of elasmobranchs caught in groundfish surveys shows high densities of spurdog south and southwest of Inishmore, with more than 400 individuals caught in one survey haul in 2016. Clarke et al. (2016) state that there have also been recent reports of angel sharks in inner Galway Bay, and that the area is a refuge for flapper skate.

Commercially exploited species
A large haddock spawning and nursery ground is located offshore from the Aran Islands on a large patch of deep circalittoral mud. This area also overlaps with *Nephrops norvegicus* grounds (see Annex E). The area between the Aran Islands and Galway is a herring nursery ground and there are several small herring spawning grounds in this area. Furthermore, Galway Bay is a whiting spawning and nursery ground. While there is currently no evidence of spawning site fidelity for sprat, high catches of juveniles are observed in groundfish surveys in this area (Marine Institute, 2021). Protection of sprat is important, as it is a primary food source for many seabirds and cetaceans.

Cetaceans
Bottlenose dolphin concentrations occurred close to the coast and in between islands, with the highest densities (4.45/100km^2) recorded off Black Head. This species was recorded year-round with higher sightings recorded in June. Lower densities (0.01-0.26/100km^2) of minke whales exist within the site compared to other sites. The highest densities (3.01/100km^2) of harbour porpoise were recorded off Black Head, present throughout the year with higher sightings recorded during the summer. Berrow et al. (2014) recorded an overall density estimate of 1.65km^2 which gave an abundance of 372 ± 105 of harbour porpoise in Galway Bay. Other species recorded during 2005-2021 included occasional sightings of humpback (n=27) and killer whales (n=9). Common dolphins were abundant throughout the site.

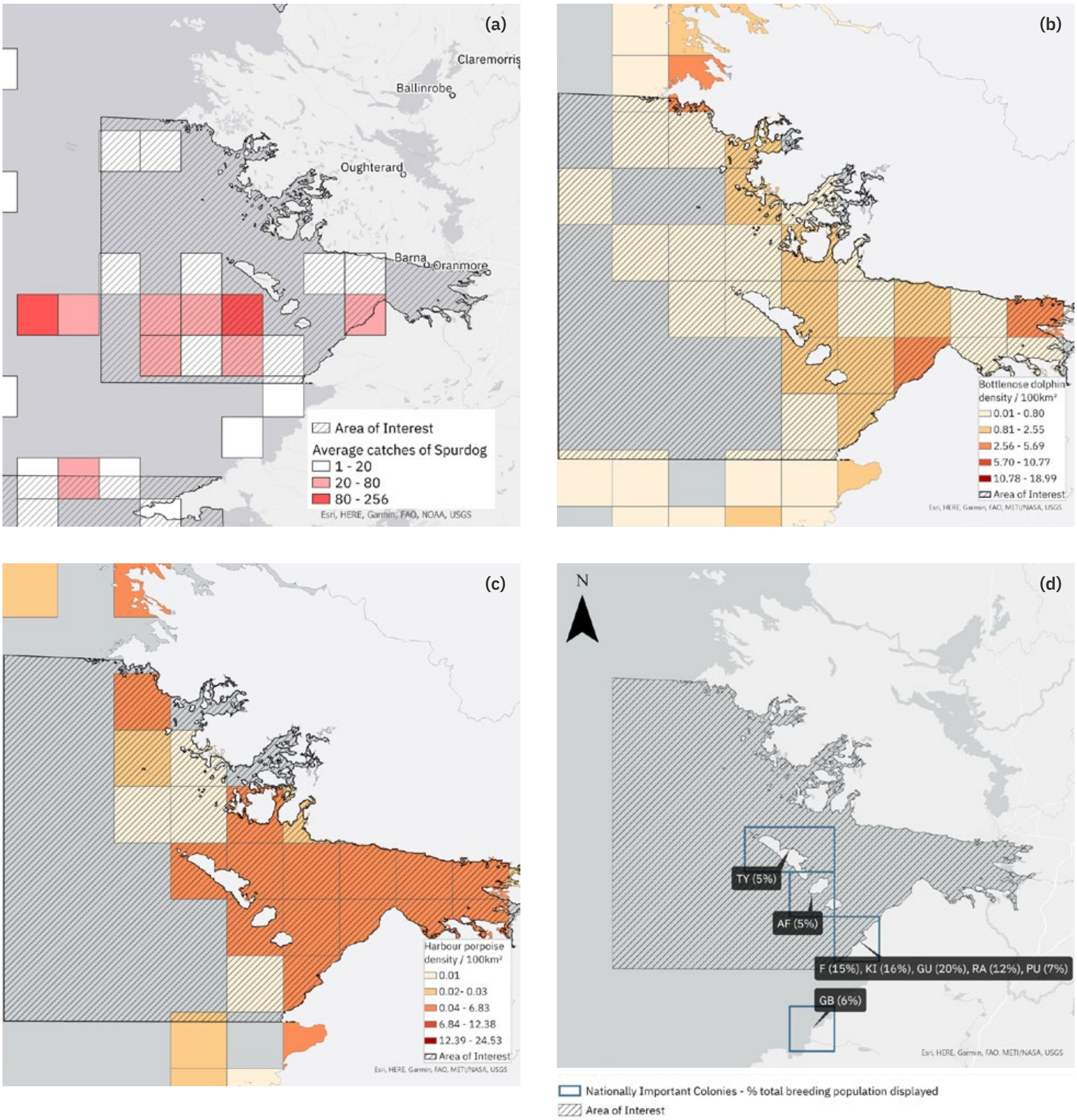


Figure 2.6.2
(a) Average catches of spurdog in the Galway area; (b) Densities per 100km² of bottlenose dolphin (2005-2021); (c) Densities per 100km² of harbour porpoise (2005-2021); (d) Nationally important seabird colonies within the Galway Bay and Islands AOI, with the proportion of the national total of breeding pairs (%) shown (AF – little tern; F – fulmar; GB – great black-backed gull; GU – guillemot; KI – kittiwake; PU – puffin; RA – razorbill; TY – black guillemot)

AREA OF INTEREST

Loop Head to Kenmare

2.7

Qualifying Interests

- **Seabed features of conservation importance** *Zostera*, maerl, native oyster (*Ostrea edulis*), mussel, *Laminaria spp.*.
- **Cetaceans** Bottlenose dolphin, harbour porpoise, humpback whale, minke whale, Risso's dolphin, common dolphin
- **Elasmobranchs** Thornback ray (*Raja clavata*), stingray (*Dasyatis pastinaca*), undulate ray (*Raja undulata*), blue skate (*Dipturus batis*), angel shark (*Squatina squatina*), spurdog (*Squalus acanthias*), Tope (*Gelaorhinus galeus*), white skate (*Rostroraja alba*), basking shark (*Cetorhinus maximus*)
- **Commercially Exploited Species** Whiting, herring, haddock, cod, crayfish
- **Birds: Breeding** fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, black-headed gull, herring gull, lesser black-backed gull, common gull, great black-backed gull, European storm-petrel, Manx shearwater, great skua, Arctic tern, common tern, sandwich tern, gannet, cormorant, shag
- **Birds: Frequent non-breeding** Sooty shearwater
- **Birds: Infrequent non-breeding** Balearic shearwater, Cory's shearwater, Great shearwater, Sabine's gull, Wilson's storm-petrel, pomarine skua, Arctic skua

Spatial Extent
6,705km² **1.37%** of Maritime Area

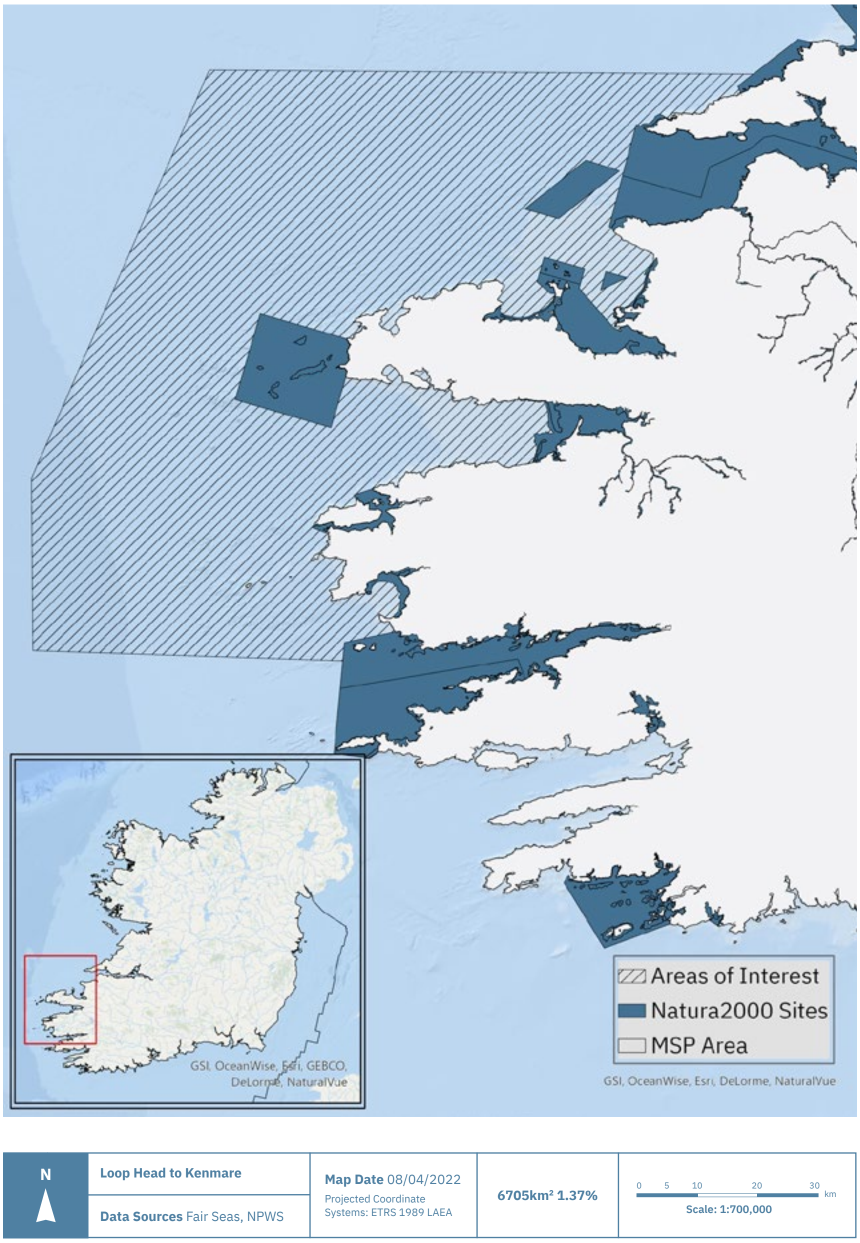


Figure 2.7.1: Loop Head to Kenmare Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.7.1: Main broad-scale seabed habitat types covered within Loop Head to Kenmare AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Circalittoral rock and other hard substrata	29%
Deep circalittoral sand	27%
Deep circalittoral coarse sediment	22%
Circalittoral fine sand or Circalittoral muddy sand	5%
Deep circalittoral mud	4%
Circalittoral coarse sediment	2%
Other	5%
Unclassified	6%

St Finans Bay,
Co. Kerry

Primary Reasons for Site Importance

Tralee and Dingle Bays are breeding areas for several threatened species of shark, ray and skate (Clarke et al., 2016). This is an important Area of Interest for cetaceans, exhibiting high densities of bottlenose dolphins in Brandon Bay and to a lesser extent Tralee Bay. It is used regularly by individual bottlenose dolphins from the adjacent Shannon Estuary SAC, and has high densities of harbour porpoise with presence year-round. Five percent of all harbour porpoise sightings within Ireland's EEZ occurred within this site, accounting for 20% of the overall total number of individuals (n=20,263) recorded between 2005-2021.

This site hosts the highest densities of minke whale recorded within the EEZ, accounting for 30% of all sightings made of this species, 25% of the overall total number of individuals (n=14,238). This site also hosts the highest densities of humpback whales recorded within Ireland's EEZ, accounting for 45% of all sightings of this species, 51% of the overall total number of individuals (n=2,747). High densities of Risso's dolphin also occurred, with 24% of all sightings for this species, accounting for 26% of the overall total number of individuals (n=3,904). Nineteen percent of common dolphin sightings within Ireland's EEZ occurred within this site, accounting for 22% of the overall total number of individuals (n=296,489) recorded between 2005-2021.

The islands and archipelagos that skirt the peninsulas of Kerry are some of Ireland's most prominent seabird breeding sites. At the most westerly point of Europe, these striking nearshore islands annually accommodate aggregations of seabirds on an internationally significant scale, particularly for burrow-nesting seabird species such as Manx shearwater, puffin, and storm-petrel. By far the largest of Ireland's six gannetries is located within this site (Little Skellig).

Description of Features

Seabirds
Within this AOI lies the Bridges of Ross, not far from Loop Head in Clare, which is an important migration bottleneck, with almost 60,000 birds recorded during a three-year survey period (Keogh et al., 2014). Heading south towards Tralee Bay are the Magharee Islands, a network of small rocky outcrops popular with breeding terns (Arctic tern and Sandwich tern). At the most westerly point of Europe can be found the Blasket Islands, with several colonies of international importance for Manx shearwater and European storm-petrel, and several other noteworthy colonies of lesser black-backed gull, puffin, razorbill and fulmar. Off the next peninsula to the south are the Skellig Islands, which are of equal significance, providing ideal nesting habitat for internationally important colonies of northern gannet, European storm-petrel and puffin. With the last census estimating in excess of 35,000 breeding pairs of gannets (Newton et al., 2015a), this colony represents 74% of the national breeding population, equating to 5% of the European biogeographic population. The thousands of puffins on Skellig Michael (Great Skellig) and Puffin Island are an iconic sight for both domestic and international tourism.
The largest puffin colony was previously the aptly named Puffin Island, with the Seabird 2000 census showing the island to be inhabited by over a quarter (26%) of Ireland's estimated breeding population (Mitchell et al., 2004). It is also an internationally important colony for European storm-petrel. However, new data yet to be published suggests that recent estimates on Great Skellig may surpass the colony size of Puffin Island. The Critically Endangered Balearic shearwater, although scarce, has been observed around the Blasket and Skellig Islands in the past.

> "In the southwest of Ireland, crayfish populations have declined since the traditional pots were replaced by tangle nets in the 1970s."

Habitats
The proposed MPA covers several important inshore bays and estuaries, including ones that are already designated SACs or SPAs, e.g. the Shannon Estuary, Tralee and Brandon Bays, Dingle Bay, the Blaskets, Valentia Island and Kenmare Bay. Proper management of these sites would already contribute substantially to the protection of habitats within them, however SACs and SPAs only afford protection to a small subset of listed habitats and species. An extension of these sites into one larger MPA would allow movement between core areas of species and their habitats and – crucially – protect some species that might not currently be afforded protection within existing SACs.

Particular species of interest outside the current SAC network is *Zostera* in Dingle Bay, *Laminaria spp.* all along the coastline, and the high variation in seabed habitat types, e.g. circalittoral rock between Loop Head and the Blaskets and circalittoral fine sand in the Shannon Estuary and Dingle Bay.

Elasmobranchs
Sharks, skates and rays are not protected inside the current network of SACs. Angling records and egg case surveys have highlighted the area (Tralee Bay in particular) as one of the last remaining hotspots and breeding areas for several threatened elasmobranchs (Varian et al., 2020; Marine Institute, 2019). A survey of sharks, skates and rays in north Kerry (Tralee, Brandon and Dingle Bays) was conducted by the Marine Institute in 2017-2019. A total of 12 species were captured during the survey, of which three are listed as Critically Endangered (angel shark, blue skate and flapper skate), two are listed as Endangered (stingray, undulate ray) and a further three are Vulnerable (tope, cuckoo ray, spurdog) (see Annex F). The survey report notes that the waters off north Kerry are internationally important as they hold some of the last remaining refuges for angel shark and white skate (Tully et al., 2021). While no adult white skates were found during the Marine Institute survey, the report states that Varian et al. (2020) recorded live egg cases of white skate in Tralee Bay.

Analysis of the IWDG database and the ObSERVE survey data indicate high densities of basking sharks around the Blasket Islands (see Annex F). The Area of Interest has one of the highest levels of basking shark sightings in Ireland (21% of total sightings), with individual sightings reporting as many as 60 individuals present at one point.

Commercially exploited species
Whiting spawning grounds extend all along the south coast and up into Kenmare Bay. Whiting nursery habitat extends all along the southwest peninsulas and into Dingle Bay. Herring spawning grounds are more patchy, with grounds all around the Dingle Peninsula and a large spawning ground in the mouth of the River Shannon. Herring nursery grounds extend from Dingle Bay southwards to Bantry Bay. A haddock nursery ground is located west of the Dingle Peninsula. Cod nursery grounds are located all around the Irish coast (see Annex E).

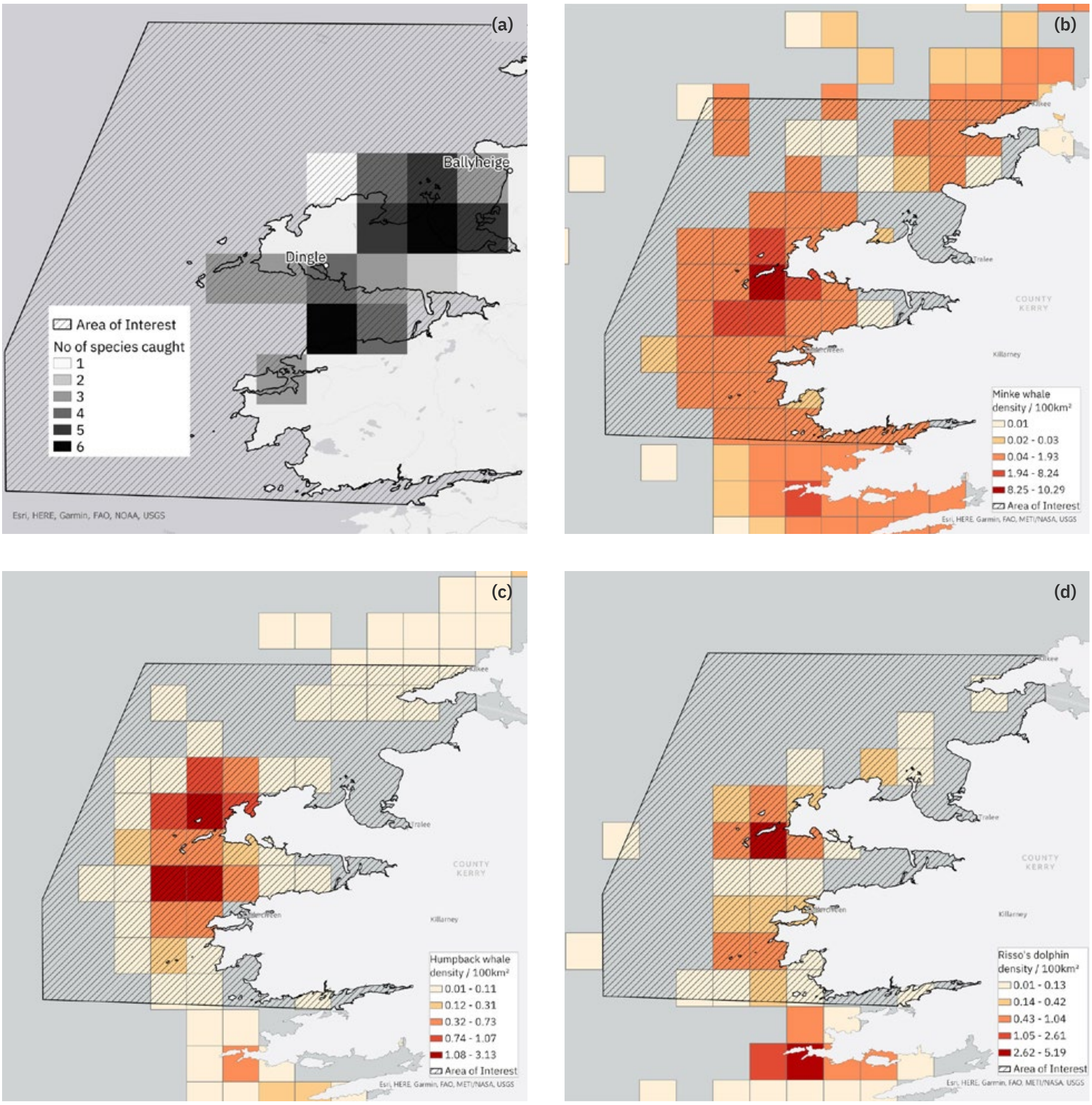
Crayfish, *Palinurus elephas*, are globally classed as Vulnerable and declining. In the southwest of Ireland, crayfish populations have declined since the traditional pots were replaced by tangle nets in the 1970s. This type of fishing gear has a high bycatch rate of threatened sharks, skates and rays as well as seals, and is one of the main threats to the endangered elasmobranchs in this area. An ongoing project by the Marine Institute aims to improve the status of elasmobranchs and crayfish stocks by trialling the use of traps and creating a crayfish management plan with bycatch mitigation measures. The poor status of crayfish means it will greatly benefit from improved management of the area, which MPA designation could aid in.

Cetaceans
High species richness was recorded between 2005-2021 in this site. Moderately high densities of bottlenose dolphin recorded within Tralee Bay (2.11/100km²) and higher densities in Brandon Bay (4.27/100km²). Levesque et al. (2016) showed that Brandon Bay, and to a lesser extent Tralee Bay, are used regularly by individual bottlenose dolphins from the adjacent Shannon Estuary SAC, which is designated because of the species. Of the 70 dolphins recognised individually between 2008 and 2016 in the area, 95% had been recorded as part of the Shannon dolphin population. High densities were also recorded off Ventry Harbour (16.09/100km²), with the highest recorded at Loop Head (18.99/100km²) (see Annex C).

High densities (24.53/100km²) of harbour porpoise were recorded within the established Blasket Islands SAC, with lower densities throughout the rest of the site, distribution more south of Dunmore Head. Presence year-round, with greater sighting records during the summer months. The presence of calves was recorded in July.

High densities of humpback whales within the site, with dense concentrations north (3.13/100km²) and south (1.7/100km²) of the Blasket Islands. Sightings occurred from April to November, with peak sightings in August. High densities (10.29/100km²) of minke whale were recorded within the site south of the Blasket Islands, presence year-round with the exception of January. High densities of Risso's dolphin (4.79/100km²) have been recorded south of the Blasket Islands and between Puffin Island and the Skellig Islands (see Annex C). Sightings occurred from March to November, with peak sightings in June. There were lower densities (0.01 – 0.28/100km²) of fin whales across the site with small clusters around the Blasket Islands. Sightings occurred from April to November, with peak sightings in August.

Small numbers (n=16) of killer whales were observed within the site with concentrations north and south of the Blasket Islands. Seasonal variable abundances of common dolphins can be seen within this area and further south, but occurrence is recorded annually.



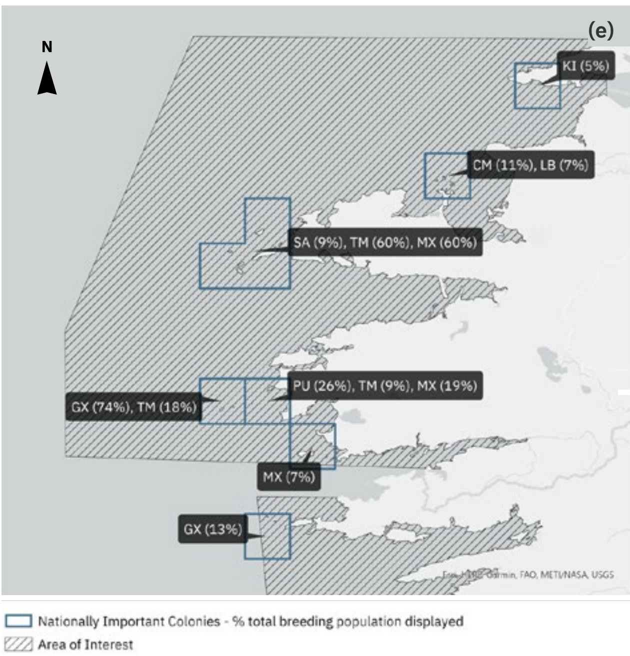


Figure 2.7.2
(a) Elasmobranch species richness observed during north Kerry survey. Several of these sharks, skate and ray species are threatened with extinction; (b) Densities per 100km² of minke whale (2005-2021); (c) Densities per 100km² of humpback whale (2005-2021) d) Densities per 100km² of Risso's dolphin (2005-2021) (e) Nationally important seabird colonies within Loop Head to Kenmare AOI with the proportion of the national total of breeding pairs (%) shown (CM – common gull; GX – gannet; LB – lesser black-backed gull; MX – Manx shearwater; KI – kittiwake; PU – puffin; SA – shag; TM – European storm-petrel).

AREA OF INTEREST

Southwest Coast 2.8

Qualifying Interests

- **Seabed features of conservation importance** *Zostera, Laminaria spp.*.
- **Cetaceans** Fin whale, harbour porpoise, humpback whale, minke whale, Risso's dolphin, bottlenose dolphin, common dolphin
- **Elasmobranchs** Basking shark (*Cetorhinus maximus*)
- **Commercially Exploited Species** Herring, whiting
- **Birds: Breeding** Fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, black-headed gull, herring gull, lesser black-backed gull, common gull, great black-backed gull, Mediterranean gull, little gull, Manx shearwater, Leach's storm-petrel, European storm-petrel, great skua, Arctic tern, common tern, sandwich tern, gannet, cormorant, shag
- **Birds: Frequent non-breeding** Sooty shearwater, Arctic skua
- **Birds: Infrequent non-breeding** Balearic shearwater, Cory's shearwater, great shearwater, Wilson's storm-petrel, long-tailed skua, pomarine skua

Spatial Extent
7,333km² **1.5%**
of Maritime Area

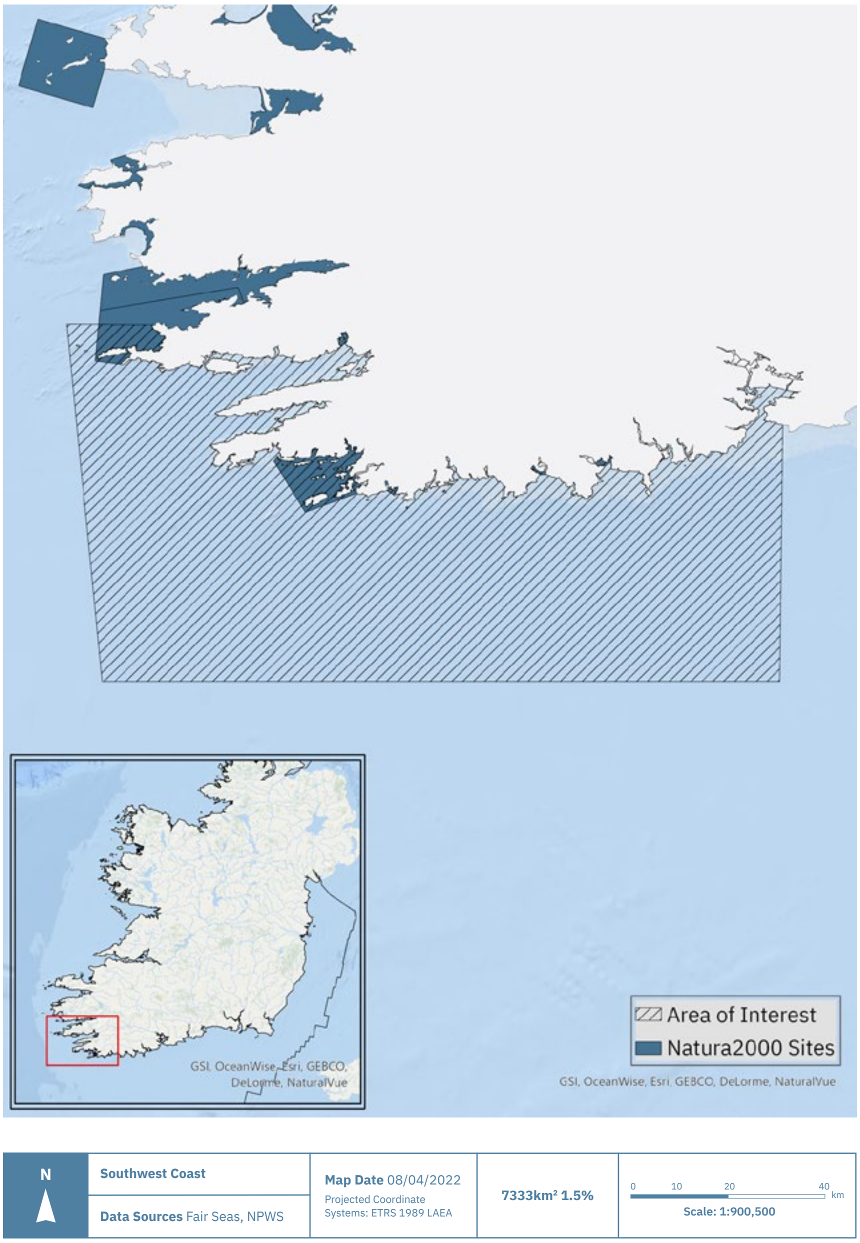


Figure 2.8.1: Southwest Coast Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.8.1: Main broad-scale seabed habitat types covered within Southwest Coast AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep circalittoral mud	42%
Circalittoral rock and other hard substrata	25%
Deep circalittoral coarse sediment	15%
Unclassified	7%
Deep circalittoral sand	4%
Circalittoral sandy mud	3%
Other	3%

Chimmney Cove,
Co. Cork

"There are several seagrass beds along this stretch of coast that are not currently protected, including several inside Bantry Bay."

Primary Reasons for Site Importance

This is an important Area of Interest for cetaceans and exhibits high species richness. The highest densities of fin whales recorded within Ireland's EEZ exist in this site – accounting for 43% of sightings within Ireland's EEZ, 49% of the overall total number of individuals (n=6,123) recorded between 2005-2021. Thirty-seven percent of humpback whale sightings occurred within this site, accounting for 36% of the overall total number of individuals (n=2,747). The highest densities of Risso's dolphin recorded within Ireland's EEZ were recorded within this site – 40% of sightings, accounting for 43% of the overall total number of individuals (n=3,904). Twenty-three percent of minke whale sightings occurred within this site, accounting for 63% of the overall total number of individuals (n=14,238). Twenty-one percent of harbour porpoise sightings occurred within this site, accounting for 28% of the overall total number of individuals (n=20,263). Thirty-six percent of common dolphin sightings within Ireland's EEZ occurred within this site, accounting for 55% of the overall total number of individuals (n=296,489), where groups of up to 2,000 individuals have been recorded. The location of this site is a virtual gateway for seabirds travelling to Ireland, as the ocean's currents essentially split here with water either heading up the west coast or alternatively along the south coast. This attracts a high diversity of seabird species, offering easy access and transit to many rich coastal habitats in such places as Roaringwater Bay and Bantry Bay.

Description of Features

Seabirds
This Area of Interest is one of the most diverse areas for seabird species, with 22 different species recorded in one offshore 100km^2 area out of the 31 different species recorded in total over the survey period, including the Critically Endangered Balearic shearwater on a couple of occasions. Bull Rock is one of the six gannet colonies (gannetries) in Ireland, and Cape Clear is an important migration bottleneck region. Most 100km^2 grid cell areas had more than 10 different species of seabird observed in them, making this area a consistent hotspot of seabird activity.

Habitats
On the south coast, the nearshore habitat out to 12 nm is dominated by the EUNIS seabed habitat type 'circalittoral rock and other hard substrata', which then changes to 'deep circalittoral mud'. The large Bantry, Kenmare and Roaringwater bays are very diverse in terms of seabed habitats. There are several seagrass beds along this stretch of coast that are not currently protected, including several inside Bantry Bay. Also of note are the kelp forests within Bantry Bay and along the south coast which urgently need protection (see Annex B). The south coast has few SACs, and all are very small inshore sites. This represents a major gap in Ireland's inshore MPA network.

Elasmobranchs
Analysis of the IWDG database and ObSERVE survey data indicates high basking shark densities on the southwest coast. The area has the highest amount of basking shark sightings in the country, with over 30% of all sightings recorded from this area. Single sightings often report multiple individuals, mostly between 10 and 20, and one sighting recorded the highest number of individuals ever recorded – 100 – south of Rosscarbery (see Annex F).

Elasmobranch records from groundfish surveys show moderate species richness in the area, with a maximum of six species caught in outer Roaringwater Bay (see Annex F).

Commercially exploited species
A large whiting spawning and nursery ground passes through this area. There are several small herring spawning and nursery grounds. A large haddock spawning ground is located around 13km offshore from the southwest coastline. While there is currently no evidence of spawning site fidelity for sprat, high catches of juveniles are observed in groundfish surveys in this area (Marine Institute, 2021). A large proportion of sprat landings are from inner Bantry and Kenmare Bays, including in Kenmare River SAC (Marine Institute, 2021). Protection of sprat is important, as it is a primary food source for many seabirds and cetaceans.

Cetaceans
This area is important as a foraging area for both humpback and fin whales, with data over a number of decades to support this. A small number of whale-watching boat tours operate in this area. Distribution of fin whales is widespread throughout the site with high densities (2.66/100km^2) from Cape Clear Island to the Old Head of Kinsale and further offshore (see Annex C). Presence exists year-round, excluding March when no sightings were made. Lower densities of humpback whales throughout the site with higher densities (1.02/100km^2) concentrated between Cape Clear and the Old Head of Kinsale. Sightings occurred throughout the years.

Moderate densities of bottlenose dolphins are evident along the coast, with higher densities (3.12/100km^2) around Dursey Island and at the mouth of Cork Harbour (10.77/100km^2). These high numbers at Cork Harbour are likely due to the resident group of eight individuals related to the Shannon SAC dolphins and a solitary dolphin. High densities of Risso's dolphin (5.19/100km^2) around Dursey Island with lower densities throughout the rest of the site. No sighting records were made in February and December.

Distribution of minke whale is widespread throughout the site with high densities (10/100km^2) from Cape Clear Island to Galley head and further offshore. Sightings were recorded throughout the seasons. High densities of harbour porpoises throughout the site particularly off Toe Head (10.21/100km^2) and within the Roaringwater Bay and Islands SAC (9.06/100km^2), of which the porpoises are a qualifying feature.

Between 2005-2021 sporadic sightings (n=22) of killer whales were recorded. Atlantic white-sided dolphins and long-finned pilot whales were observed occasionally. Common dolphins were abundant throughout the site with 28 encounters with calves, predominantly during the month of October.

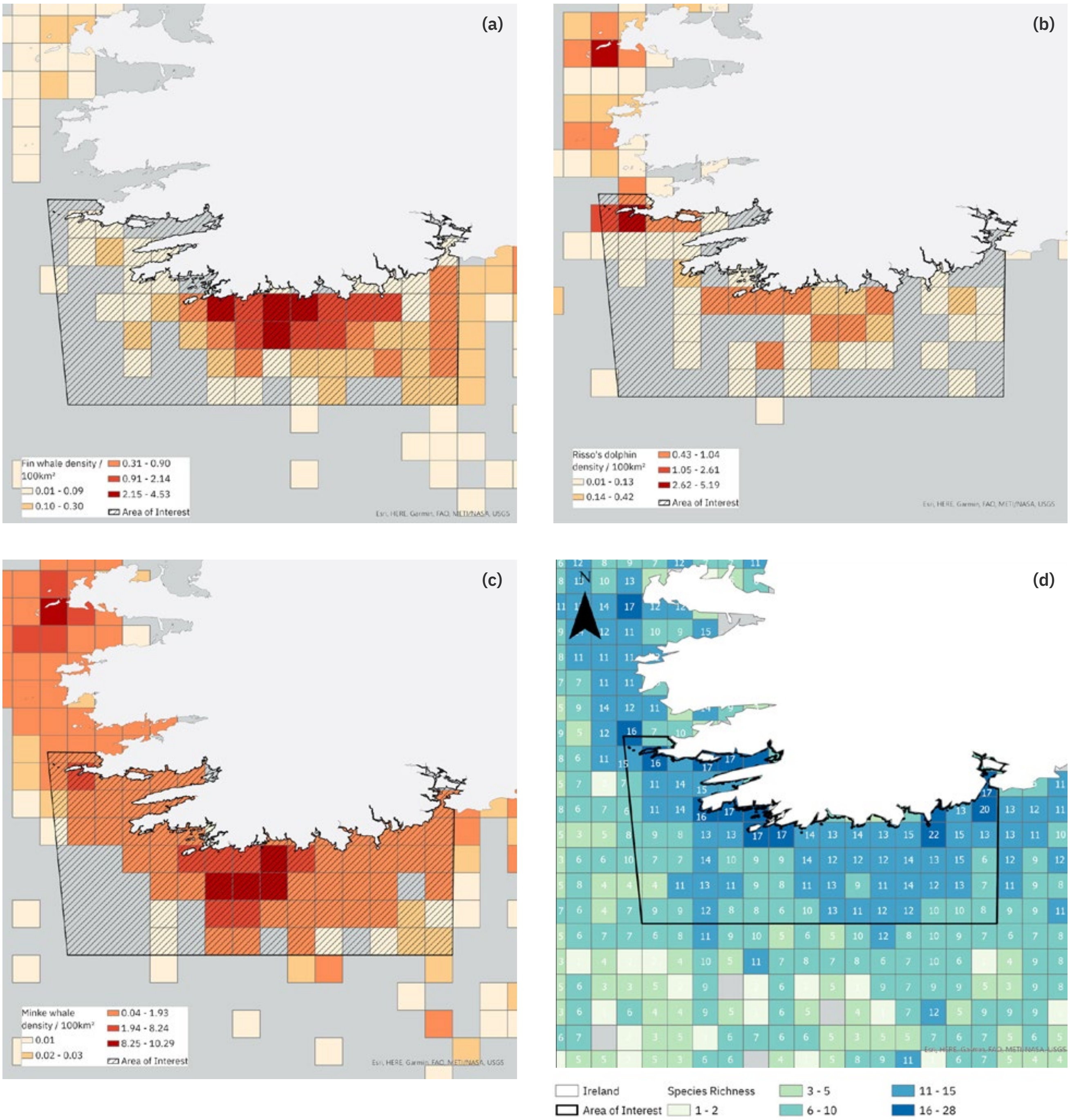


Figure 2.8.2
(a) Densities per 100km² of fin whale (2005-2021); (b Densities per 100km² of Risso's dolphin (2005-2021); (c) Densities per 100km² of minke whale (2005-2021) within the Southwest Coast AOI; (d) High richness of seabird species within the site, especially at Cape Clear and Roaringwater Bay, Dursey Island, and Old Head of Kinsale.

AREA OF INTEREST

Southeast Coast 2.9

Qualifying Interests

- **Seabed features of conservation importance** *Laminaria spp.*
- **Cetaceans** Fin whale, Risso's dolphin, harbour porpoise
- **Elasmobranchs** Spurdog (*Squalus acanthias*) , thornback ray (*Raja clavata*), tope (*Galeorhinus galeus*)
- **Commercially Exploited Species** Herring, cod, haddock, whiting
- **Birds: Breeding** Fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, black-headed gull, herring gull, lesser black-backed gull, great black-backed gull, little gull, Mediterranean gull, Leach's storm-petrel, European storm-petrel, Manx shearwater, great skua, Arctic tern, common tern, roseate tern, Sandwich tern, little tern, cormorant, shag, gannet
- **Birds: Frequent non-breeding** Arctic skua
- **Birds: Infrequent non-breeding** Balearic shearwater, Cory's shearwater, great shearwater, sooty shearwater, Sabine's gull, Wilson's storm-petrel, pomarine skua, long-tailed skua, black tern

Spatial Extent
7,124km² **1.46%**
of Maritime Area

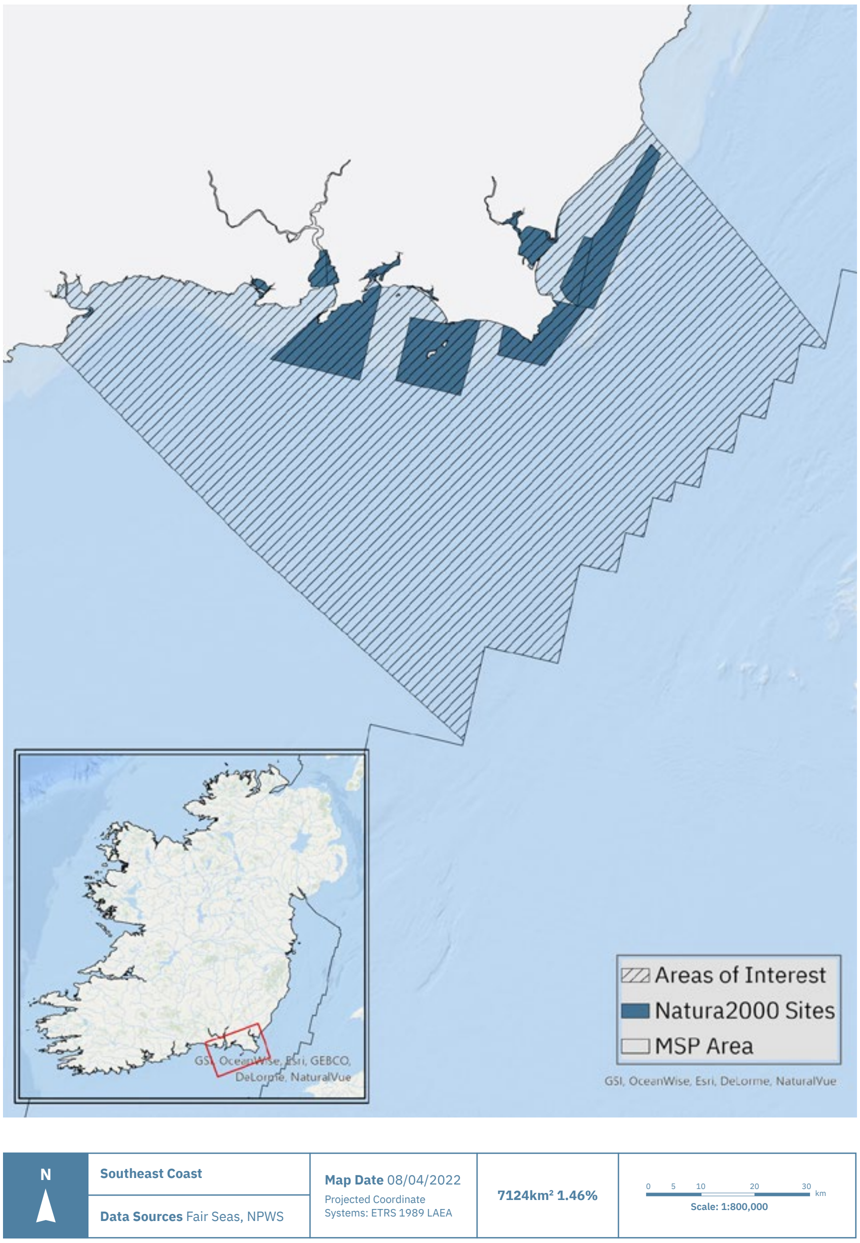


Figure 2.9.1: Southeast Coast Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.9.1: Main broad-scale seabed habitat types covered within Southeast Coast AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep circalittoral sand	37%
Deep circalittoral coarse sediment	31%
Circalittoral rock and other hard substrata	7%
Circalittoral coarse sediment	6%
Circalittoral fine sand or circalittoral muddy sand	6%
Deep circalittoral mud	4%
Unclassified	3%
Other	4%

Carnivan Bay,
Co. Wexford

"Areas south of Hook Head and towards the UK border showed high elasmobranch species richness with nine species recorded in several areas."

Primary Reasons for Site Importance

There is a 130km long and 20km wide cod spawning ground running parallel to the south coast, which is one of only two cod spawning grounds in Irish waters. Between 2005-2021 16% of fin whale sightings within Ireland's EEZ occurred within this site, accounting for 14% of the overall total number of individuals (n=6,123). Fourteen percent of Risso's dolphin sightings occurred within this site, accounting for 10% of the overall total number of individuals (n=3,904). Four percent of harbour porpoise sightings occurred within this site, accounting for 3% of the overall total number of individuals (n=20,263). Seabirds with colonies on the east coast of Ireland, as well as the coast of Wales and Cornwall in England depend on this area for vital foraging during chick-rearing. The majority of the newly arrived Mediterranean gull breeding occurs here at Lady's Island Lake, which is also a hotspot for terns and black-headed gulls.

Description of Features

Commercially exploited species
Several commercially exploited species use this area as spawning and/or nursing grounds, including herring, cod, haddock and whiting (see Annex E). While there is currently no evidence of spawning site fidelity for sprat, high catches of juveniles are observed in groundfish surveys in this area (Marine Institute, 2021). A large proportion of sprat landings are from in and around the Waterford Estuary (Marine Institute, 2021). Protection of sprat is important, as it is a primary food source for many seabirds and cetaceans.

Elasmobranchs
Areas south of Hook Head and towards the UK border showed high elasmobranch species richness with nine species recorded in several areas. Spurdog, thornback ray and tope occur in high densities in this area. An average 11 individuals of tope were caught in groundfish survey hauls off the coast of Wexford, which is one of the highest densities in the country (see Annex F).

Habitats
The seabed in this Area of Interest is very diverse, consisting of roughly equal parts of sand and coarse sediment, with muddy patches and rocky substrate also present. Circalittoral rock is present from the coastline out to 4.5 nm. Large parts of these rocky areas occur in existing SACs, especially Hook Head SAC and the Saltee Islands SAC. In the shallow parts of these areas large kelp forests are known to exist, while deeper areas are characterised by sponge and sea squirt communities (NPWS, 2014; NPWS, 2013).

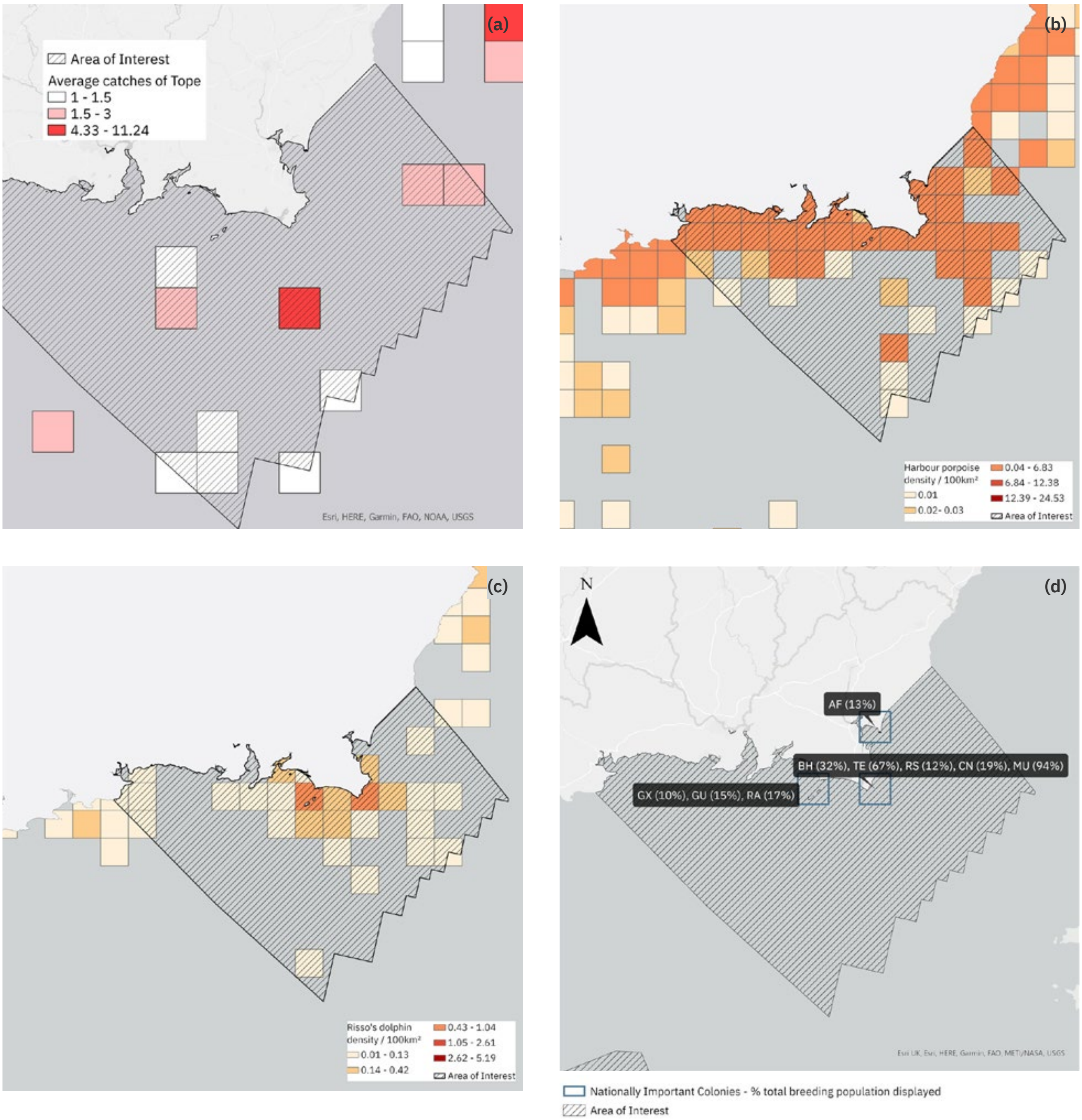
Seabirds
This Area of Interest is a true hotspot of seabird activity, with 34 of the 38 total number of species identified within the explored data occurring in this region. The highest level of species richness occurs in this area, with 28 different species recorded at at least one point in time off Carnsore Point in Wexford, which is a major migration bottleneck. The Seatrack migration survey (Keogh et al., 2014) recorded approximately 43,000 birds over a four-year period (2010-2103) with consistently high diversity each year (21-23 species present). Several key colonies exist within this Area of Interest. Internationally important colonies of roseate terns and Sandwich terns are located at Lady's Island Lake. The Saltees Islands host large colonies of gannets, guillemots, razorbills, puffins, kittiwakes, and cormorants. A large gannet colony lies just across the border in Wales (Grassholm).

Cetaceans
High cetacean species diversity was recorded in this area generally at lower densities for most species compared to other sites. High densities (1.51/100km^2) of fin whales were recorded close to the coast, observed during every month except March and April. High densities of Risso's dolphins (1.04/100km^2) were recorded off Carnsore Point, particularly in the summer months.

Moderate to high densities (1.08/100km^2) of harbour porpoise are distributed adjacent to the coast. Presence recorded year-round with greater sightings during January, July and November. Moderate densities (0.95/100km^2) of minke whale were recorded in this site compared to other sites, with high concentrations recorded off Helvick Head. Presence was observed year-round with the exception of February.

Lower densities (1.24/100km^2) of bottlenose dolphins compared to other sites, with occasional sightings throughout the year. Sightings were made from February to November with higher sightings during summer months. Lower densities (0.28/100km^2) of humpback whales compared to sites further west, with concentrations recorded outside Waterford Harbour, and sightings records peaking in January (see Annex C).

Killer whales were sighted on a small number of occasions (n=4). Common dolphins were abundant throughout the site. Six percent of common dolphin sightings within Ireland's EEZ occurred within this site, accounting for 3% of the overall total number of individuals (n=296,489) recorded from 2005-2021.



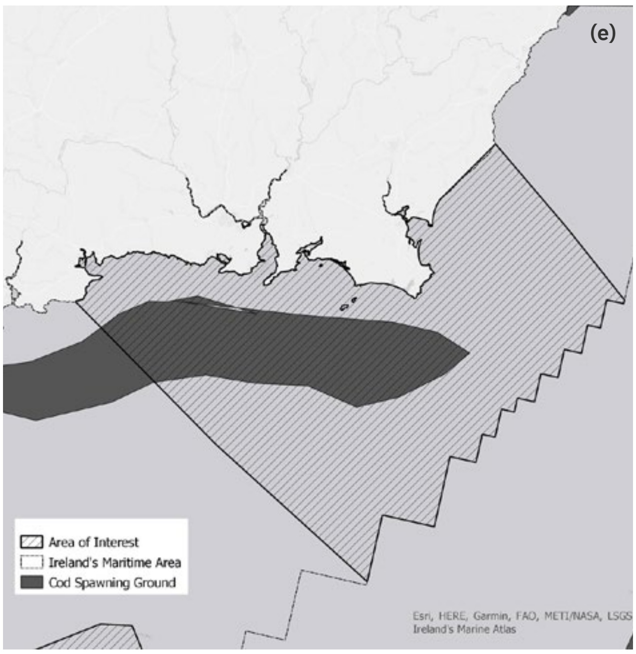


Figure 2.9.2
(a) Average catches of tope; (b) Densities per 100km² of harbour porpoise (2005-2021); (c) Densities per 100km² of Risso's dolphin (2005-2021); (d) Nationally important seabird colonies at the Southeast Coast AOI, with the proportion of the national total of breeding pairs (%) shown (AF – little tern; BH – black-headed gull; CN – common tern; GX – gannet; GU – guillemot; MU – Mediterranean gull; RA – razorbill; RS – roseate tern; TE – sandwich tern) (e) Cod spawning ground within the Southeast Coast AOI

AREA OF INTEREST

East Coast 2.10

Qualifying Interests

- **Seabed features of conservation importance** Seapens and burrowing megafauna communities, *Modiolus modiolus*, *Sabellaria spinulosa*
- **Cetaceans** Harbour porpoise, minke whale
- **Elasmobranchs** Spurdog (*Squalus acanthias*), thornback ray (*Raja clavata*)
- **Commercially Exploited Species** Nephrops, cod, herring, whiting, haddock
- **Birds: Breeding** Manx shearwater, Arctic tern, common tern, roseate tern, Sandwich tern, little tern, fulmar, puffin, guillemot, razorbill, black guillemot, kittiwake, black-headed gull, herring gull, lesser black-backed gull, common gull, great black-backed gull, little gull, Mediterranean gull, European storm-petrel, great skua, cormorant, shag, gannet
- **Birds: Frequent non-breeding** Arctic skua
- **Birds: Infrequent non-breeding** Balearic shearwater, great shearwater, sooty shearwater, Sabine's gull, pomarine skua, long-tailed skua, black tern

Spatial Extent
4,346km² **0.89%**
of Maritime Area

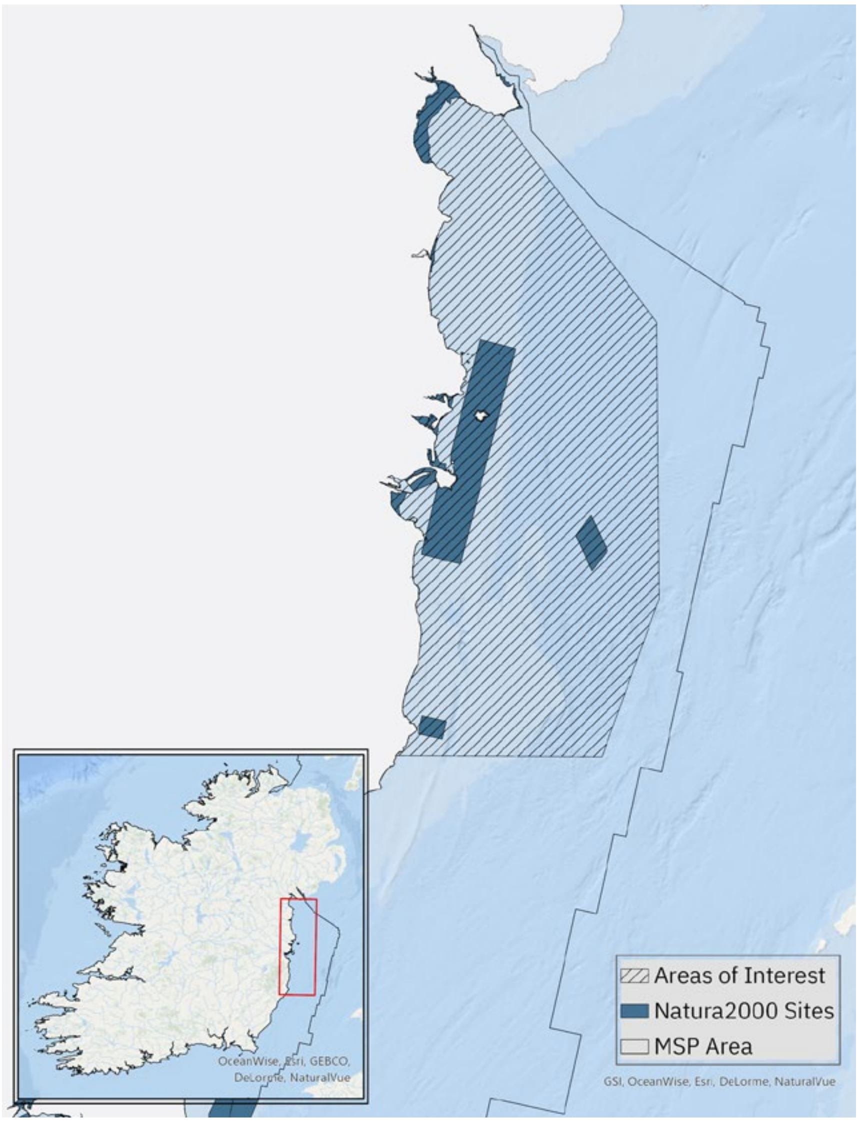


Figure 2.10.1: East Coast Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

N	East Coast **Data Sources** Fair Seas, NPWS	**Map Date** 08/04/2022 Projected Coordinate Systems: ETRS 1989 LAEA	4346km² 0.89%	0 5 10 20 30 km Scale: 1:800,000

Table 2.10.1: Main broad-scale seabed habitat types covered within East Coast AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep circalittoral mud	29%
Deep circalittoral sand	25%
Circalittoral coarse sediment	13%
Deep circalittoral coarse sediment	12%
Circalittoral fine sand or circalittoral muddy sand	8%
Circalittoral sandy mud	3%
Infralittoral fine sand or Infralittoral muddy sand	2%
Other	7%

Howth Harbour,
Co. Dublin

"The most important roseate tern colony in all of Europe occurs on the small island of Rockabill each year."

Primary Reasons for Site Importance

One of only two cod spawning grounds occur in this area, covering 65% of the AOI (see Figure 2.10.2(a). The Great Irish Sea Mudbelt, a large patch of deep circalittoral mud, is home to Nephrops and seapens. Harbour porpoise are ubiquitous throughout the site: 37% of all sightings within Ireland's EEZ occurred here, accounting for 30% of the overall total number of individuals (n=20,263) recorded between 2005-2021. Seasonal abundance of minke whales is apparent. The most important roseate tern colony in all of Europe occurs on the small island of Rockabill. Lambay Island is one of the most diverse locations for seabirds in the country. Kilcoole hosts the largest little tern colony. The Irish Sea is a vital feeding ground for not only birds breeding in Ireland, but also supports colonies in the United Kingdom (UK).

Description of Features

Seabirds
The east coast of Ireland in the Irish Sea is extremely diverse in species of seabird. With the exception of Cory's shearwater, little auk and Wislon's storm-petrel, all other species of seabird identified across the dataset occurred at least once within this region. All five red-listed species are accounted for (Balearic shearwater, Leach's storm-petrel, puffin, kittiwake and razorbill). All recorded tern species are observed here. The most important roseate tern colony in all of Europe exists on the small island of Rockabill each year. Lambay Island provides a nesting site for guillemot and shag colonies of international importance, while also accommodating large colonies of kittiwake, razorbill, cormorant, puffin, fulmar and several gull species, making it one of the most diverse and abundant seabird hotspots across Ireland's entire Maritime Area. Kilcoole in County Wicklow has the most important little tern colony in Ireland.

Cetaceans
Lower densities of bottlenose dolphins have been recorded throughout the site, while, high densities exist off the Frazer Bank (7.59/100km^2) and south to Broad Lough (0.86/100km^2). Sightings occur year-round, with higher sighting records during the summer months.

Harbour porpoise are ubiquitous throughout the site, with higher densities recorded north of Howth (19.17/100km^2) and south of the Frazer Bank (11.5/100km^2). Sightings occur year-round with peak counts in August. The Rockabill to Dalkey Island SAC was designated with harbour porpoise as a qualifying feature in 2013. In a 2008 survey, calves accounted for 8% and 6% of the porpoises surveyed in North County Dublin and Dublin Bay, respectively (Berrow et al., 2014). Site surveys north of Howth returned mean density of 1.32 harbour porpoise per km^2 (Meade et al., 2017).

Moderate densities (0.2/100km^2) of minke whale recorded throughout the site with observations made during March to October and December, with higher numbers recorded during the summer months (see Annex C). Low densities of killer whales and Risso's dolphins have been recorded from sporadic sightings over the years. Infrequent sightings of common dolphins (n=35) were distributed throughout the site.

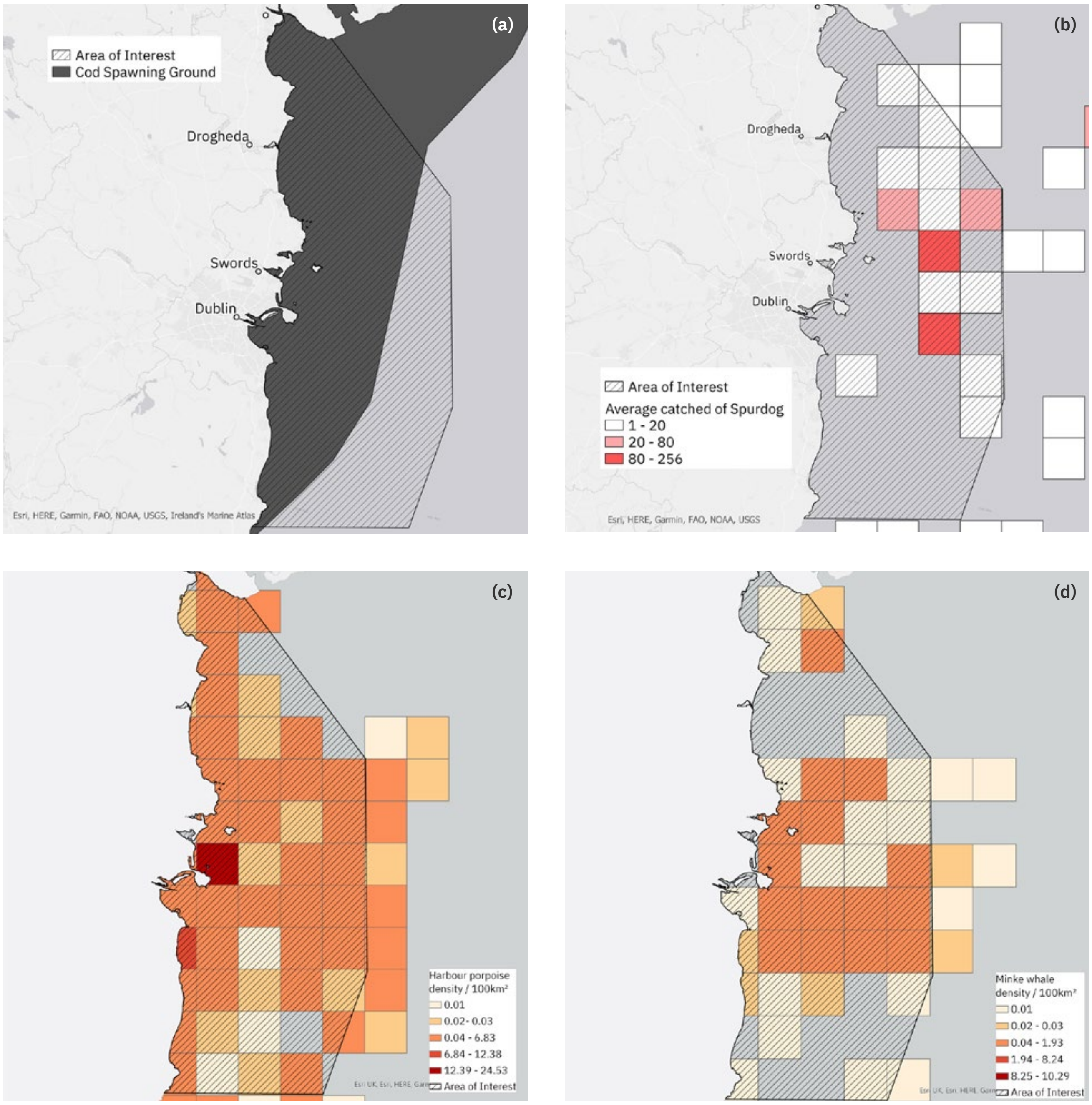
Habitats
OSPAR and GBIF data show several records for *Modiolus modiolus* (horse mussels) and *Sabellaria spinulosa* in this area of the Irish Sea, especially off the coasts of Dublin and Wicklow. An extension to the Wicklow Reef SAC is therefore recommended.

The northern part of the proposed site also features rare seabed habitats. The OSPAR listed threatened and/or declining habitat 'Seapens with burrowing megafauna' can be found here. The area to the east of Dundalk Bay is predominantly dense mud/silt in which *Nephrops norvegicus* build their burrows. The seabed sediments of the Western Irish Sea Mudbelt experience near 0% sediment mobilisation, significantly less than areas elsewhere in the Irish Sea (Coughlan et al., 2021). This naturally low sediment mobilisation means the area is more vulnerable to bottom trawling compared to areas that are frequently disturbed naturally through wave or tidal action. Furthermore, trawling activity may coarsen the fine sediment, making it less suitable for Nephrops (Coughlan et al., 2021). There is scope for this area to be expanded out to the maritime border with the UK in order to link the AOI to the UK's 'Queenie Corner' marine conservation zone, which is designated for seapen and burrowing megafauna communities and subtidal mud.

While there are no functional *Ostrea edulis* reefs left in this area, historical data shows that the east coast was once rich in this habitat type (Went, 1963). We therefore recommend that the native oyster be restored within this area as they provide an essential ecosystem service as a hard-habitat for other fauna, fix nutrients within their feeding, and have high water-filtration rates (Coen et al., 2007). They also stabilise seabed sediments when they form reefs, potentially representing a nature-based solution to climate change and coastal flooding (Hynes et al., 2022).

Commercially exploited species
Several commercial fish species utilise this area as nursery and/or spawning habitat, including some that have poor stock statuses (e.g. cod, haddock, whiting, herring). The area is also important for *Nephrops norvegicus*, which overlap strongly with locations of seapens discussed above (see Annex E for Nephrops and B for seapen distribution).

Elasmobranchs
The area has moderate elasmobranch species richness, but several threatened species occur in high densities. Spurdog and thornback ray numbers are very high to the east of Howth. One area shows a maximum of 825 individuals of spurdog and 120 individuals of thornback ray caught during the past 20 years of groundfish surveys, compared to only 40 individuals of spurdog and six individuals of thornback ray caught in the areas directly adjacent. This high variation is not assumed to be due to effort bias, as the average numbers caught per survey haul are also shown to be high for this area (see Annex F).



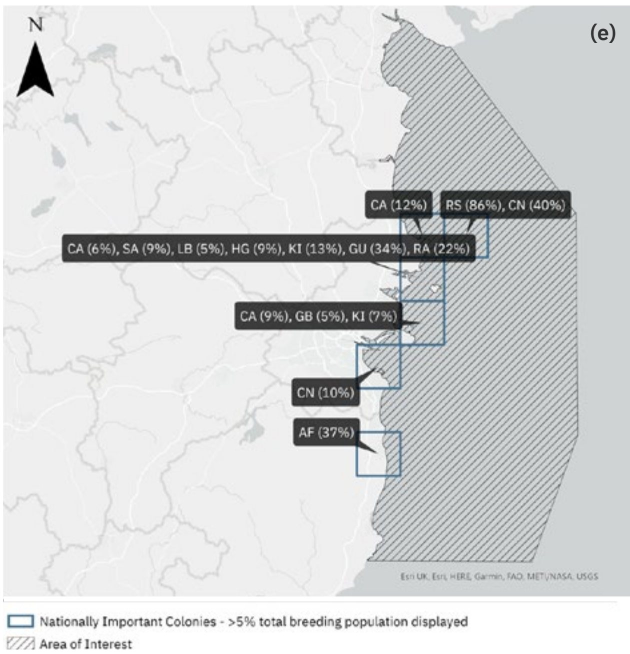


Figure 2.10.2
(a) Cod spawning ground; (b) Average catches of spurdog; (c) Densities per 100km² of harbour porpoise (2005-2021); (d) Densities per 100km² of minke whale (2005-2021) (e) Nationally important seabird colonies within the East Coast AOI with the proportion of the national total of breeding pairs (%) shown (AF – little tern; CA – cormorant; CN – common tern; GB – great black-backed gull; GU – guillemot; HG – herring gull; KI – kittiwake; LB – lesser black-backed gull; RA – razorbill; RS – roseate tern; SA – shag)

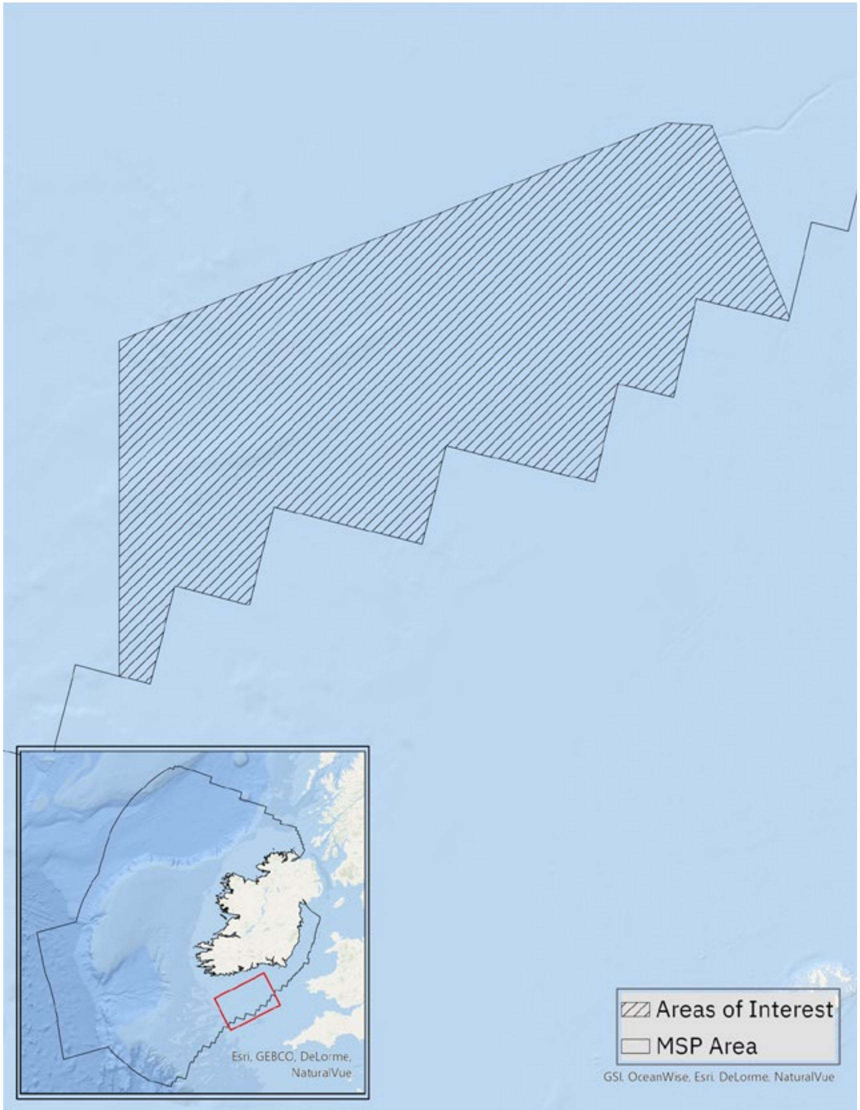
AREA OF INTEREST

Celtic Sea 2.11

Qualifying Interests

- **Seabed features of conservation importance** Seapens and burrowing megafauna communities
- **Cetaceans** Common dolphin, bottlenose dolphin
- **Elasmobranchs** Shagreen ray (*Leucoraja fullonica*), spurdog (*Squalus acanthias*)
- **Commercially Exploited Species** Nephrops norvegicus
- **Birds: Breeding** Manx shearwater, fulmar, puffin, razorbill, guillemot, kittiwake, black-headed gull, herring gull, common gull, lesser black-backed gull, great black-backed gull, Mediterranean gull, European storm-petrel, great skua, gannet
- **Birds: Frequent non-breeding** Cory's shearwater, great shearwater, sooty shearwater
- **Birds: Infrequent non-breeding** Sabine's gull, Arctic skua, pomarine skua

Spatial Extent
5,855km² **1.2%**
of Maritime Area



N | **Celtic Sea** | **Data Sources** Fair Seas, NPWS | **Map Date** 08/04/2022 | Projected Coordinate Systems: ETRS 1989 LAEA | **5855km² 1.2%** | 0 5 10 20 30 km | Scale: 1:800,000

Figure 2.11.1: Celtic Sea Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.11.1: Main broad-scale seabed habitat types covered within Celtic Sea AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
A5.15: Deep circalittoral coarse sediment	7%
A5.27: Deep circalittoral sand	24%
A5.37: Deep circalittoral mud	69%

Primary Reasons for Site Importance

Nephrops norvegicus and seapens colonise the muddy sediment in this area. It borders two UK Marine Conservation Zones (MCZs) which are also designated for shelf sediments.

Description of Features

Seabirds
This Area of Interest has 21 different species recorded within its boundary over the study period, including three red-listed species (kittiwake, puffin, and razorbill). As this is an area that shares a border with the United Kingdom and established MCZs, it is expected that this area is used by birds from UK colonies.

Habitats
The area features the OSPAR threatened and/or declining habitat 'Seapens and burrowing megafauna'. The seabed substrate is largely dominated by deep mud with patches of sand also present. This Area of Interest borders two UK MCZs, Greater Haig Fras and North-East of Haig Fras. Greater Haig Fras protects continental shelf seabed that surrounds an isolated fully submarine bedrock outcrop. North-East of Haig Fras is also designated for the protection of sedimentary features, predominantly sand and mud.

Elasmobranchs
There is moderate to high elasmobranch species richness in this area, with a total of five species recorded in one area. The shelf sediments southwest of Ireland have higher shagreen ray occurrences compared to elsewhere in Irish waters. Very little is known about the life-history of this species (Clarke et al., 2016).

Spurdog also occur in moderate densities in this area. Flapper skate also occurs here (see Annex F).

Commercially exploited species
This deep mud area is colonised by *Nephrops norvegicus*, which overlaps with seapen locations.

Cetaceans
Lower numbers of cetaceans were recorded in this site compared to other sites, which may be attributable to lower survey effort. Common dolphins were the most abundant species (n=143) observed in this area and were distributed throughout the site. Lower densities of bottlenose dolphins (0.06/100km^2) compared to other sites. Sightings were during May and September to November. Lower densities of harbour porpoise (0.05/100km^2) were reported in this site. There were low sightings of fin whales (n=5) compared to areas closer to the coast.

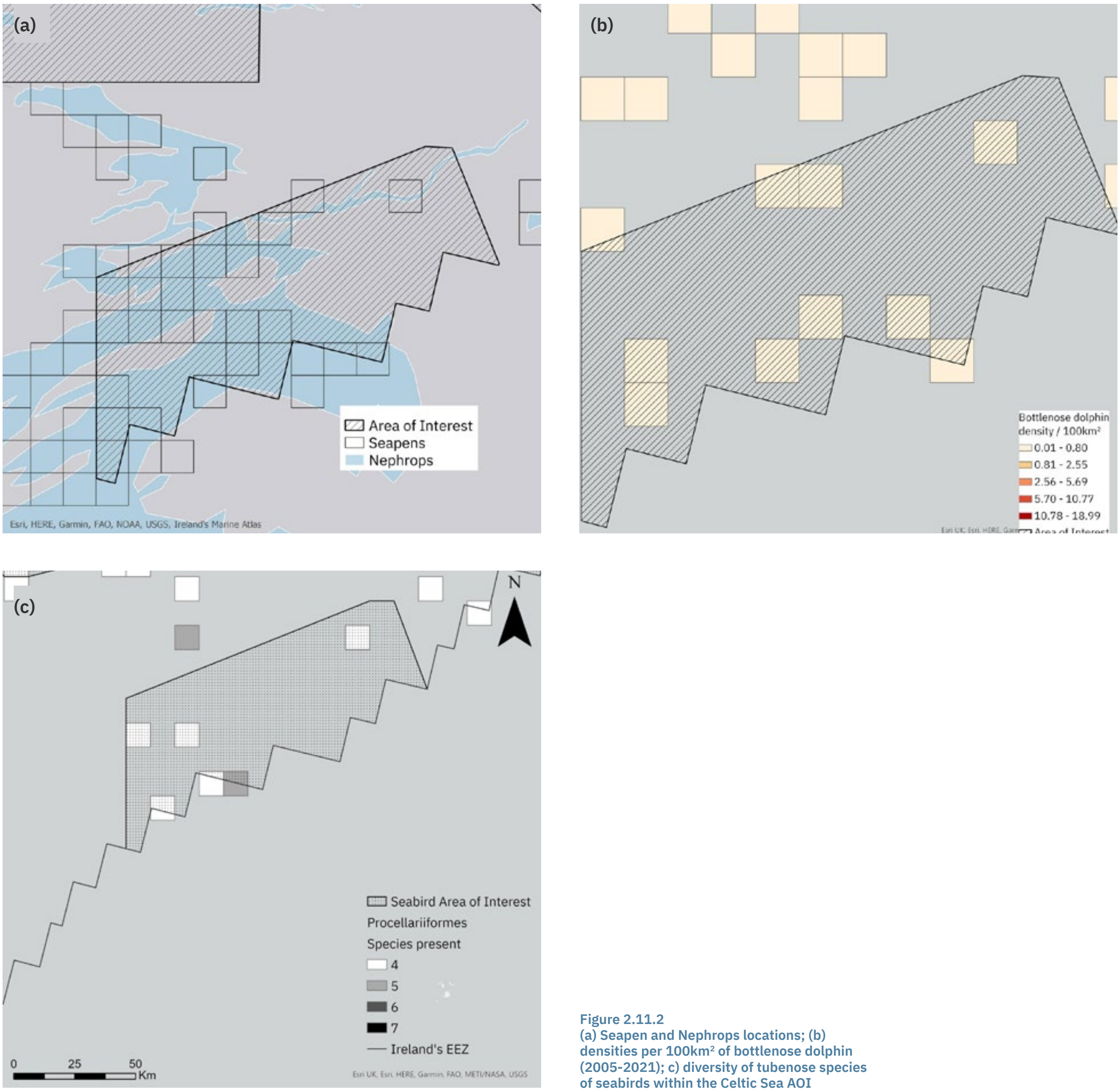


Figure 2.11.2
(a) Seapen and Nephrops locations; (b) densities per 100km^2 of bottlenose dolphin (2005-2021); c) diversity of tubenose species of seabirds within the Celtic Sea AOI

AREA OF INTEREST

Whittard Canyon 2.12

Qualifying Interests

- **Seabed features of conservation importance** Corals
- **Cetaceans** Long-finned pilot whale, beaked whale spp.
- **Commercially Exploited Species** Blue whiting
- **Birds: Breeding** Arctic tern, puffin, kittiwake, common tern, European storm-petrel, great skua, lesser black-backed gull, Manx shearwater, fulmar, gannet
- **Birds: Frequent non-breeding** Cory's shearwater
- **Birds: Infrequent non-breeding** Arctic skua, great shearwater, pomarine skua, sooty shearwater, Sabine's gull, Wilson's storm-petrel

Spatial Extent
15,402km² **3.15%**
of Maritime Area

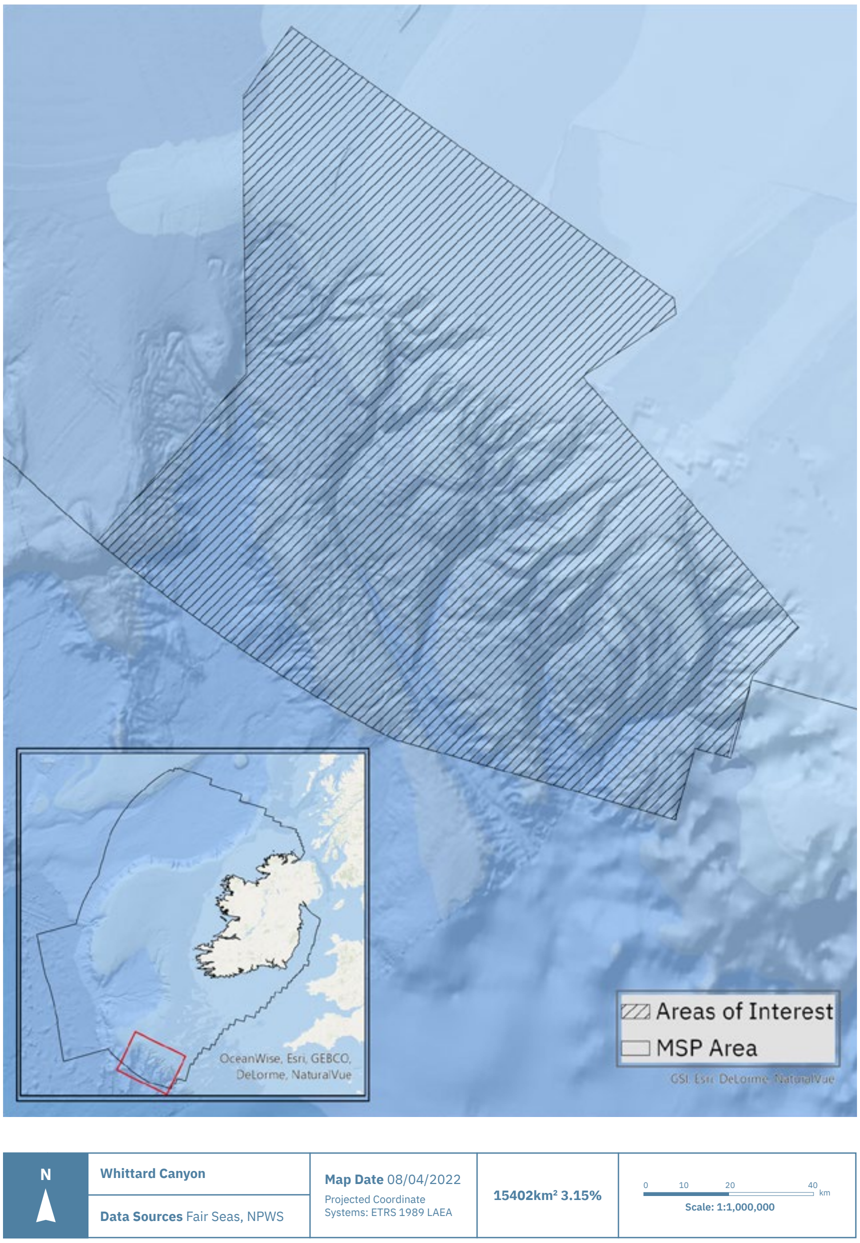


Figure 2.12.1: Whittard Canyon Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.12.1: Main broad-scale seabed habitat types covered within Whittard Canyon AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep-sea bed	84%
Other	2%
Unclassified	14%

Primary Reasons for Site Importance

This canyon system is one of the largest submarine canyons along the Celtic Margin and home to cold-water coral reefs. Across the border, the UK has designated 'The Canyons' Marine Conservation Zone, which is likely to support a variety of cetacean species.

Description of Features

Seabirds
This Area of Interest has been covered extensively in recent years by the independent scientific surveys on board the RV Celtic Explorer and as part of the ObSERVE aerial surveys. Important at-risk species are frequently present here such as the red-listed kittiwake and puffin.

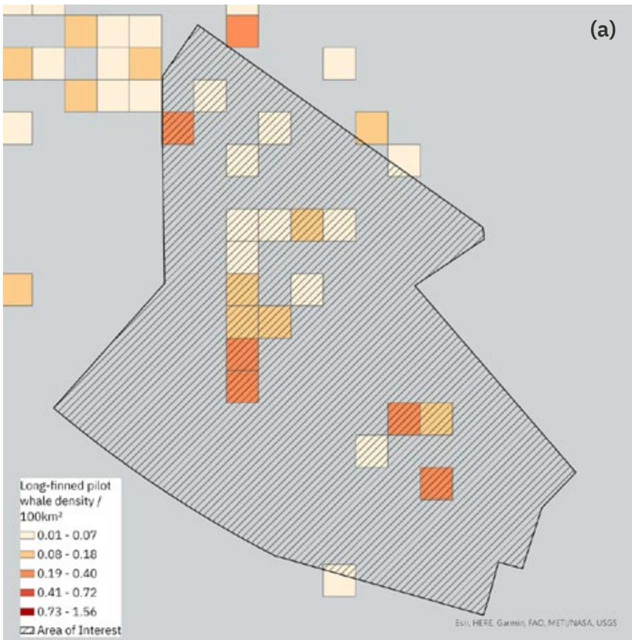
Habitat
The Whittard Canyon stretches nearly 300km through both UK and Irish waters (O'Sullivan et al., 2019). Submarine canyons are incredibly important oceanic features that funnel ocean currents, which likely enhance primary productivity (Fernandez-Arcaya et al., 2017). The environment of the Whittard Canyon is very heterogenous due to a combination of organic matter trapping, current regimes and different substrates (Amaro et al., 2015). This canyon system was surveyed as part of the SeaRover (Sensitive Ecosystem Assessment and ROV Exploration of Reef) survey in 2019 (O'Sullivan et al., 2019). The survey report and corresponding metadata highlights the presence of *Lophelia* reefs and *Desmophyllum*, *Lepidisis,* and *Madrepora* corals (O'Sullivan et al., 2019; Picton et al., 2021).

Commercially exploited species
The shelf sediments included in this Area of Interest are part of a large blue whiting nursery ground (see Annex E).

Cetaceans
The area around the Whittard canyon sees the warmest water temperatures off the Irish coast originating from sub-tropical latitudes. The area has been poorly studied but contains a wide variation of bathymetry which is likely to support beaked whales and a variety of species (MacLeod, 2005).

Lower densities (0.21/100km^2) of long-finned pilot whales have been recorded within the site compared to areas such as the shelf edge which has seen greater survey effort (see Annex C). Presence was recorded during the months of January to March, June to September, and November. The proportion of young accounted for 2% of 221 individuals, the total number recorded within this site between 2005-2021. Further concentrations of this species have been recorded within the Goban Spur area.

Low densities of fin whales (0.06/100km^2) recorded within the site, with further concentrations recorded within the Goban Spur area. Presence was recorded from June to September. Between 2005-2021 sightings of Atlantic white-sided dolphin (n=2), minke whale (n=3), striped dolphin (n=2) and northern bottlenose whale (n=1) were observed. Common dolphins were abundant throughout the site, the proportion of young accounting for 1% of 839 individuals, the total number recorded within this site.



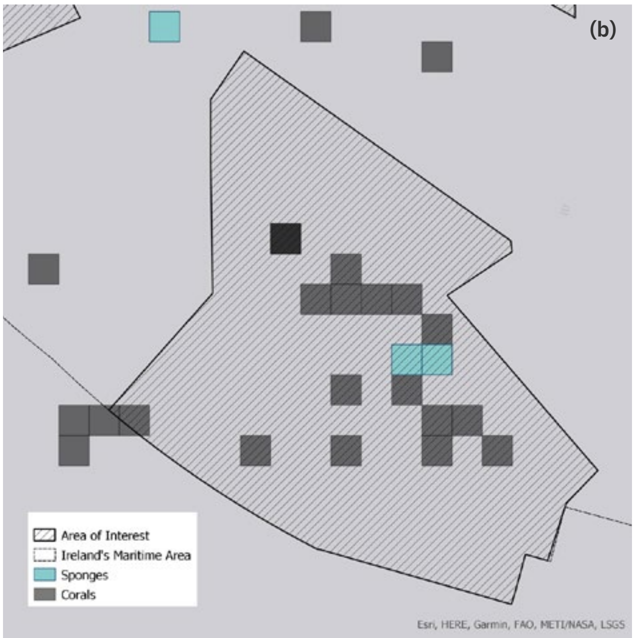


Figure 2.12.2
(a) Densities per 100km^2 of long-finned pilot whale (2005-2021); (b) Locations of coral reefs and deep-sea sponge aggregations within the Whittard Canyon AOI

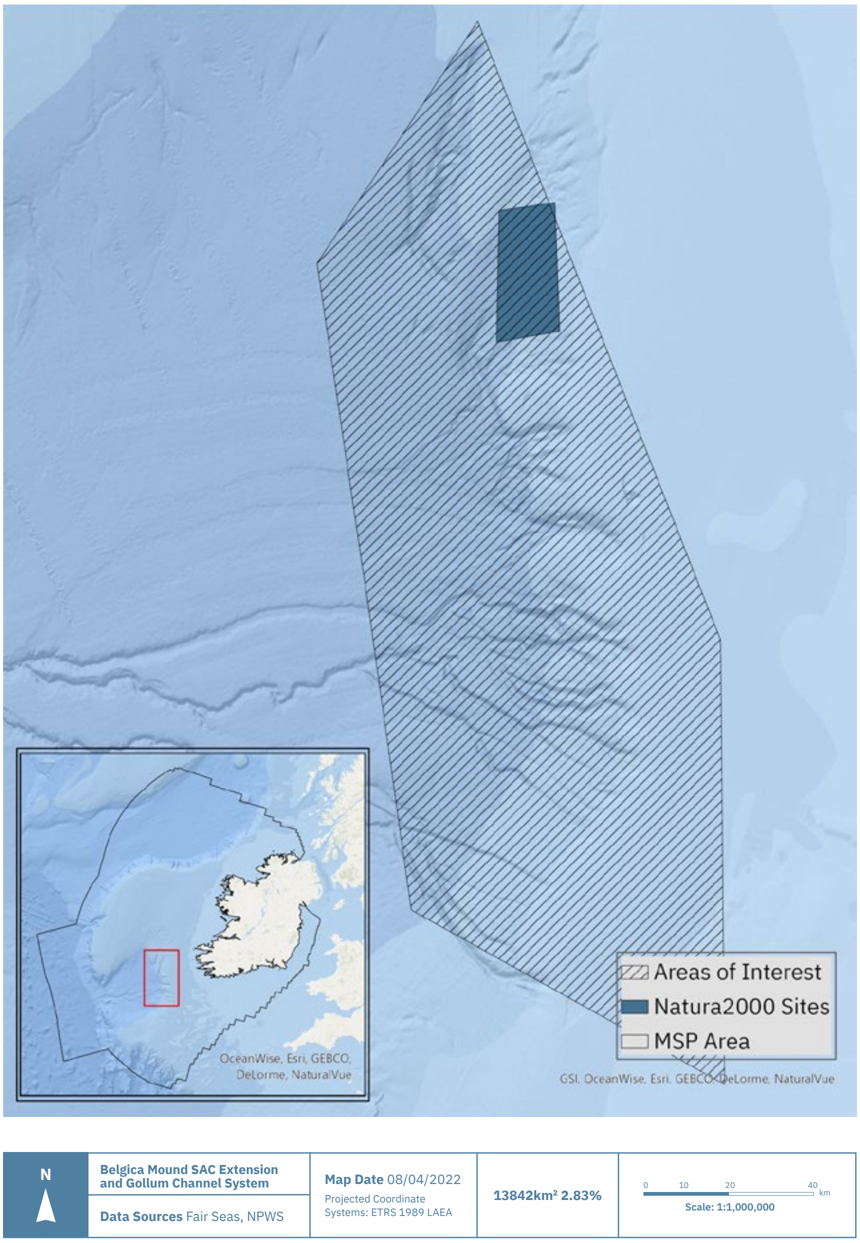
AREA OF INTEREST

Gollum Channel System

2.13

Qualifying Interests

- **Seabed features of conservation importance** Corals, deep-sea sponges
- **Cetaceans** Blue whale, fin whale, long-finned pilot whale, sperm whale
- **Commercially Exploited Species** *Nephrops norvegicus*, blue whiting
- **Birds: Breeding** Arctic tern, puffin, kittiwake, guillemot, common tern, herring gull, lesser black-backed gull, European storm-petrel, Leach's storm-petrel, great black-backed gull, great skua, Manx shearwater, fulmar, gannet
- **Birds: Frequent non-breeding** Cory's shearwater, great shearwater
- **Birds: Infrequent non-breeding** Arctic skua, long-tailed skua, pomarine skua, sooty shearwater, Wilson's storm-petrel



Spatial Extent
13,842km² **2.83%** of Maritime Area

Figure 2.13.1: Gollum Channel System Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.13.1: Main broad-scale seabed habitat types covered within Gollum Channel System AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep-sea bed	69%
Deep circalittoral sand	15%
Deep-sea mud	12%
Deep circalittoral mud	4%
Carbonate Mounds	<1%

Black-legged
kittiwake in flight

"The BoCCI red-listed kittiwake (Gilbert et al, 2021) was detected regularly in this area all year round, especially during winter months."

Primary Reasons for Site Importance

The highest sightings of blue whales recorded in Ireland's EEZ were within this site during 2012 and 2013. Sixty percent of sightings within Ireland's EEZ of this species occurred within this site, accounting for 64% of the overall total number of individuals (n=31) recorded within Ireland's EEZ between 2013-2021. Five percent of all sightings of fin whales within the EEZ occurred within this site, accounting for 6% of the overall total number of individuals (n=6,123) between 2005-2021. Twelve percent of all sightings of long-finned pilot whales occurred within this site, accounting for 11% of the overall total number of individuals (n=4,950), calves and juveniles were also present in this area. Ten percent of all sightings of sperm whales occurred within this site, accounting for 15% of the overall total number of individuals (n=245).

Description of Features

Seabirds
The occurrence of various shearwater species in this area is significant – Cory's shearwater, great shearwater, sooty and Manx, as well as all skua species that regularly occur in Irish waters. The BoCCI red-listed kittiwake (Gilbert et al, 2021) was detected regularly in this area all year round, especially during winter months. European storm-petrels are frequent in these waters, and the scarcer Wilson's storm-petrel was also recorded as recently as 2020.

Habitats
The proposed area overlaps with the Belgica Mound Province SAC, which is designated for reef habitat. Corals and carbonate mounds occur outside the SAC boundaries, which is why an expansion is recommended (see Annex B). The SeaRover survey noted a variety of corals species, including *Acanthogoria* as well as orange roughy. It is also worth noting that an appropriate buffer zone is needed around reefs in order to avoid the impact of sediment plumes from nearby trawling activity (Wilson et al., 2015).

Commercially exploited species
The muddy shelf sediments above the slope are home to *Nephrops norvegicus* and are a blue whiting nursery and spawning ground (see Annex E).

Cetaceans
The Porcupine Seabight traditionally sees an influx of tuna fishing boats mostly of Spanish and French origin from July to October. Tuna have been noted feeding on krill, which is also the prey species of blue and fin whales in this area (Wall et al., 2009). Both species have been observed feeding (Baines et al., 2013; Wall et al., 2009) and fin whales have been observed displaying breeding behaviours (Baines et al., 2017). While data offshore tends to be sparse, repeated seismic surveys in the area have consistently shown a high encounter with large whales, though species ID has often been lacking. Where species ID has been possible it shows that fin whales are the most commonly encountered large whale, with lesser numbers of blue whale (Baines et al., 2013; Lyne et al., 2012; Wall et al., 2009).

There is high species richness within this site with 15 different species and two species groups recorded throughout the recording period 2005-2021. The highest densities of blue whales (0.01-0.04/100km²) recorded in Ireland's EEZ are located within this site, with further sightings east in the Porcupine Seabight Basin (see Annex C). All observations within the site were recorded in the month of September.

Blue whales are listed as Endangered on the IUCN Red List and are protected under the OSPAR agreement.

Fin whale observations were distributed throughout the site with densities of 0.01-0.47/100km². Sightings occurred during the months of June to November with peak counts in September. Low to high densities of long-finned pilot whales (0.01-0.38/100km²) were distributed throughout the site and were observed in all months except for January and April. The proportion of juveniles and calves accounted for 7% of the total number (n=547) of individuals recorded within the site throughout the recording period.

High densities of sperm whales (0.14/100km²) were distributed along the slope edge with observations made in April, May, July and September.

Lower densities of minke whale (0.02/100km²) were distributed throughout the site with higher sightings in June. Lower densities of bottlenose dolphin (1.07/100km²) were distributed throughout the site. Low densities of harbour porpoise (0.03/100km²) were recorded within the site with the majority of sightings located east of the site on the bank (see Annex C). Sightings were recorded in January, February and June.

During 2005-2021 few sightings of humpback whale (n=3), killer whale (n=2), unidentified beaked whale species (*Ziphiidae*) (n=5), Risso's dolphin (n=6), striped dolphin (*Stenella coeruleoalba*) (n=7) and white-beaked dolphin (n=3) were observed. One sighting of Sowerby's beaked whale (*Mesoplodon bidens*) consisted of five individuals.
Common dolphins were abundant throughout the site, the proportion of young accounted for 0.6% of 3,248 individuals recorded within the site during the recording period.

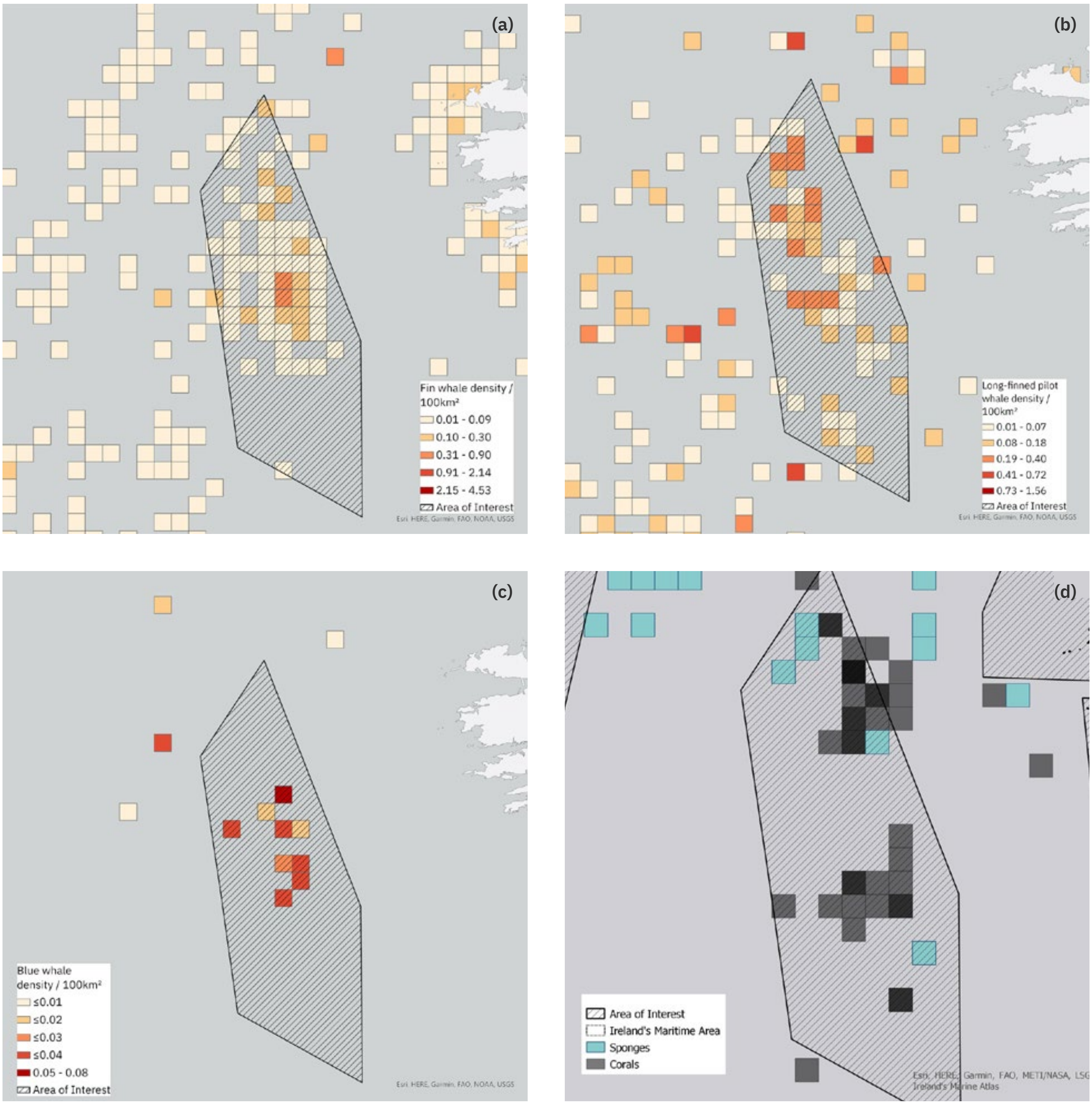


Figure 2.13.2
(a) Densities per 100km² of fin whale (2005-2021); (b) Densities per 100km² of long-finned pilot whale whale (2005-2021); (c) Densities per 100km² of blue whale (2005-2021); (d) Locations of coral and deep-sea sponges within the Gollum Channel System AOI

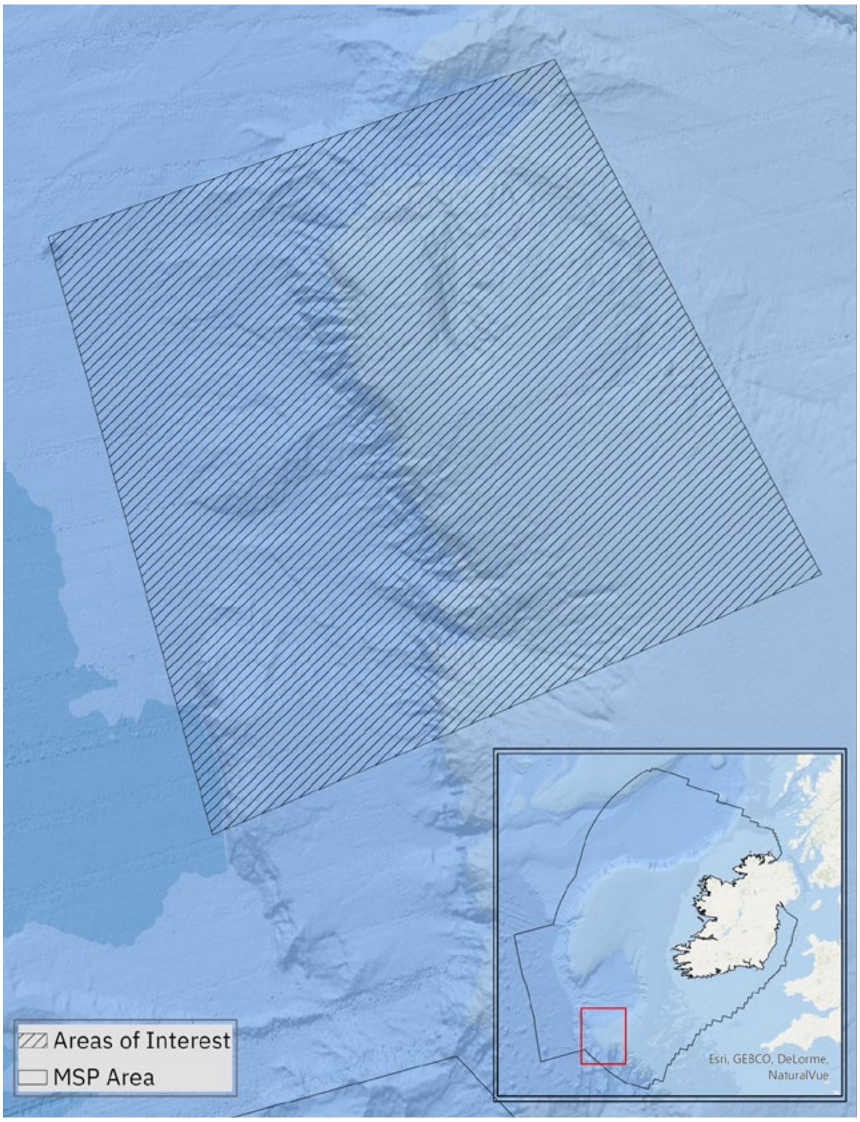
AREA OF INTEREST

Pendragon Basin 2.14

Qualifying Interests

- **Cetaceans** Fin whale, long-finned pilot whale, sperm whale, Cuvier's beaked whale, Sowerby's beaked whale
- **Birds: Breeding** Puffin, kittiwake, great skua, lesser black-backed gull, Manx shearwater, fulmar, gannet, black-headed gull, storm-petrel
- **Birds: Frequent non-breeding** Cory's shearwater
- **Birds: Infrequent non-breeding** great shearwater, sooty shearwater

Spatial Extent
7,774km² **1.59%**
of Maritime Area



N	Pendragon Basin / **Data Sources** Fair Seas, NPWS	**Map Date** 08/04/2022 Projected Coordinate Systems: ETRS 1989 LAEA	7774km² 1.59%	0 5 10 20 km Scale: 1:640,000

Figure 2.14.1: Pendragon Basin Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.14.1: Main broad-scale seabed habitat types covered within Pendragon Basin AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep-sea bed	100%

Primary Reasons for Site Importance

Ten months of acoustic data from the ObSERVE Programme has indicated a seasonal presence of deeper diving species in this area, such as Cuvier's beaked whale (*Ziphius cavirostris*), which was detected for 80% of the monitoring period, as well as detecting species such as the blue whale, whose infrasonic calls can be detected up to 200km away from the site.

Description of Features

Seabirds
The level of surveying for seabirds here is still relatively low, the lowest of all Areas of Interest identified, with the majority of sightings within the last 10 years resulting from the ObSERVE Aerial Survey (2016). Fulmar and gannet made up the majority of these sightings, with other wide-ranging, abundant species such as shearwaters, skuas and puffins. Petrels were recorded in this area during the 2016 survey, but not identified to species level.

Cetaceans
Lower numbers of cetacean sightings were recorded in this site compared to other sites, which may be attributable to lower visual survey effort during the recording period (2005-2021). Low densities of fin whales (0.1/100km^2) were recorded within the site. Observations for this species were made from May to November with peak observations in May. There were moderate densities of long-finned pilot whales (0.34/100km^2) compared to other sites. Observations of this species were made from April to September. Low densities of sperm whales (0.02/100km^2) were recorded with observations made during May, September and October (see Annex). There were a low number of sightings of bottlenose dolphin (n=5), minke whale (n=6), unidentified beaked whale species (n=2) and common dolphins (n=15).

During the ObSERVE Acoustic Project Berrow et al. (2018) acoustically detected fin whales for 68% of the 231 days monitored within this site. Long-finned pilot whales were detected for 30%; sperm whale for 90%; Cuvier's beaked whale for 80%; Sowerby's beaked whale for 19%; delphinid clicks for 96%; blue whale for 1.7%; and humpback whale for 1.2%; giving an indication of cetacean activity within the site.

Seabed habitats
This area is exclusively classified as 'Deep-sea bed' under the EUNIS habitat classifications.

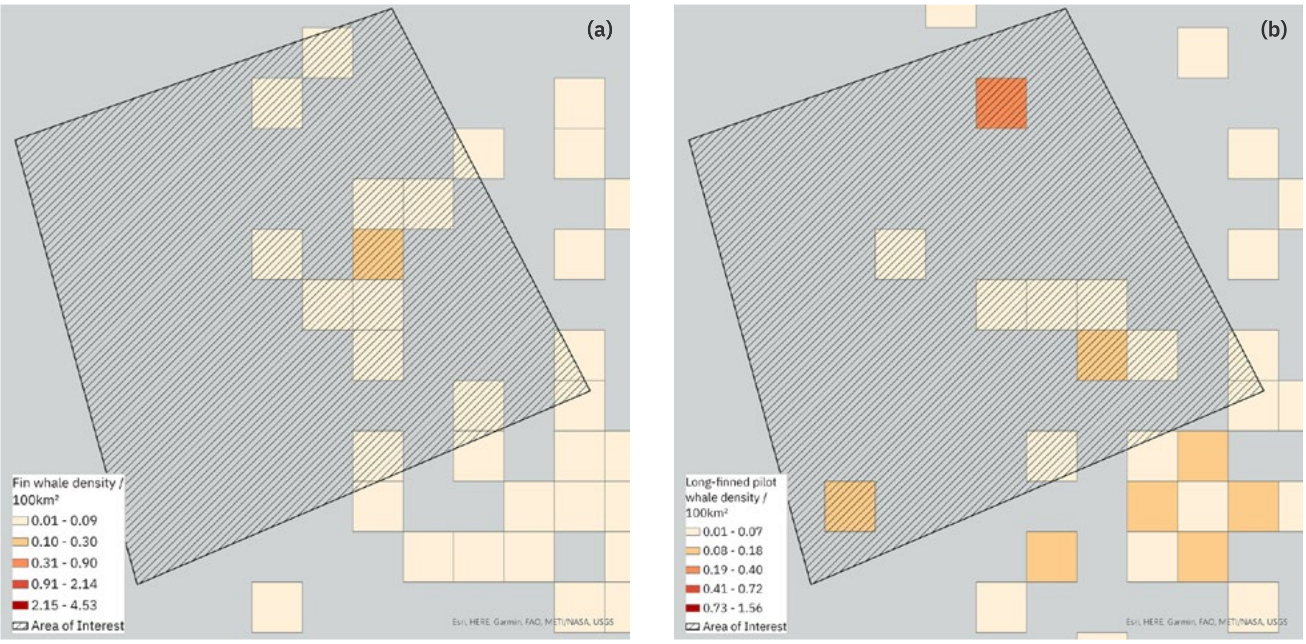


Figure 2.14.2
(a) Densities per 100km^2 of fin whale (2005-2021);
(b) Densities per 100km^2 of long-finned pilot whale (2005-2021) within the Pendragon Basin AOI

"During the ObSERVE Acoustic Project Berrow et al. (2018) acoustically detected fin whales for 68% of the 231 days monitored within this site."

AREA OF INTEREST

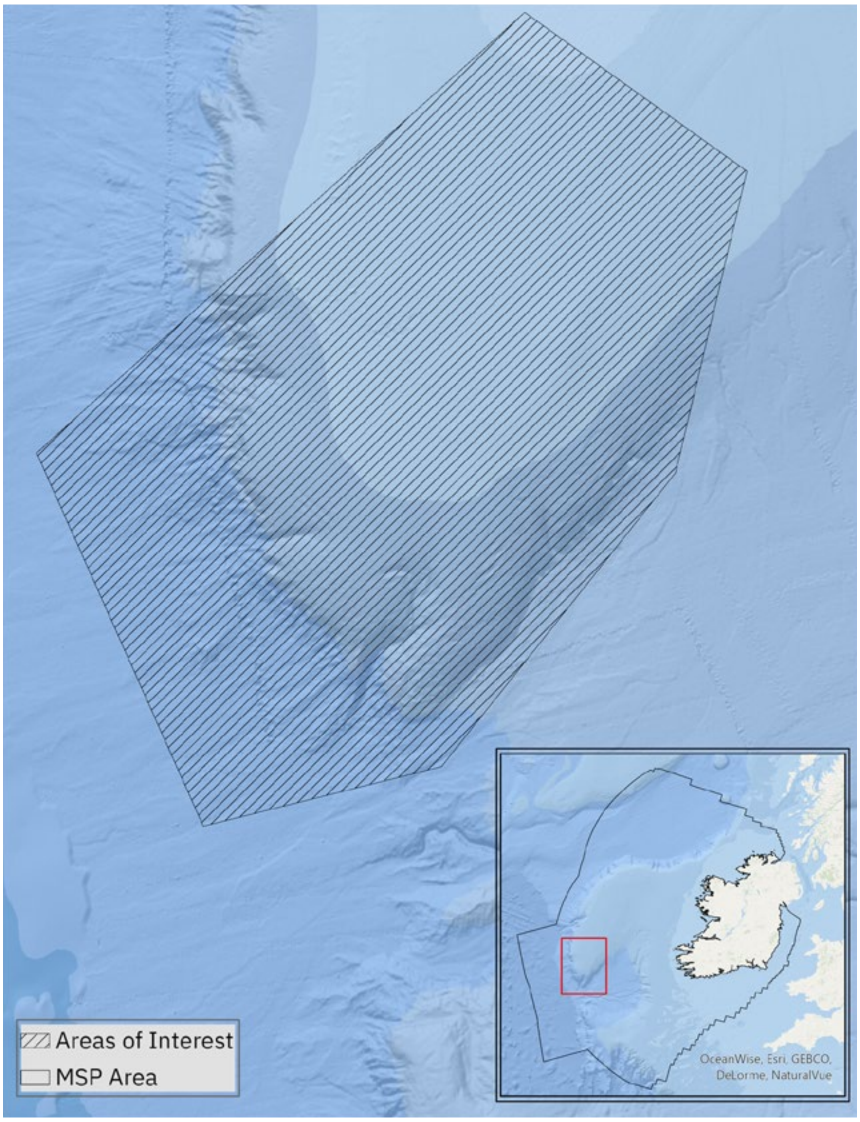
Bríd Basin and Porcupine Bank

2.15

Qualifying Interests

- **Seabed features of conservation importance** Seapen and burrowing megafauna communities, corals, deep-sea sponges
- **Cetaceans** Cuvier's beaked whale, Sowerby's beaked whale, long-finned pilot whale and sperm whale
- **Elasmobranchs** Kitefin shark (*Dalatias licha*), birdbeak dogfish (*Deania calcea*), Portuguese dogfish (*Centroscymnus coelolepis*), Longnose velvet dogfish (*Centroselachus crepidater*)
- **Commercially Exploited Species** Blue whiting
- **Birds: Breeding** puffin, kittiwake, herring gull, European storm-petrel, Leach's storm-petrel, great skua, Manx shearwater, fulmar, gannet
- **Birds: Infrequent non-breeding** Cory's shearwater, great shearwater, sooty shearwater

Spatial Extent
17,522km² **3.58%**
of Maritime Area



N	Bríd Basin and Porcupine Bank Data Sources Fair Seas, NPWS	Map Date 08/04/2022 Projected Coordinate Systems: ETRS 1989 LAEA	17522km² 3.58%	0 5 10 20 30 40 km Scale: 1:1,000,000

Figure 2.15.1: Bríd Basin and Porcupine Bank Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.15.1: Main broad-scale seabed habitat types covered within Bríd Basin and Porcupine Bank AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep-sea bed	91%
Deep-sea mud	9%
Carbonate Mounds	<1%

Sperm Whales

"Thirty encounters of common dolphins were recorded within the site consisting of large groups of up to 100 animals."

Primary Reasons for Site Importance

A variety of seabed species occur in this area, with Nephrops and seapens found on the shelf sediments and diverse coral and sponges found on the continental slope. During the ObSERVE Acoustic Project some of the highest levels of cetacean activity was recorded at an acoustic mooring positioned within this site. Seasonal variation in acoustic detections varied across species. Cuvier's beaked whale was detected during spring, summer and autumn months for 98% of the monitoring period, while Sowerby's was detected for 38% of the monitoring period.

Description of Features

Habitats
This AOI covers a wide depth range. The northern half of the site covers relatively shallow (<500m) continental shelf mud, while the southern half includes the continental slope as it drops down to a depth of 4,000m. The mud on the continental shelf is colonised by seapens and *Nephrops norvegicus*. Three different species of seapen are recorded in the Area of Interest with a fourth species recorded to the north of the AOI boundary on the Nephrops grounds (Aristegui et al., 2020). 'Seapens and burrowing megafauna communities' are an OSPAR listed threatened and/or declining habitat. The muddy sediment is likely to have a high carbon sequestration potential (Parker et al., 2016).

The area was surveyed by the deep-water habitat survey SeaRover in 2018/2019. The survey studied 154 locations of the Irish continental slope between 2017 and 2019 using remotely operated vehicles. The study found large purple sea cucumbers and urchins, as well as corals and a wide variety of sponges along the slopes of the Porcupine Bank (O'Sullivan et al., 2018; O'Sullivan et al., 2019). The EUNIS seabed habitat type is primarily deep-sea bed with carbonate mounds.

Elasmobranchs
Analysis of anglerfish and megrim survey hauls indicate high densities of birdbeak dogfish, kitefin shark and Portuguese dogfish in this area, with moderate elasmobranch species richness overall. The area is the second most important area in the Irish Maritime Area for Portuguese dogfish according to numbers caught in fisheries surveys (highest number of individuals caught was 27). Portuguese dogfish have declined by 83% from 1993 to 2007 due to fisheries bycatch (Clarke et al., 2016). Protecting large parts of the continental shelf edge is crucial for several deep-water shark species to minimise mortality caused by deep-water fisheries. Birdbeak dogfish is usually recorded in very low numbers, but this Area of Interest has two of the highest abundances of this species within survey hauls with around eight individuals caught per haul (see Annex B3).

Commercially exploited species
The Porcupine Bank is an area of importance for blue whiting as a nursery and spawning ground.

Seabirds
As another area not as well surveyed for seabirds until recent years when larger more specialised research vessels became available, observations of seabirds in this area have resulted mainly from the ObSERVE surveys from 2015 and 2016 and independent scientific surveys conducted on board the RV Celtic Explorer. The findings of these surveys show this area to be potentially beneficial to procellarid (tubenose) species. Three BoCCI red-listed species are also represented within this area of interest (kittiwake, Leach's storm-petrel, and puffin).

Cetaceans
Lower numbers of cetacean sightings were recorded at this site compared to other sites, which may be attributable to lower visual survey effort during the recording period (2005-2021). During the monitoring period the highest density of Cuvier's beaked whale (0.1/100km^2) within Ireland's EEZ was recorded within this site (see Annex C). This species was detected acoustically for 98% of the 230 monitoring days of the ObSERVE Acoustic Project (Berrow et al., 2018). A maximum detection range of 14km for Cuvier's beaked whale from the acoustic monitoring systems indicates a localised distribution within this site. Sowerby's beaked whales were also detected acoustically for 38% of the monitoring period in all seasons, though detections were consistently lower here compared to monitoring stations further north (Berrow et al., 2018).

There were smaller densities of long-finned pilot whales (0.15/100km^2) compared to other sites. The proportion of young accounted for 8% of 71 individuals recorded within the site between 2005-2021. This species might benefit from protecting additional coverage of the Porcupine Basin. Lower densities (1.14/100km^2) of bottlenose dolphin were recorded compared to other sites, sightings were distributed across the site with peak counts in November. The proportion of young accounted for 1% of 362 individuals recorded within the site.

There were a small number of unidentified beaked whale species (n= 6), white-beaked dolphin (n=4), striped dolphin (n=3) sperm whale (n=2) and one sighting of northern bottlenose whale (*Hyperoodon ampullatus*) and beluga whale (*Delphinapterus leucas*) observed within the site. Smaller numbers of fin whales (n=14) were recorded within the site compared to the adjacent Porcupine Basin and Gollum System Channel. Thirty encounters of common dolphins were recorded within the site consisting of large groups of up to 100 animals. The proportion of young accounted for 13% of 350 individuals.

During the ObSERVE Acoustic Project Berrow et al. (2018) acoustically detected fin whales for 56% out of the 230 days monitored within this site. Long-finned pilot whales were detected for 47%; sperm whales for 86%; delphinid clicks for 95%; blue whales for 3%; and humpback whales for 3%.

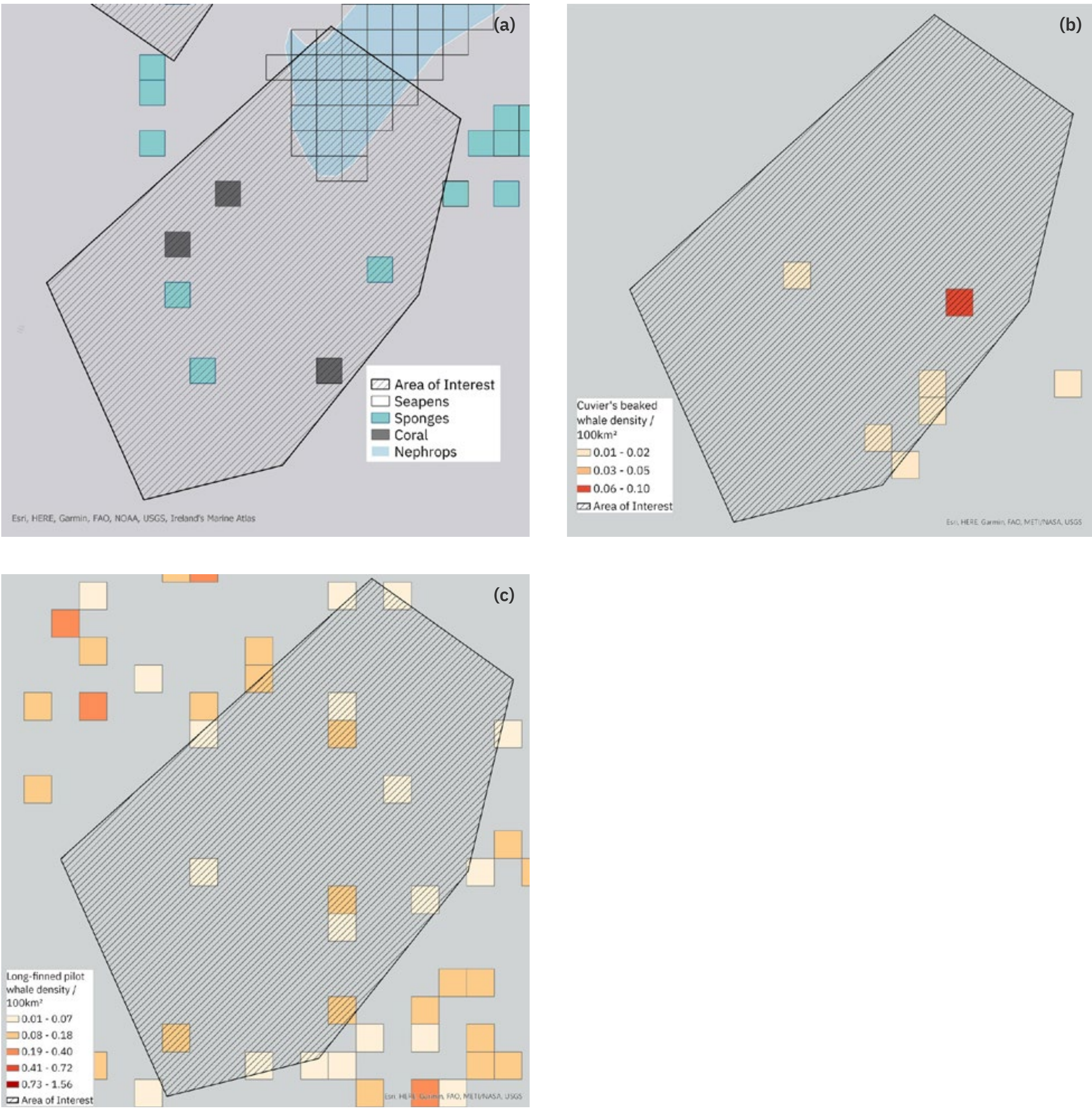


Figure 2.15.2
(a) Locations of seapen and burrowing megafauna communities, corals and deep-sea sponges; (b) Densities per 100km² of Cuvier's beaked whale (2005-2021); (c) Densities per 100km² of long-finned pilot whale (2005-2021) within the Bríd Basin and Porcupine Bank AOI

AREA OF INTEREST

Porcupine Bank Canyon

2.16

Qualifying Interests

- **Seabed features of conservation importance** Corals
- **Cetaceans** Long-finned pilot whale, sperm whale, Cuvier's beaked whale, Sowerby's beaked whale
- **Birds: Breeding** Puffin, kittiwake, European storm-petrel, great skua, Manx shearwater, fulmar, gannet
- **Birds: Frequent non-breeding** Arctic skua

Spatial Extent
4,777km² **0.98%**
of Maritime Area

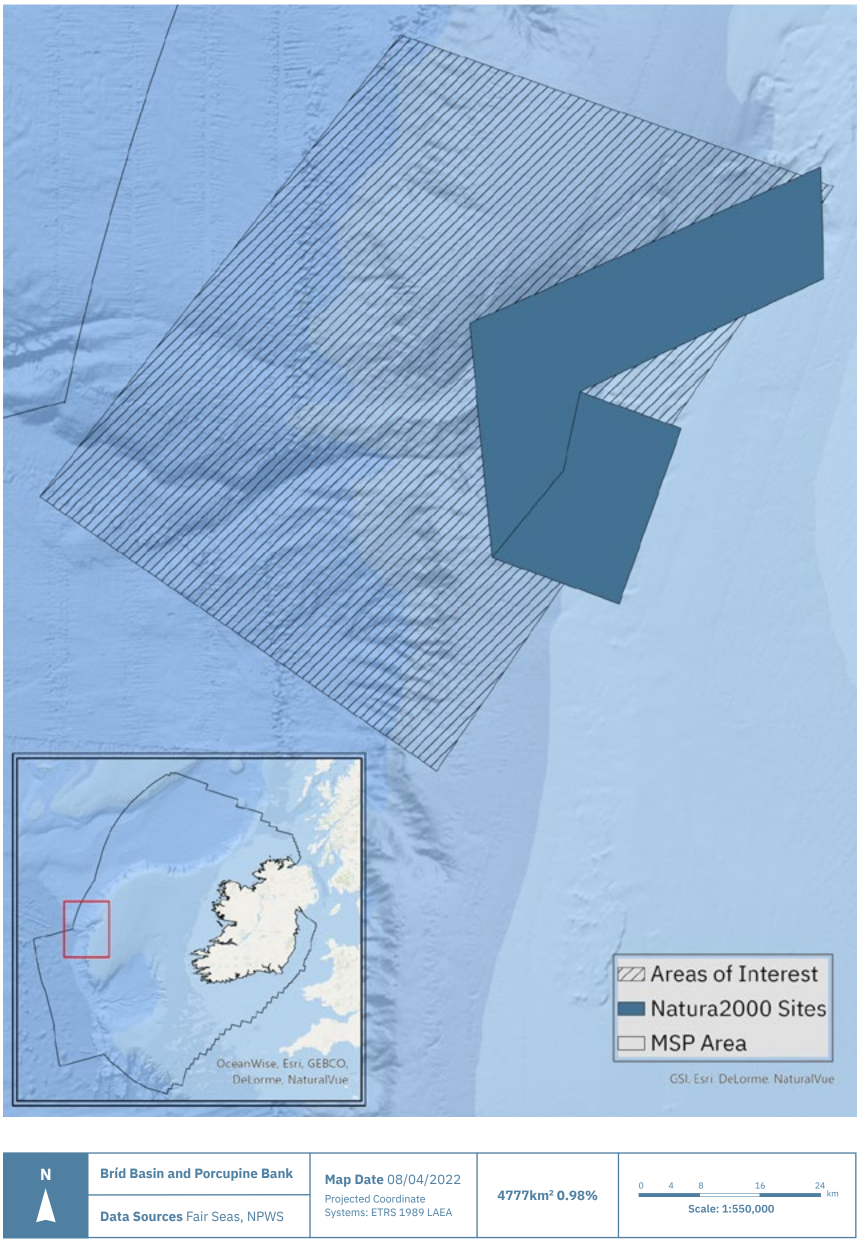


Figure 2.16.1: Porcupine Bank Canyon Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.16.1: Main broad-scale seabed habitat types covered within Porcupine Bank Canyon AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep-sea bed	99%
Carbonate Mounds	1%

Atlantic puffin

"Ocean currents funnelled through canyon systems enhance primary productivity and drive sediment transport toward deep sea environments"

Primary Reasons for Site Importance

This Area of Interest is an expansion to the existing Porcupine Bank Canyon SACs which are designated for reef habitat. It is an important area for cetaceans, particularly for deep diving species identified by the ObSERVE Programme (Berrow et al., 2018), where seasonal variation in acoustic detections was observed. There were smaller densities of long-finned pilot whales and bottlenose dolphins compared to other sites, however a high proportion of juveniles and calves were recorded within this site.

Description of Features

Seabirds
This area has been far less studied than other regions of Ireland's Maritime Area. Regardless of this, seabirds with a wide foraging range and distribution have been recorded using this area, such as kittiwake, gannet, Manx shearwater, puffin and European storm-petrel, all species with significant presence in Ireland for breeding season. Therefore, these offshore areas warrant protection and further surveying and monitoring to establish the level of abundance and persistence of at-risk species in these areas.

Habitat
Submarine canyons are important oceanic features that qualify for protection in their own right. Ocean currents funnelled through canyon systems enhance primary productivity and drive sediment transport toward deep sea environments, while shelf break areas (between deep water and shallower water continental shelf) create upwellings that drive oceanic productivity in the water column (Fernandez-Arcaya et al., 2017). This site is an extension to the existing Porcupine Bank Canyon and South-West Porcupine Bank SACs. The existing SACs are designated for reef habitat. The SeaRover project surveyed this area in 2018 (O'Sullivan et al., 2018). SeaRover spatial data indicates that a variety of corals and sponges occur along the slope of the Porcupine Bank outside of the existing SAC. An expansion to this SAC is therefore recommended. The EUNIS seabed habitat type is primarily deep-sea bed with carbonate mounds located on the eastern edge of this Area of Interest.

Cetaceans
High densities of long-finned pilot whales (0.61/100km²) (see Annex C) were recorded in this site with peak counts in July. The proportion of young accounted for 11% of 199 individuals. Long-finned pilot whale tonal calls were detected acoustically during spring, summer and autumn within this site during the ObSERVE Acoustic Project (Berrow et al., 2018).

A small number of sightings of Cuvier's beaked whale (n=3) were recorded in November and this species was detected using acoustic devices during the spring, summer and autumn within the site (Berrow et al., 2018). One sighting of Sowerby's beaked whale was also made within the site, and it was detected during all seasons within this site (Berrow et al., 2018).

There were small densities of bottlenose dolphins (0.26/100km²). The proportion of young accounted for 13% of 98 individuals recorded within this site.

Moderate densities of sperm whales (0.05/100km²) were recorded during the months of March, July, October and November with peak sightings in March. This species was detected during the spring, summer and autumn months on static and towed passive acoustic surveys (Berrow et al., 2018). Gordon et al. (2021) estimates densities at 4.6 individuals per 1,000km² (0.21 CV, 3.0-6.9 CI) of a 31,346km² area, which encompassed this site.

A small number of sightings were made of fin whales (n=4) however, they were detected acoustically during spring, summer and autumn months (Berrow et al., 2018). Small numbers of white-beaked (n=2), common (n=18) and striped dolphin (n=2) and unidentified beaked whale species (n=3) were also observed. A group of killer whales were observed within this site during the 2007 CODA survey (Hammond et al., 2009).

During the ObSERVE Acoustic Project Berrow et al. (2018) detected fin whales for 99% out of the 210 days monitored within this site. Long-finned pilot whales were detected for 50%; sperm whales for 87%; Sowerby's beaked whale for 54%; Cuvier's beaked whale for 98%; Northern bottlenose whale for 0.9%; delphinid clicks for 97%; and blue whales for 2.8%. Humpback whales and sei whales were also detected.

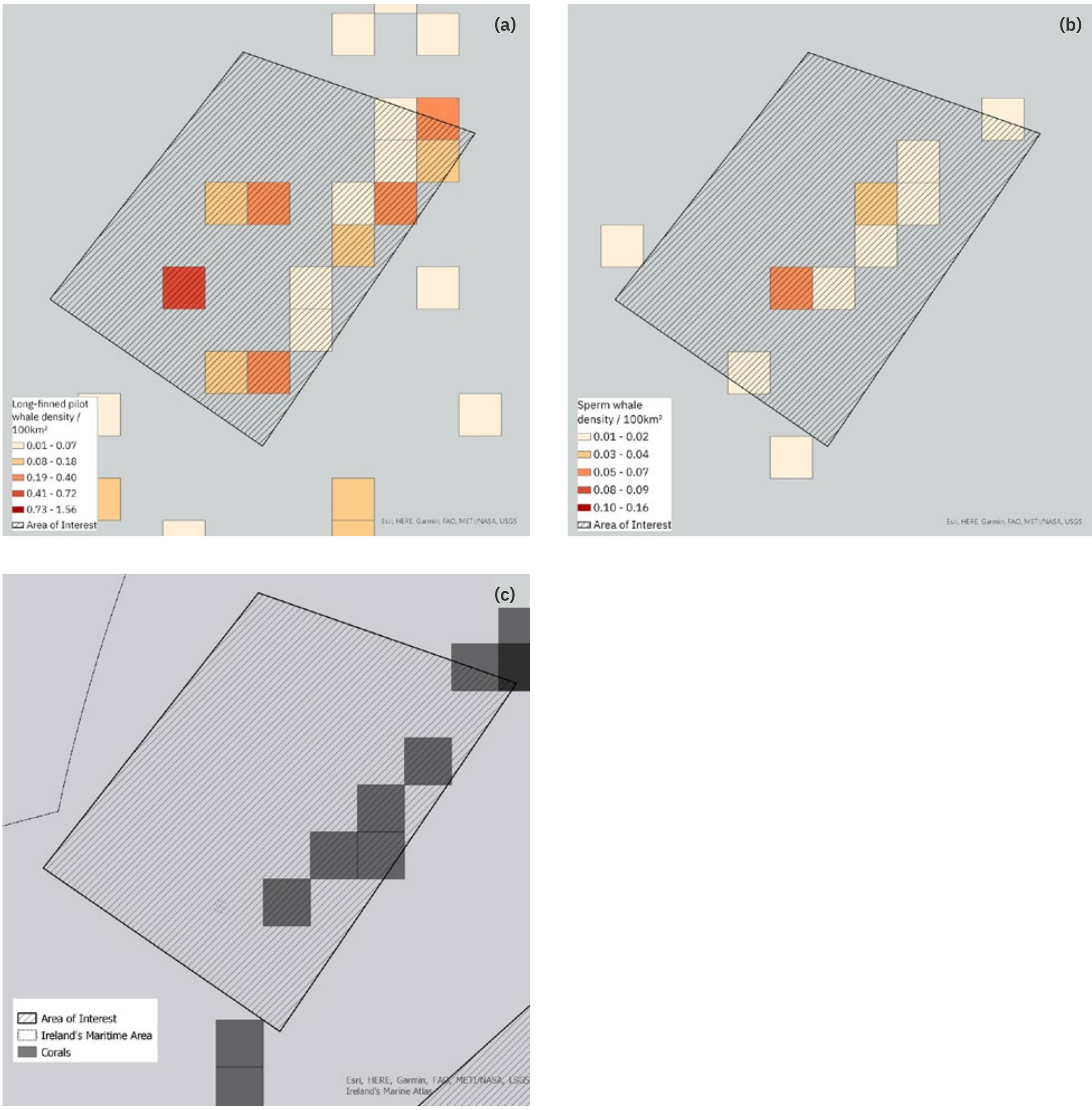


Figure 2.16.2
(a) Densities per 100km^2 of long-finned pilot whale (2005-2021); (b) Densities per 100km^2 of sperm whale (2005-2021); (c) Locations of corals within the Porcupine Bank Canyon AOI

AREA OF INTEREST

Northwest Continental Shelf

2.17

Qualifying Interests

- **Seabed features of conservation importance** Corals, deep-sea sponges, seapens and burrowing megafauna communities
- **Cetaceans** Atlantic white-sided dolphin, long-finned pilot whale, beaked whale species, Cuvier's beaked whale, Sowerby's beaked whale, bottlenose dolphin, fin whale, sperm whale
- **Elasmobranchs** Leafscale gulper shark (*Centrophorus squamosus*), Portuguese dogfish (*Centroscymnus coelolepis*), birdbeak dogfish (*Deania calcea*), flapper skate (*Dipturus intermedius*), thornback ray (*Raja clavata*), spurdog (*Squalus acanthias*), Longnose velvet dogfish (*Centroselachus crepidater*), Cuckoo ray (*Leucoraja naevus*)
- **Commercially Exploited Species** Blue whiting nursery and spawning grounds
- **Birds: Breeding** Arctic tern, common tern, puffin, black-headed gull, kittiwake, herring gull, great black-backed gull, lesser black-backed gull, European storm-petrel, Leach's storm-petrel, great skua, Manx shearwater, fulmar, gannet, razorbill, guillemot
- **Birds: Frequent non-breeding** Arctic skua, Cory's shearwater, great shearwater, long-tailed skua, pomarine skua, sooty shearwater
- **Birds: Infrequent non-breeding** Iceland gull, Sabine's gull, Wilson's storm-petrel

Spatial Extent
53,854km² **11.02%**
of Maritime Area

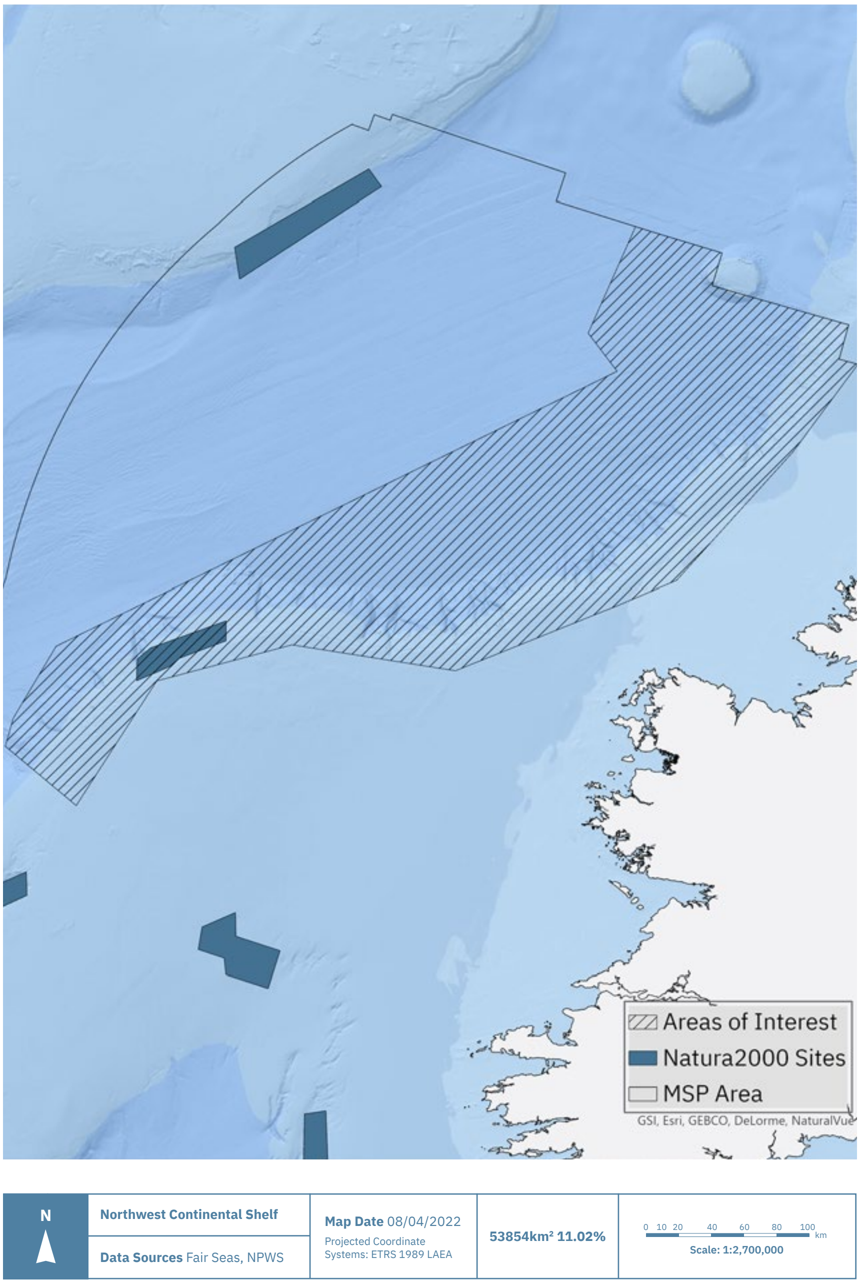
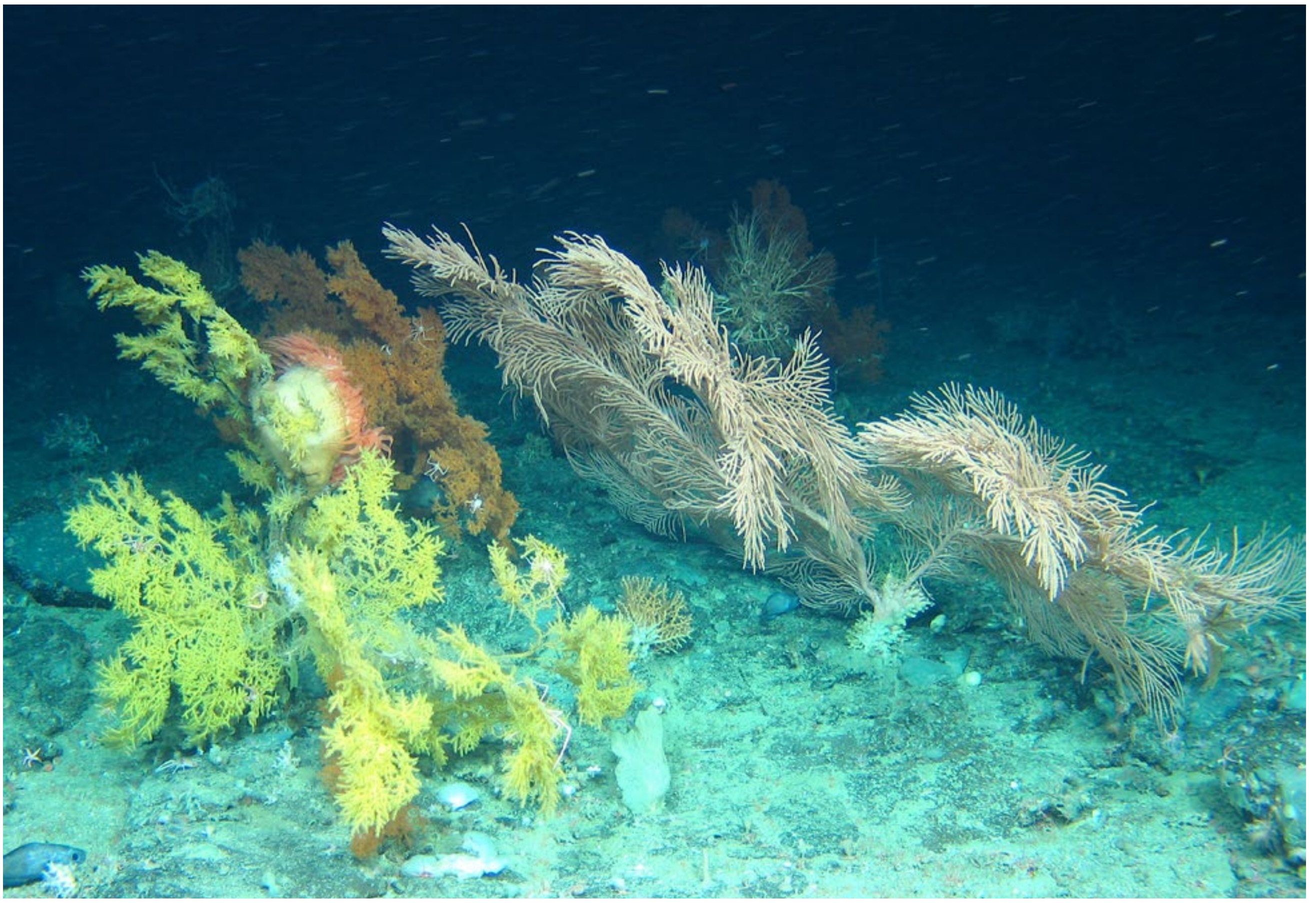


Figure 2.17.1: North-West Continental Shelf Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.17.1: Main broad-scale seabed habitat types covered within North-west Continental Shelf AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
Deep-sea mud	95%
Deep circalittoral coarse sediment	3%
Deep circalittoral mixed sediments	1%
Seamounts, knolls and banks	1%



Coral Garden

Primary reasons for site importance

This area is important due to the continental shelf edge which has high diversity of corals (O'Sullivan et al., 2017) and deep-sea elasmobranchs. The northern part of this Area of Interest, which borders UK waters, includes Ireland's only seamount. The rare EUNIS seabed habitat type 'deep-sea rock', which are carbonate mounds, also occurs in this area. The SeaRover survey observed a number of elasmobranch egg cases among sponge and coral fields (O'Sullivan, 2017). This site is an important Area of Interest for cetaceans as it covers a range of habitats such as basins, slopes, canyons and the abyssal plain. Fourteen different species were recorded within this site. The highest densities of Atlantic white-sided dolphins in Ireland's EEZ are recorded within this site, predominantly on the shelf edge, with 50% of sightings, accounting for 28% of the overall total number of individuals (n=800), however the vast scale of this AOI should be considered.

Description of Features

Habitats
This Area of Interest follows the seabed as it descends from the top of the Irish continental shelf steeply down into the deep Rockall Trough. The high depth variation ensures that a wide range of biodiversity is covered within the site.

The coral reefs along this part of the Irish continental slope were surveyed by the SeaRover project in 2017. Several deep-water coral reefs were recorded along the many submarine canyons, as well as a variety of seapens, anenomes and sponges (see Annex B)(O'Sullivan et al., 2017). The SeaRover survey reports describe the presence of juvenile orange roughy in some locations, as well as elasmobranch egg cases, juvenile elasmobranchs and eel (O'Sullivan et al., 2017) as well as a high number of black coral species, hard bottom anemone aggregations and much more (Picton et al., 2021). This indicates that the coral reefs in the area are important nursery habitats for several long-lived, rare, or threatened species. Several trawl marks were observed in the northern slopes in this site and discarded fishing gear was evident throughout (Picton et al., 2021). The northern border to Scotland's waters features Ireland's only seamount, the Hebrides Terrace Seamount. The Scottish side of this seamount is a designated MPA called the Barra Fan and Hebrides Terrace Seamount Marine Protected Area. In addition to the seamount and its associated communities, the Scottish MPA is designated for the feature 'deep-sea muds', 'orange roughy', 'sea-pen and burrowing megafauna communities', 'offshore sands and gravels' and 'continental slope'.

The dominant EUNIS seabed habitat type is deep-sea mud, however carbonate mounds and deep-sea rock also occur in small patches. An SAC already exists in the southern part of this area, the North-West Porcupine Bank SAC, which is designated for reef habitat. The SeaRover survey metadata highlight presence of trawl marks, including within the existing SAC. A high proportion of SeaRover survey dives observed discarded fishing gear within this Area of Interest (O'Sullivan et al., 2017). Coral reefs must be better protected from physical disturbance if they are to recover from historical trawling activity.

Elasmobranchs
The continental slope and shelf edge areas along the slope in this AOI have very high elasmobranch species richness with up to 20 species recorded in one area, which is the highest number of elasmobranch species recorded overall. Deepwater shark species thrive in this habitat and fisheries surveys have shown high densities of threatened species including leafscale gulper shark, cuckoo ray, Portuguese dogfish, birdbeak dogfish, flapper skate, thornback ray, and spurdog.

> "This site is an important Area of Interest for cetaceans as it covers a range of habitats such as basins, slopes, canyons and the abyssal plain."

Birdbeak dogfish are especially abundant along the continental slope in this area with one survey haul catching as many as 450 individuals (see Annex F). As described in the Habitats section above, the SeaRover project recorded elasmobranch egg cases in this area (O'Sullivan et al., 2017), which indicates that it is used as a nursery ground.

Cetaceans

In 2013 the Western shelf edge from Donegal to the Whittard Canyons, excluding the Porcupine Seabight, was designated as a protected area for beaked whales to mitigate offshore oil and gas exploration (RPS, 2014) but was discontinued after 2016. High species richness exists within this site, with varied densities for each species.

The highest density of Atlantic white-sided dolphins (2.5/100km^2) within Ireland's EEZ was recorded within this site. This species is distributed throughout the site and recorded during May, June, July and November, with peak sightings in July. Group sizes ranged from 1-250 individuals.

Long-finned pilot whales are distributed throughout the site with the highest densities recorded on the shelf edge (1.56/100km^2). Observations were made during all months with the exception of October, with peak sightings in November. The proportion of young accounted for 3% of 1,648 individuals. Tonal calls from long-finned pilot whales were detected during the ObSERVE Acoustic Project in all seasons, but were highest over the Erris Basin, particularly during summer and autumn. Towed passive acoustic monitoring detected long-finned pilot whales over the Erris Basin in all seasons (Berrow et al., 2018).

Relatively high densities of bottlenose dolphin occur and the species is distributed throughout the site with highest densities along the shelf edge (2/100km^2). The species was predominantly recorded during the months of March to September with peak sightings in November. The highest density of killer whales (0.75/100km^2) throughout the EEZ was recorded east of this site in the Erris Basin, however small numbers were recorded within this site (n=3) (see Annex C).

Small numbers of beaked whale species were recorded, with low densities of Cuvier's (0.05/100km^2) and Sowerby's (0.03/100km^2) beaked whales which were recorded on the continental shelf as well as on the abyssal plain. One of two sightings of Sowerby's beaked whale with attendant calves were recorded in this site in a water depth of 2,588m (Berrow et al., 2018a). Berrow et al. (2018) reported Sowerby's beaked whale clicks during all seasons, at all listening stations within the site, with the highest rate recorded at the most northerly stations. Cuvier's beaked whales were detected at all listening stations in all seasons, with the exception of the most northern station in spring and autumn.

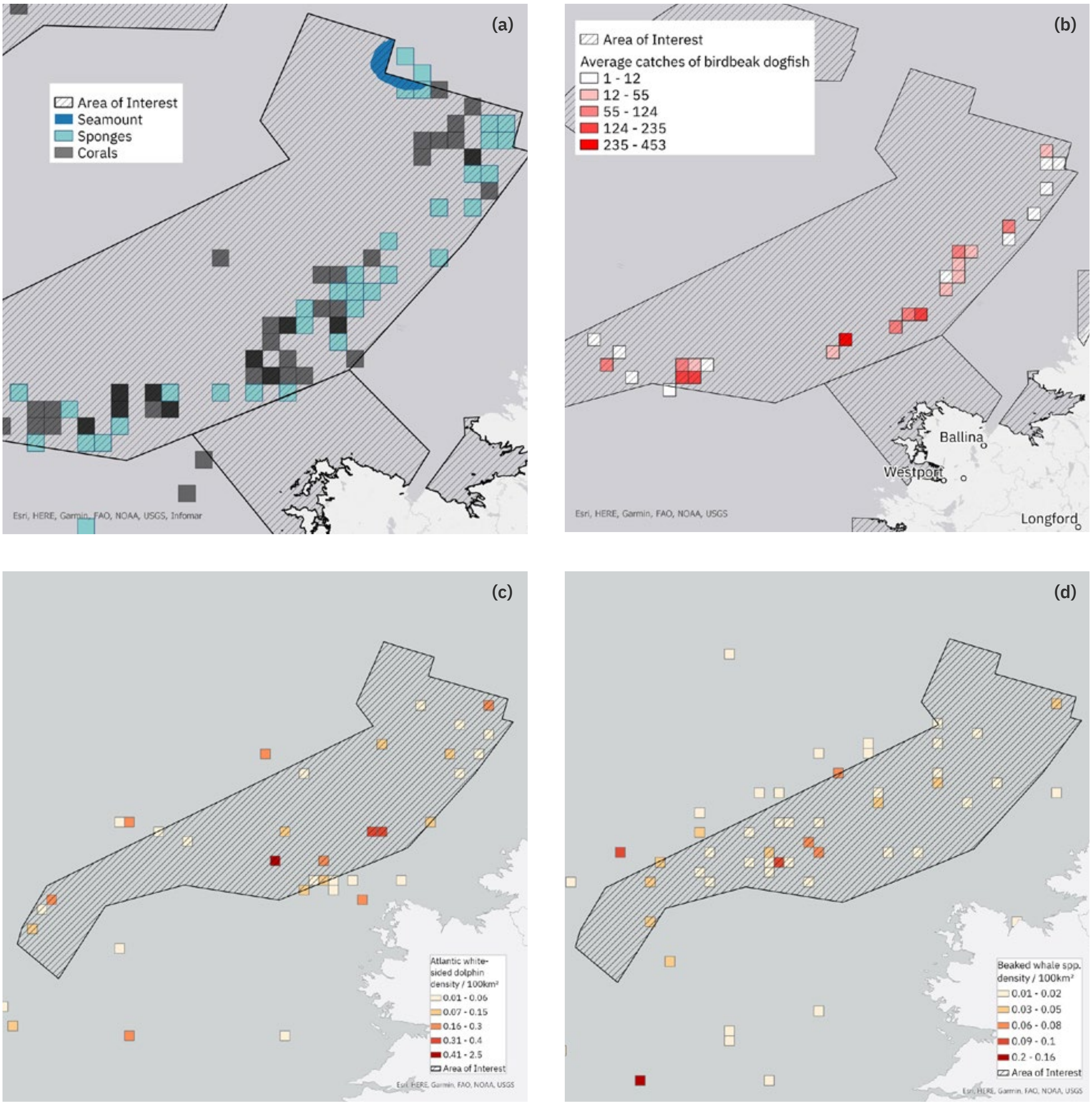
Fin whales are distributed throughout the site with the highest densities recorded on the shelf (0.12/100km^2). Higher numbers are recorded during summer months. Berrow et al. (2018) acoustically detected this species at all monitoring stations during spring, summer and autumn. Rogan et al. (2018) found the continental slope and nearby deep waters to be an important area for this species, possibly for feeding and/or migration. Ten sightings within this site were recorded as either fin, blue or sei whale along the shelf edge.

The highest densities of sperm whales were recorded in the Rockall Trough (0.09/100km^2) however, sightings are distributed throughout the site with concentrations on the shelf. Observations were recorded in most months with the exception of October, November, December and January. Berrow et al. (2018) reported that the relative abundance of sperm whales clustered over the Colm, Fursa and Macdara basins during spring, but were more evenly spread out during the summer and autumn. Listening stations positioned within the site consistently recorded the highest detection rates, which generally increased from spring to autumn, and were detected in all seasons. Gordon et al. (2020) estimated densities of this species as 3.8 individuals per 1,000km^2 within a 52,676km^2 area, which encompassed the majority of this site.

Observations between 2005-2021 also recorded harbour porpoise (n=4), white-beaked dolphin (n=4), minke whale (n=12), northern bottlenose whale (n=3), false killer whale (*Pseudorca crassidens*) (n=1) and striped dolphins (n=2). Common dolphins were abundant throughout the site. The proportion of young accounted for 2% of 1,057 individuals.

Seabirds

Twenty-five different species of seabirds are represented within this area, based on observed sightings over the past four decades. The edge of the continental shelf is much closer to mainland Ireland here than in any other part of the country, and this is important for bird colonies located in counties Donegal, Sligo and Mayo. This area is somewhat well surveyed up to the shelf edge by fisheries-based surveys such as the Western European Shelf Pelagic Acoustic Survey and the Blue Whiting Acoustic Survey.



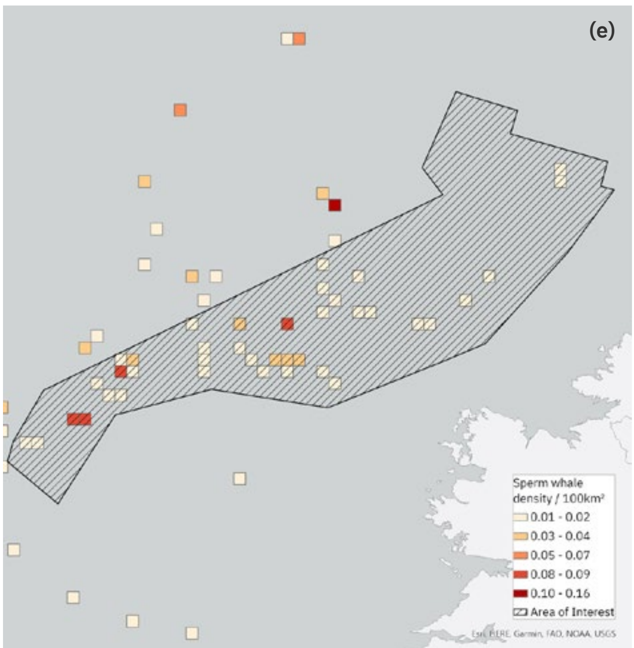


Figure 2.17.2
(a) Locations of seamount, coral reefs and deep-sea sponge aggregations; (b) Average catches of birdbeak dogfish; (c) Densities per 100km² of Atlantic white-sided dolphin (2005-2021); (d) Densities per 100km² of beaked whale species (2005-2021); (e) densities per 100km² of sperm whale (2005-2021) within the North-West Continental Shelf AOI

AREA OF INTEREST

Southeast Rockall Bank

2.18

Qualifying Interests

- **Seabed features of conservation importance** Corals, deep-sea sponges, seapens
- **Cetaceans** Sperm whale, long-finned pilot whale
- **Elasmobranchs** Longnosed skate (*Dipturus oxyrinchus*), shagreen ray (*Leucoraja fullonica*), Portuguese dogfish (*Centroscymnus coelolepis*), leafscale gulper shark (*Centrophorus squamosus*)
- **Birds: Breeding** Arctic tern, puffin, kittiwake, guillemot, herring gull, lesser black-backed gull, European storm-petrel, great skua, Leach's storm-petrel, Manx shearwater, fulmar, gannet
- **Birds: Non-breeding** Arctic skua, long-tailed skua, Balearic shearwater, Cory's shearwater, great shearwater, sooty shearwater, little auk, pomarine skua

Spatial Extent
15,113km² **3.09%**
of Maritime Area

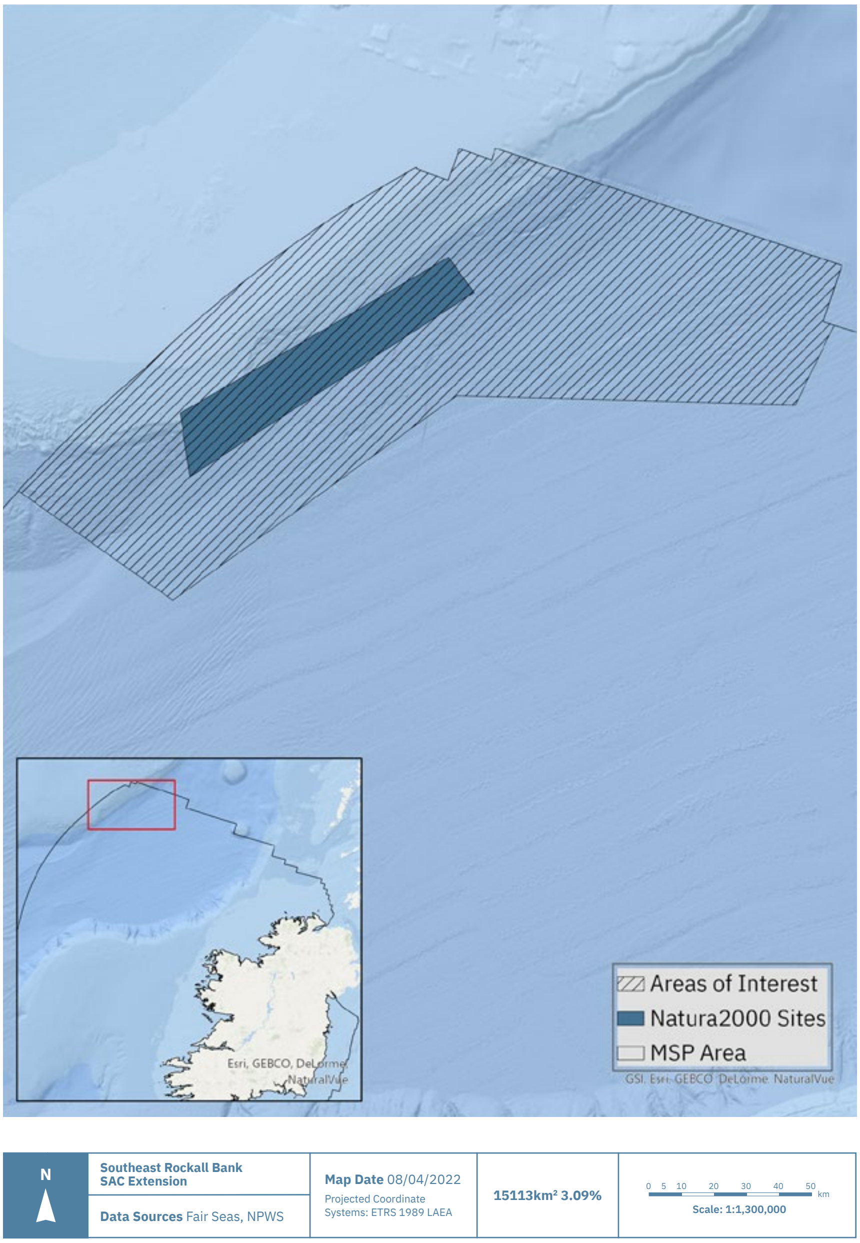


Figure 2.18.1: South-East Rockall Bank Area of Interest. MSP = Marine Spatial Planning Assessment Area, i.e. Ireland's Maritime Area

Table 2.18.1: Main broad-scale seabed habitat types covered within Southeast Rockall Bank AOI

EUNIS Level 3 Habitat Type	Habitat as % of Total AOI Area
A6.5: Deep-sea mud	98%
A6.2: Deep-sea mixed substrata	1%

Adult gannet and chick

Primary Reasons for Site Importance

The Area of Interest is important for cold-water coral reefs. Reduced sightings of cetaceans are recorded at this site, likely due to lack of survey effort. Cetaceans are mentioned within the NPWS site synopsis of this SAC. This is potentially an area of consistently intense use by a wide variety of seabird species and would benefit from increased surveying across all seasons.

Description of Features

Habitats
The eastern slope of the Rockall Bank was surveyed by the SeaRover project in 2018 (O'Sullivan et al., 2018). The SeaRover metadata describes the area in places as 'very diverse' with coral and sponge reefs on mixed substrate (see Annex B). The SeaRover survey report shows the reef-forming coral Lophelia pertusa to be present in shallower waters above -700m, while steeper and deeper slopes were home to Solenosmilia coral (O'Sullivan et al., 2018). However, a high proportion of the biogenic reef was found to be dead, with often less than 25% of living biogenic reef present (O'Sullivan et al., 2018). The AOI is an expansion of the existing South-east Rockall Bank SAC, which is designated for reef habitat. The area across the Scottish border is also designated reef SAC, the 'East Rockall Bank' SAC.

Elasmobranchs
The area is important for deep-sea elasmobranchs. Clarke et. al (2016) state that longnosed skate (conservation status: Vulnerable) is recorded here in low but stable numbers, along with shagreen ray, Portuguese dogfish, and leafscale gulper shark.

Cetaceans
Reduced sightings were recorded at this site, likely due to lack of survey effort. There were small densities of bottlenose dolphin (0.24/100km^2), sperm whale (0.07/100km^2), fin whale (0.02/100km^2) and long-finned pilot whale (0.08/100km$^{2)}$. One sighting of a beaked whale was recorded.

Seabirds
Within this area, 20 different species of seabird were recorded over the full survey period, and all five BoCCI red-listed species (Balearic shearwater, kittiwake, Leach's storm-petrel, razorbill and puffin). This area appears particularly popular with shearwaters, petrels and skuas, along with the wide-ranging species such as gannet and fulmar. As the farthest reaching area of Ireland's EEZ, the number of survey transects through this region are far fewer than those areas closer to land (1995, 2000, 2001, 2005, 2014, 2018), but the data shows strong utilisation by a variety of bird life in this region.

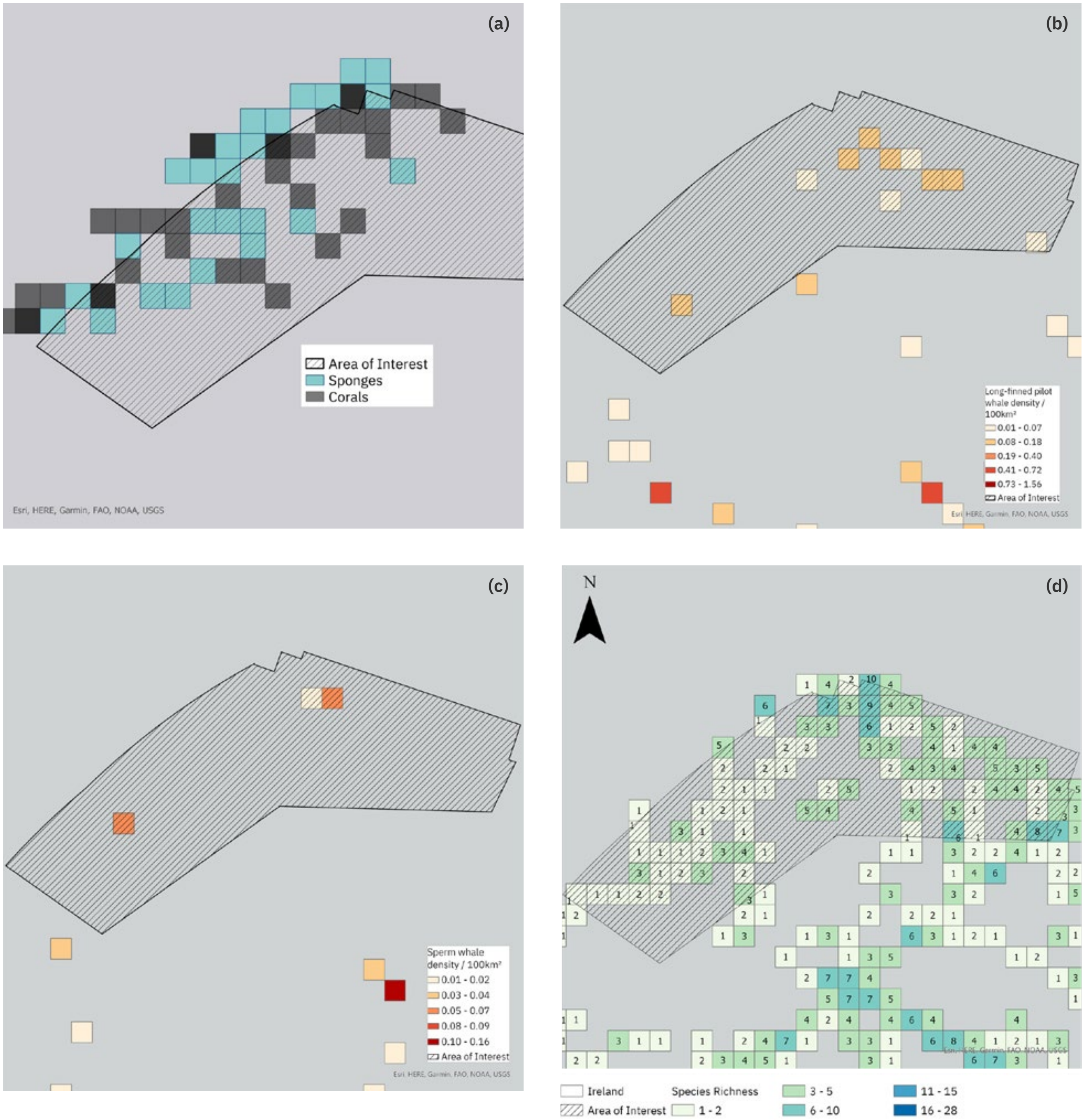


Figure 2.18.2
(a) Location of coral reefs and deep-sea sponge aggregations; (b) Densities per 100km² of long-finned pilot whale (2005-2021); (c) Densities per 100km² of sperm whale (2005-2021) within the South-East Rockall Bank AOI; (d) Species richness of seabird species within the AOI.

Dursey Island,
Co. Cork

3 Examples of Species of Conservation Importance

3.1 Seabirds

Ireland has 24 breeding species of seabird and several other species that do not breed here but spend a portion of their annual migration in Irish waters. Ireland's marine territory plays host to seabirds from every direction including North America, Europe and Africa. Many are highly migratory, widely distributed species such as the black-legged kittiwake, northern fulmar, and Atlantic puffin. Others have smaller ranges largely within Europe, such as the herring gull and shag.

3.1.1 Why seabirds need MPAs

MPAs present an opportunity to protect important marine areas from the adverse effects of human activity, which play a primary role in the decline of seabird health and survival in our marine ecosystems (BirdLife International, 2018). Seabirds, like many other top marine predators, experience a multitude of anthropogenic threats in their environment. Scotland's Nature Agency (NatureScot) identified no fewer than 35 marine pressures resulting from human activities, many of which present a significant risk to seabirds at every life stage, in both acute and chronic scenarios.

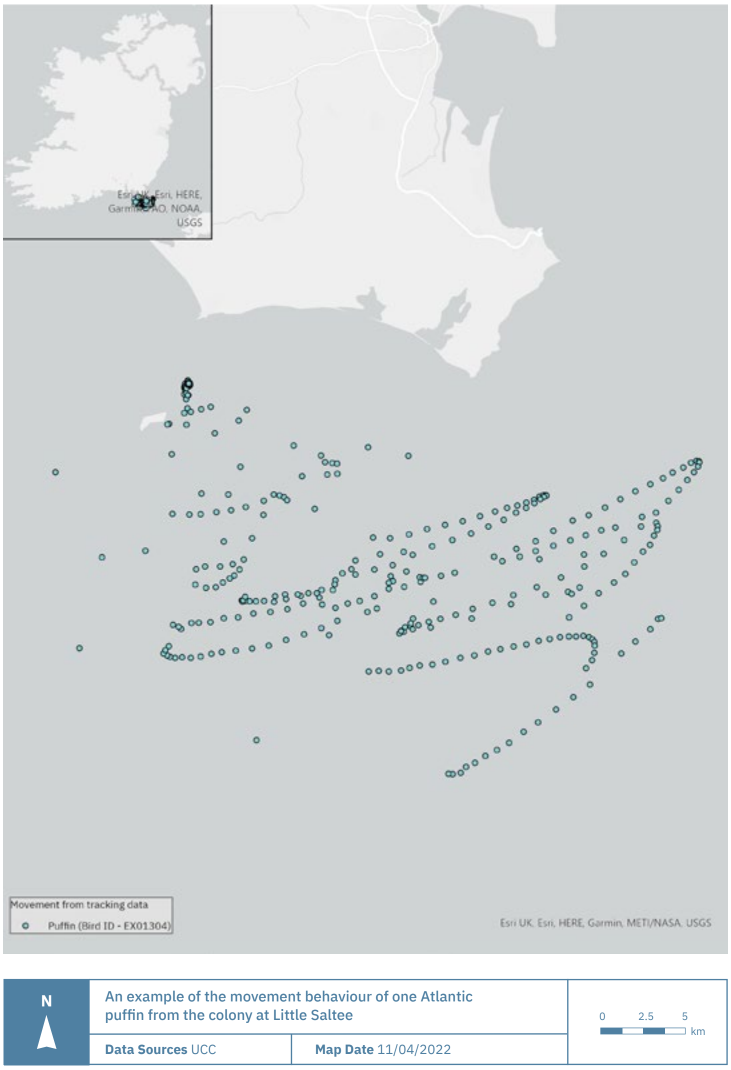
3.1.2 Roseate tern – *Sterna dougallii*

The roseate tern is one of five tern species that breed in Ireland. Every year they journey from West Africa to a select few locations mostly in the Irish Sea. The two main Irish colonies are located on Rockabill, off the coast of Dublin, and Lady's Island Lake in Wexford (Cummins et al., 2019). On its own, the 2020 breeding population of roseate terns on Rockabill represented more than 60% of the total European breeding population, making it by far the most important colony in Europe (Macleod-Nolan, 2021). Roseate terns are drawn to the Irish Sea, an area which in the past has been a reliable source of sandeels and clupeids, making up a large portion of their diet during chick-rearing (Newton and Crowe, 2000).

Historically, North Atlantic populations of roseate terns suffered significant declines but have been slowly increasing since the 1990s (Mitchell et al., 2004). The Seabird 2000 census placed the population of Rockabill at 613 pairs (Mitchell et al., 2004) and this has since climbed to 1,704 pairs (BirdWatch Ireland data). Intensive conservation efforts in recent years have played a significant role in the recovery of numbers at these important sites (Acampora et al., 2018).

Since 1989, wardens have monitored the breeding season each year, reducing the risk of predation, providing nest boxes for attracting prospective pairs and a drier and warmer microhabitat for safer egg incubation. All birds have been fitted with ID rings for long-running demographic study and in some cases geolocator tags have documented annual movements and identified wintering sites (Redfern et al., 2021). Roseate terns are at risk from hunting during the winter period in Africa. While in Europe for the breeding season, the main threats are human disturbance, predation by other birds and ground predators such as rats, as well as pollution and disease (Avery et al., 1995).

Figure 3.1.1 Recorded offshore sightings of roseate terns



Black-legged kittiwake and chick

Atlantic puffin

Figure 3.1.2 An example of the movement behaviour of one Atlantic puffin from the colony at Little Saltee

3.1.3 Atlantic puffin – *Fratercula arctica*

The conservation status of the Atlantic puffin in Europe is Endangered (IUCN, 2021). Although they have an estimated European population of 3.7 – 4.1 million breeding pairs, the population size is understood to have decreased by some 68% over the last half century (BirdLife International, 2021).

There are several important colonies for these iconic seabirds on every coastline around Ireland, with the aptly named Puffin Island in Co. Kerry hosting the highest number of breeding pairs. The Seabird 2000 census showed that the Skellig Islands (Kerry), Cliffs of Moher (Clare), Saltees Islands (Wexford), Bills Rocks (Mayo), Illaunmaster (Mayo), and Tory Island (Donegal) each hosted >10% of the national breeding population (Mitchell et al., 2004). Puffins are one of the most popular seabirds in Ireland for tourism and wildlife photography due to their striking appearance and the spectacular locations of their colonies.

The main threats to this small but mighty long-distance traveller are largely associated with climate change. Rising sea temperatures and changes in the movement and availability of their food supply (Durant et al., 2003; Sandvik et al., 2005) are the main drivers behind their decline, as well as the overexploitation of their prey by commercial fishing. An insufficient supply of food greatly affects their breeding success (BirdLife International, 2021). Like other smaller seabirds that breed in Ireland, sandeels make up an important portion of their diet during the breeding season, and past incidences of starvation in chicks have been directly linked to low sandeel abundance (Martin, 1989).

3.1.4 Black-legged kittiwake – *Rissa tridactyla*

The black-legged kittiwake is Ireland's most abundant breeding species of gull, but it has experienced a 35% decline in breeding population: this is a major source of concern for the future population of this seabird (Cummins et al., 2019).

The largest colonies of kittiwakes are found at the Cliffs of Moher (Co. Clare) and Lambay Island (Co. Dublin), Horn Head (Co. Donegal) and Great Saltee (Co. Wexford). Apart from the colony on Great Skellig, all major colonies have seen significant declines since the Seabird 2000 census, with the Cliffs of Moher, Great Saltee and Horn Head breeding populations essentially halving (-48.3%, -51.2% and -52.% respectively) (Cummins et al., 2019).

Kittiwakes feed mostly on small pelagic fish such as sandeel, sprat and herring, as well as some invertebrates like squid and shrimp (Chivers et al., 2012). Therefore, unsustainable fishing practices in relation to these fish stocks are having ongoing implications for the breeding success of kittiwakes (Cummins et al., 2019).

Balearic shearwater in flight

Climate change has also caused significant changes in prey availability (BirdLife International, 2019). Kittiwakes often fall victim to longline fisheries (especially in areas where there is little or no regulation or monitoring), but this is not as prevalent in Northern Atlantic regions.

Based on tracking data for kittiwakes nesting on Lambay Island, a potential MPA for the species at this location was identified (Fig. 3.1.3.)(Chivers et al., 2013). Similar research for other major colonies would greatly increase our knowledge of this seabird species in Ireland's marine territory.

3.1.5 Balearic shearwater – *Puffinus mauretanicus*

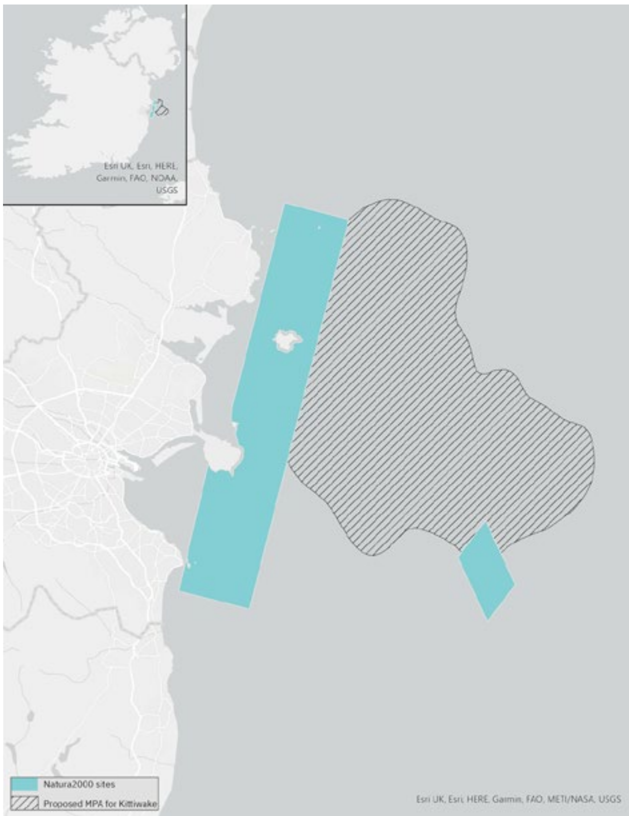
Balearic shearwaters are named as such because their breeding population is confined to the Balearic Islands in the Mediterranean Sea. Irish waters are considered to be part of their native range, although sightings over the years have been sporadic. The majority of recorded occurrences have been in the Celtic Sea and Irish Sea, usually from July to November.

Their main diet is small fish such as sardines, as well as small crustaceans and squid, but they are also attracted to discards from fishing vessels (Arcos and Oro, 2002). They are impressive divers, occasionally exceeding depths of 35 m (Meier, 2015).

Of all the species of seabird positively identified in Irish waters over the study period, the Balearic shearwater is the only one that is assessed to be Critically Endangered by the IUCN. It has been in this category since 2004, and when last assessed the population was estimated to be approximately 19,000 mature individuals and declining (BirdLife International, 2018). If the current rate of decline continues, this species may become extinct in approximately 40 years (mean estimate) (Oro et al., 2004).

A long-lived species that begins breeding after three years (Oro et al. 2004), the main threat to this seabird is incidental mortality from contact with fishing activities (bycatch), with an estimated 50% of deaths attributed to this (Genovart et al., 2016).

“Balearic shearwaters are named as such because their breeding population is confined to the Balearic Islands in the Mediterranean Sea”



N

Proposed MPA boundary for black-legged kittiwake based on tracking data of birds breeding on Lambay Island

Data Sources DHLGH, Birdwatch Ireland, Queens University | **Map Date** 11/04/2022

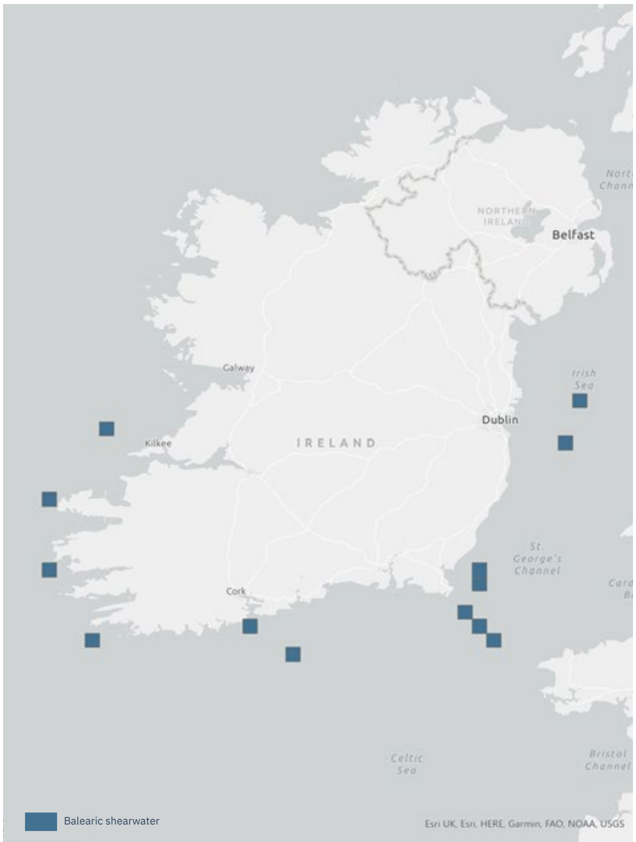
0 2.5 5 10 km

N

Distribution of Balearic shearwater

Data Sources IUCN, Birdlife International | **Map Date** 11/04/2022

0 250 500 km



N

Recorded offshore sightings of the Balearic shearwater (1980–2020)

Data Sources IUCN, Birdlife International | **Map Date** 11/04/2022

0 25 50 100 km

Figure 3.1.3
Proposed MPA boundary for black-legged kittiwake based on tracking data of birds breeding on Lambay Island

Figure 3.14
Distribution of Balearic shearwater

Figure 3.1.5
Recorded offshore sightings of the Balearic shearwater

Cuvier beaked whale

3.2 Cetaceans

There are at least 26 cetacean species present in Ireland, from the harbour porpoise to the largest animal on the planet, the blue whale. Some species are migratory and follow food sources to Irish waters, like humpback and fin whales off the southwest and south coast, while others are resident year-round. Critical habitats such as the Shannon Estuary are known to be an important hotspot, where a unique genetically discrete population of bottlenose dolphins live. A myriad of marine habitats occur in our waters, from sheltered bays and the shallow waters of the continental shelf to deep complex canyon systems and abyssal plains, providing places to live, feed and breed. This makes Irish waters one of the most important places in Europe for cetaceans, due to the sheer amount of habitat diversity within a single state's waters. Ireland is particularly important for the amount of shelf-edge habitat that supports great feeding grounds for our diverse and relatively large cetacean populations.

3.2.1 Why cetaceans need MPAs

Under the EU Habitats Directive, SACs have been designated for the protection of Annex II cetaceans (harbour porpoise and bottlenose dolphin) in Ireland. There are five SACs for cetaceans to date; three with harbour porpoise as a qualifying interest (Roaringwater Bay and Islands, Blasket Islands and Rockabill to Dalkey Islands) and two with bottlenose dolphins as a qualifying interest (Lower River Shannon and West Connacht Coast). Marine mammals face numerous anthropogenic impacts and threats including bycatch in commercial or artisanal fisheries, environmental pollution, marine litter, habitat degradation (for example associated with offshore energy and oil and gas exploration), habitat loss, noise disturbance, prey reductions, vessel traffic and ship strikes, in addition to climate change. Many populations of large whales are recovering from overexploitation by commercial hunting.

An absence of good global estimates of abundance and knowledge on the distribution of many marine mammal species (Williams et al., 2014) poses a significant problem for marine mammal conservation planning, therefore it is important that we continue to work towards identifying critical habitats for cetaceans through targeted research and through citizen science. Critical habitats for cetaceans include those that are essential for important life history and behavioural traits such as feeding, breeding and raising young, seasonal concentrations, migration routes and residency. For cetaceans, creating and managing effective MPA networks depends on the strict protection of substantial critical habitats, the implementation of ecosystem-based and network-based approaches in order to protect cetaceans into the future, as well as a generous use of the precautionary approach when designing and designating MPAs (Hoyt, 2005). Management plans should be adaptive, constantly reviewed and responsive to changes in populations, as well as including threats within the design and monitoring processes (Clarke et al., 2010).

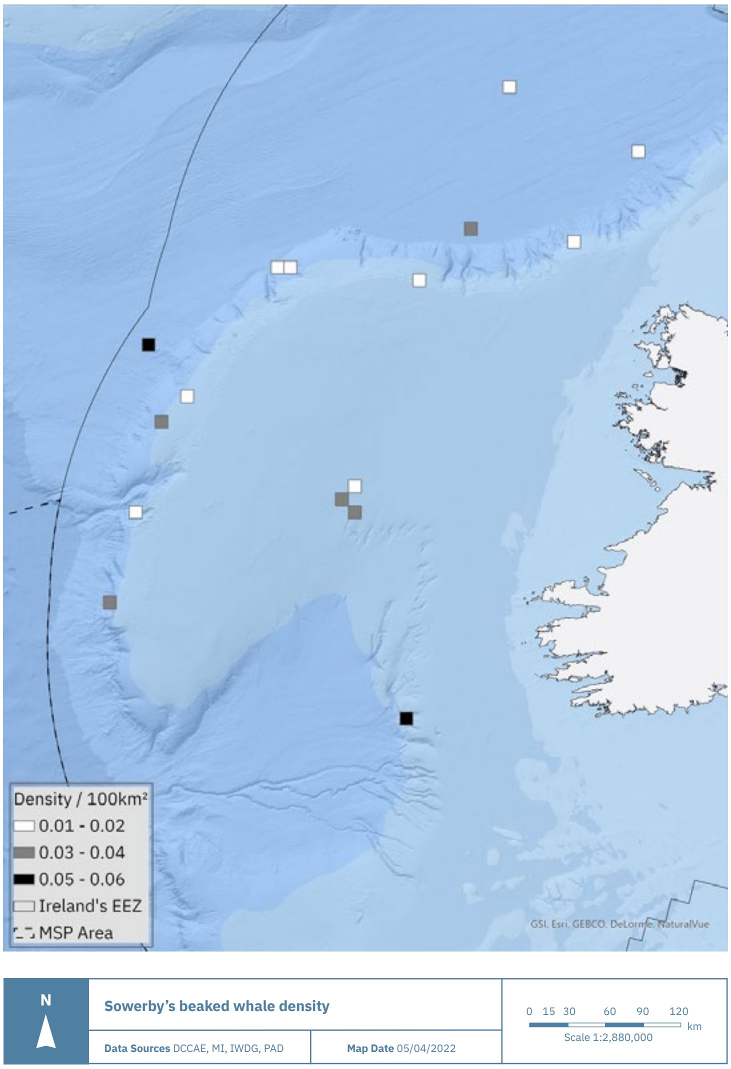


Figure 3.2.1
Sowerby's beaked whale density

"Fin whales are the second largest animal on the planet, reaching approximately 25m in length"

Fin whale, West Cork

3.2.2 Cuvier's beaked whale – *Ziphius cavirostis* and Sowerby's beaked whale – *Mesoplodon bidens*

Cuvier's and Sowerby's beaked whales belong to the family Ziphiidae. Beaked whales are one of the most enigmatic families of marine mammals, this is in part due to their oceanic distribution and preference for deep waters. Multidisciplinary survey techniques that incorporate passive acoustic monitoring indicate the distribution of these species is associated with steep continental slope habitats in the Northeast Atlantic (Rogan et al., 2017; Kowarski et al., 2018; Breen et al., 2020). Feeding at depth, Cuvier's and Sowerby's beaked whales hunt using echolocation. Their main prey includes cephalopods and meso-bathypelagic fish (Hernandez-Milian et al., 2017).

In spite of their oceanic habitat, beaked whales are particularly vulnerable to anthropogenic threats, including noise, ship strikes, contaminants and prey depletion (Rogan et al., 2017; Lusher et al., 2018). Noise pollution originating from high-intensity sounds, especially mid-frequency active sonar used during naval research, is of particular concern for these species due to its potential to impact at the population level (Macleod et al., 2004; Dolman et al., 2021). Cuvier's and Sowerby's beaked whales are currently listed as Least Concern on the IUCN Red List, however, due to their elusive nature as well as their living offshore means that the data we have is limited. Further survey effort exploring the spatial and temporal overlap between anthropogenic stressors, such as ocean noise, and beaked whale habitat and distribution will aid the creation and effective management of MPAs for these species.

3.2.3 Fin whale – *Balaenoptera physalus*

Fin whales are the second largest animal on the planet, reaching approximately 25m in length, and they occur year-round in the offshore Irish waters of the North Atlantic (Delarue et al., 2009). Fin whales are present offshore in deep waters between 1,000-3,500m during summer months and are frequently sighted in Irish inshore waters feeding on small sprat (Sprattus sprattus) and herring (Clupea harengus) shoals during autumn and winter months (Whooley et al., 2011; Ramesh et al., 2021). They are listed as Vulnerable on the IUCN Red List and classed as Near Threatened in Europe. Baleen whales use low-frequency (10-100 Hz) signals to communicate over long distances; fin whales in particular use 40 Hz vocalisations to hunt. Noise produced by the shipping industry overlaps with this frequency bandwidth and as a result can negatively influence feeding behaviour, and it also has the potential to reduce the hearing and communication range for this species, an impact known as 'masking' (Ramesh et al., 2021).

3.2.4 Sperm whale – *Physeter macrocephalus*

Sperm whales are the largest of the toothed whales (odontocetes) and are the biggest predators operating in mesopelagic and bathypelagic ecosystems, feeding predominantly on cephalopod species. Inhabiting deep waters off continental shelf edges and the open ocean, there is robust evidence to suggest Irish waters provide important feeding habitats for male sperm whales (Barile et al., 2021). Because this species is rarely found in waters less than 200m deep, it will seldom come within 100km of the coastline – which can create logistical challenges for survey and monitoring efforts (Gordon et al., 2020). Barile et al. (2021) demonstrated that using static acoustic recorders is an effective monitoring tool for assessing sperm whale abundance and distribution, with sperm whale clicks being detected on 79% of monitoring days between 2014 and 2016.

In addition to being a top predator sperm whales are also important ecosystem engineers that enhance primary productivity and help capture carbon out of the atmosphere. They do this by defecating at the surface of the water and thus transporting key nutrients from the deep ocean into the photic zone (Gordon et al., 2020).

"Bottlenose dolphins are a robust species measuring up to 3.8m in length and are widespread in Irish waters"

3.2.5 Bottlenose dolphin – *Tursiops truncatus*

Bottlenose dolphins are a robust species measuring up to 3.8m in length and are widespread in Irish waters, occurring inshore, offshore and in estuaries and bays. Genetic studies have shown that there are three discrete genetic populations in Irish waters (Mirimin et al., 2011; Nykänen et al., 2019). One population is largely confined to the Shannon Estuary and adjacent waters; there is a coastal population ranging along the whole Irish coast but especially off the Connemara-Mayo coastline; and there is an offshore population which ranges from Scotland to the Azores. Although bottlenose dolphins are widespread around the Irish coastline, each population – particularly those coastal communities – has become highly specialised to its environment, creating many conservation and management implications (Louis et al., 2014; Oudejans et al., 2014). Consequently, inshore populations with restricted ranges and relatively narrow ecological niches adapted to their local habitat face significant risks from anthropogenic pressures (Bejder et al., 2006). In addition, interaction with fisheries has also been identified as a concern, particularly for the offshore population (Read, 2008).

To date, there are two SACs for bottlenose dolphins in Ireland, namely the Lower River Shannon SAC and the West Connacht Coast SAC which extends from Slyne to Erris Heads. Designated under the Wildlife Act (39/1976 and 38/2000) and listed as an Annex II and IV of the EU Habitats Directive (43/1992), the rationale behind these sites is to protect core areas of their habitat such as important calving and feeding grounds, and they should be managed in accordance with their ecological needs.

Bottlenose dolphins, Connemara

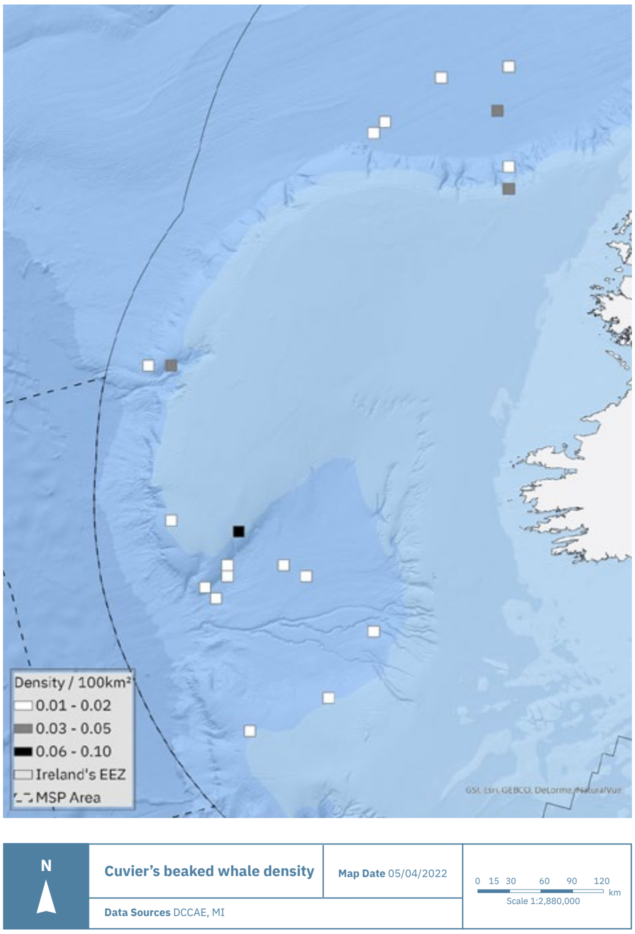
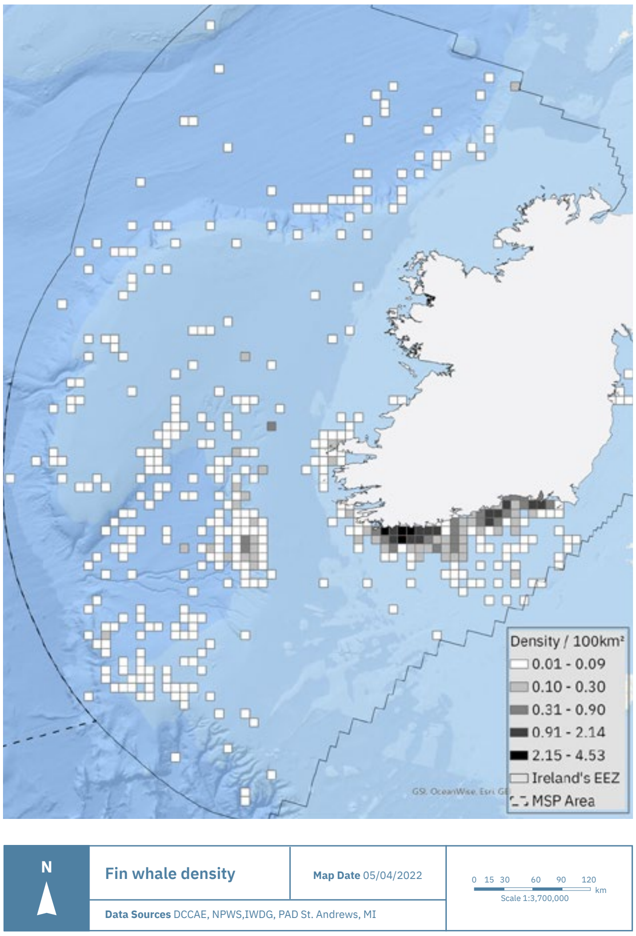
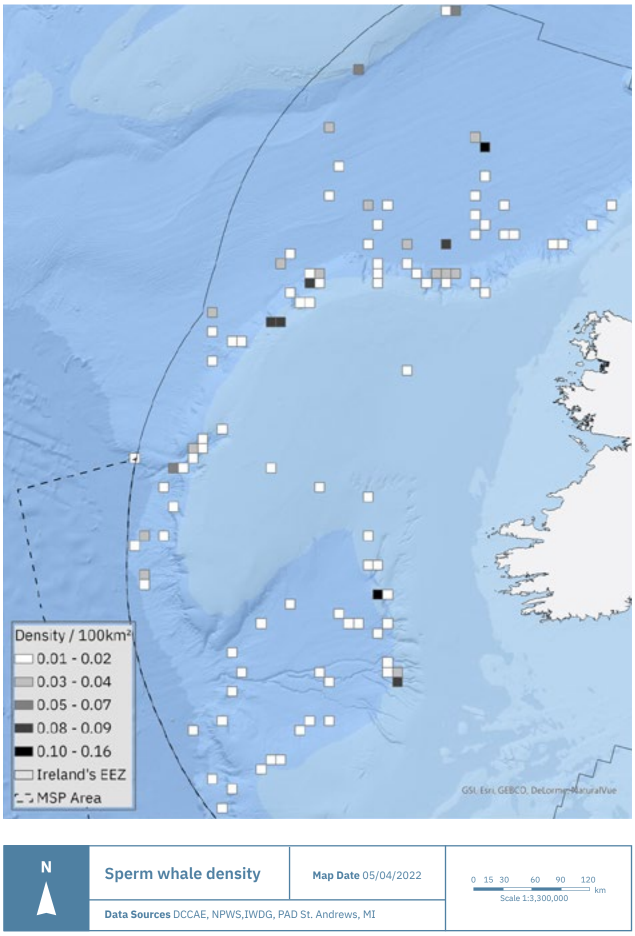


Figure 3.2.2 Curvier's beaked whale density





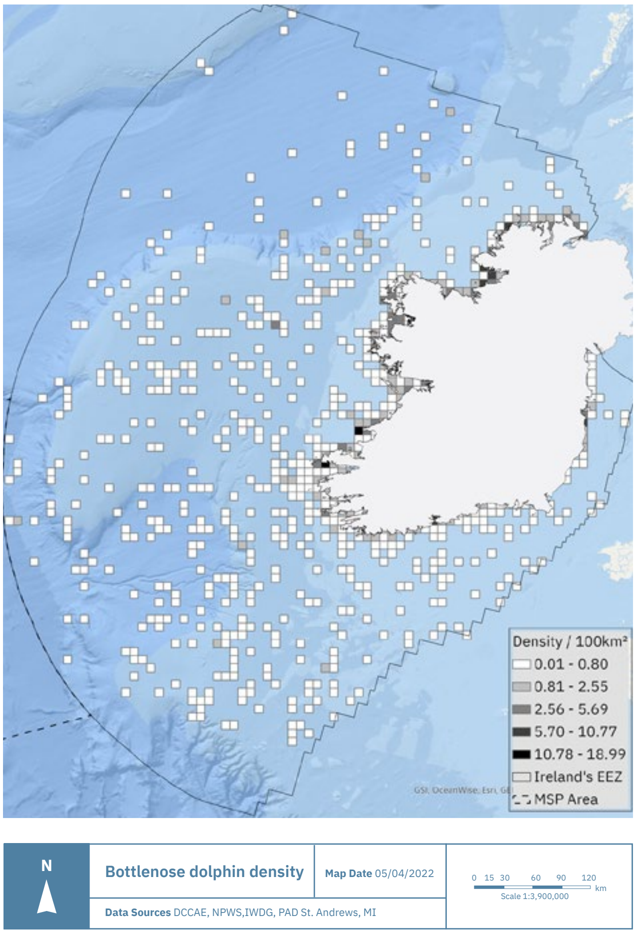
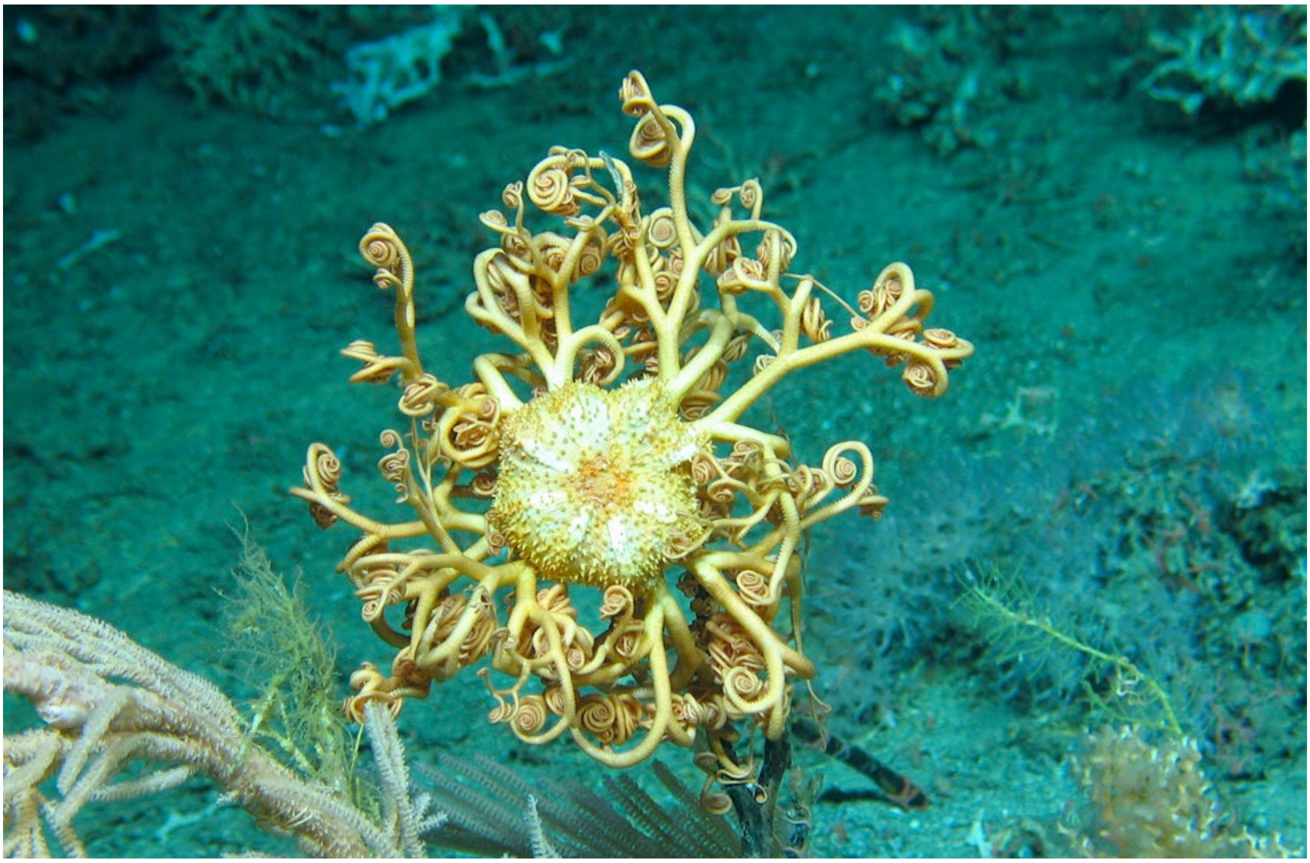


Figure 3.2.3
Fin whale density

Figure 3.2.4
Sperm whale density

Figure 3.2.5
Bottlenose dolphin density

"In addition to being a top predator sperm whales are also important ecosystem engineers that enhance primary productivity and help capture carbon out of the atmosphere."



Gorgonacephalus

3.3 Seabed Features

The proper functioning of seafloor ecosystems is vitally important for the survival of marine organisms. Many species depend on the seafloor for parts, or all, of their lifecycle. Complex, three-dimensional seafloor habitats can be formed by rocks or by plants and animals such as corals, sponges, oysters, mussels, kelp or seagrasses, among many others. Such habitats are crucial for young fish to find food and shelter from predators. The seabed also performs many ecosystem services such as carbon storage, water filtration and protecting the shoreline from wave action (Dunkley & Solandt, 2021).[11] Unfortunately, many species that form such habitats are on the decline. For example, most historical beds of the native oyster *Ostrea edulis* have been fished to functional extinction, including very large beds along the east coast of Ireland that once extended from Dublin Bay to Carnsore Point.[12]

Further offshore, cold-water coral reefs are growing abundantly along Ireland's continental slope, sheltering juvenile deep-water fish species, including orange roughy and deep-sea sharks (O'Sullivan. 2019). Ireland's shelf sediments are also of note, for the presence of vulnerable species such as the seapen and for their immense carbon storage potential (Parker et al., 2016).

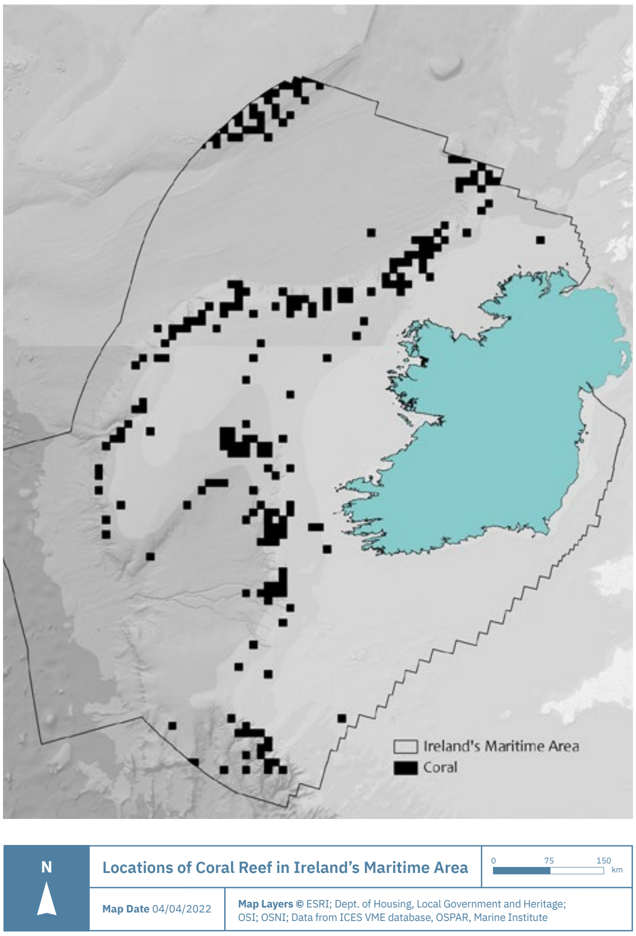
3.3.1 Why the seabed needs MPAs

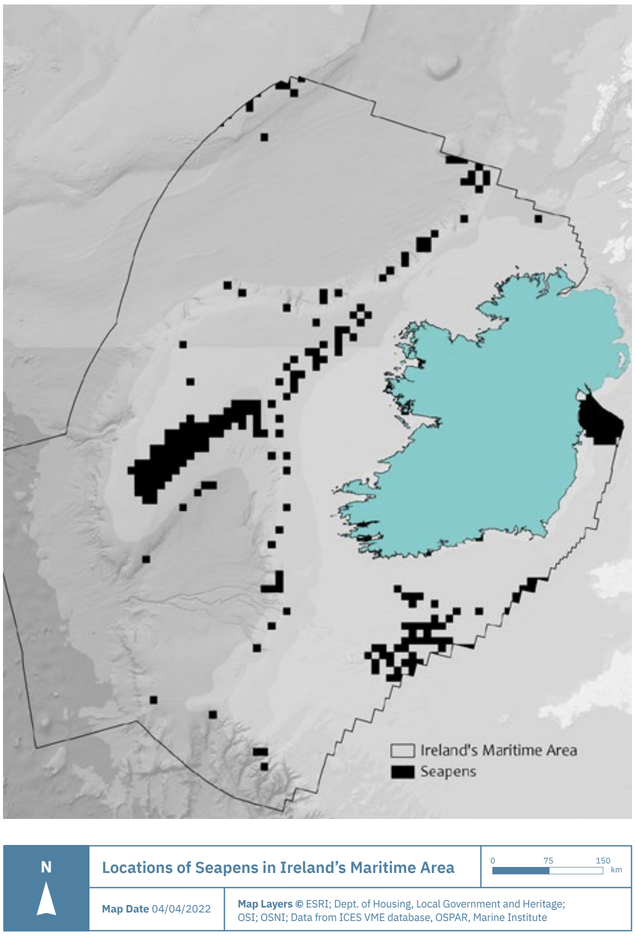
Benthic habitats or habitat-forming species strongly benefit from spatial protection measures. In the absence of physical pressures that could disturb or harm sensitive seafloor organisms, species have been shown to recover swiftly following MPA designations. In England's Lyme Bay MPA, changes to the species assemblages within the closed area, compared with outside, were seen two years after the bottom-towed gear closure. Reef-forming species that were previously only recorded on boulders began to colonise the pebbly sand between the boulders after dredging was prohibited inside the bay (Sheehan et al., 2013b). Some species are not so quick to recover on their own, however, and need some help in the form of active restoration (such as is the case for nearshore oyster, seagrass and saltmarsh habitats). Once pressures such as dredging and trawling are removed inside MPAs, restoration of oyster beds, for example, can have many benefits for the ecosystem. The latter is so-called 'passive' restoration, that simply requires removal of the impact in order to allow the seabed, and associated plants and animals, to recover. This recovery will allow restoration of ecosystem services, and accumulation of natural capital. This benefits wider society in many ways (NEF, 2021).[13]

3.3.2 Corals

Many people are unaware of the presence of coral reefs in Ireland. The cold-water corals of the north Atlantic form deep-water habitats found at depths of around 50 to 4,000m, as opposed to their better-known tropical shallow-water counterparts. Reef-forming corals such as *Lophelia pertusa* are extremely vulnerable to structural damage due to their very slow growth of 2-25mm per year. The deep waters to the west of Ireland are home to particularly diverse and ancient coral reefs which are at least 4,500 years old (Hall-Spencer et al., 2002; Roberts et al., 2006).

11 https://iwt.ie/wp-content/uploads/2021/10/final_verison_twitter-2.png
12 https://www.tcd.ie/tceh/projects/foodsmartdublin/recipes/Sept_Oyster/HistoryEcology_oyster.php
13 https://www.marlin.ac.uk/species/detail/1396





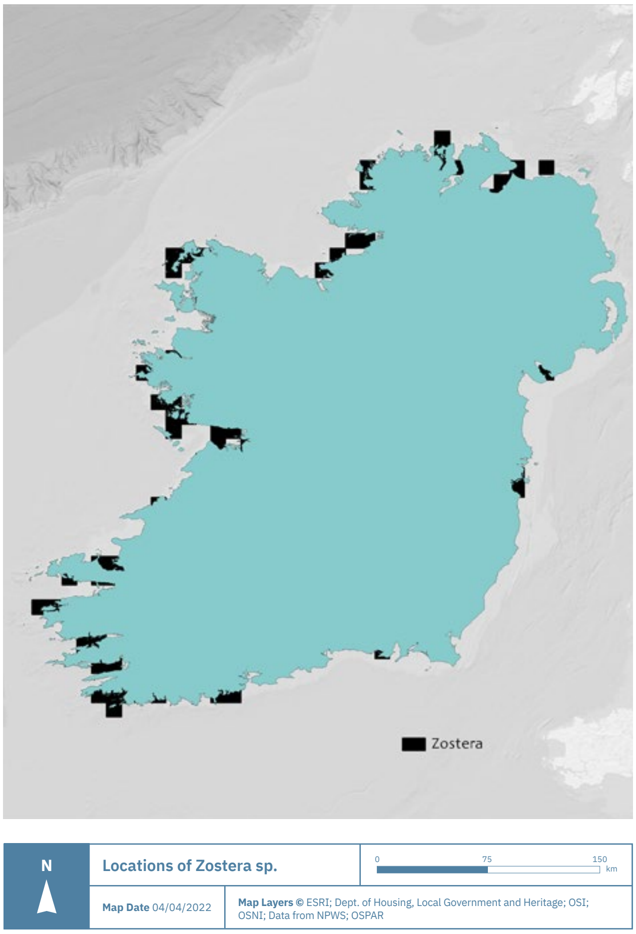


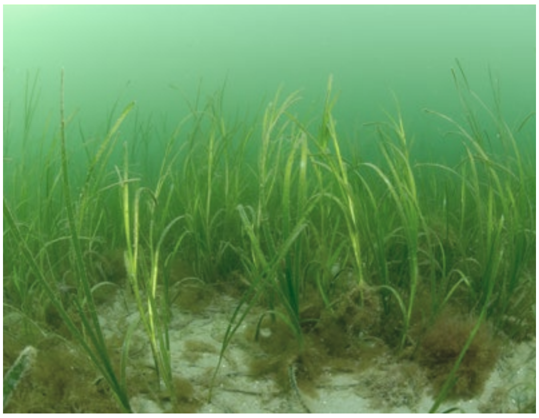
Figure 3.3.1
Coral reef locations in Ireland

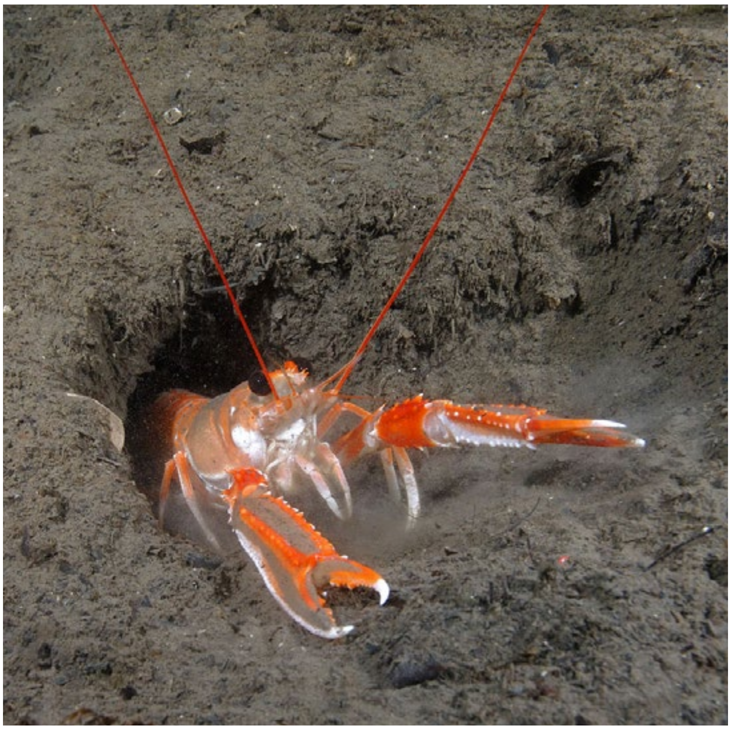
Figure 3.3.2
Seapen locations in Ireland

Figure 3.3.3
Seagrass in Ireland

"The cold-water corals of the north Atlantic form deep-water habitats found at depths of around 50 to 4,000m, as opposed to their better-known tropical shallow-water counterparts."

Eel Grass and
Dublin Bay Prawn





The Marine Institute's SeaRover surveys, conducted on the eastern slope of the Rockall Bank (O'Sullivan et al., 2017; 2018; 2019), outline the location of corals and other species as well as pressures, e.g. sediment plumes likely caused by nearby trawling activity, presence of rubbish and abandoned fishing gear. Such surveys are vital to identify the locations of vulnerable marine ecosystems and provide information on suitable conservation measures to protect these areas.

3.3.3 Seapens

A much lesser known group of animals, or rather 'animal colonies', are seapens. There are several species of seapen in Ireland, with the most common being *Virgularia mirabilis*. They colonise muddy sand to soft mud, penetrating deep into the sediment, but with their feeding arms wafting particles of food from the water column just above the seabed surface. Seapen occurrence heavily overlaps with the location of *Nephrops norvegicus* grounds in Ireland (Aristegui et al., 2021).

Seapen and burrowing megafauna communities are an OSPAR listed threatened and/or declining habitat. They are very vulnerable to structural damage from bottom trawls and OSPAR recommends that MPAs should be considered for these communities where appropriate (OSPAR Commission, 2010).

3.3.4 Seagrasses

Seagrasses are marine flowering plants that grow in dense meadows on shallow, sandy seabed. They prefer sheltered areas and are therefore very abundant in bays on Ireland's west coast. There are two species of seagrass in Ireland, *Zostera marina* and *Zostera noltii*. *Zostera marina* is the most abundant species in subtidal areas (Dale et al., 2007).

Seagrasses, and the beds they form with their root (rhizome) mats are known as 'blue carbon' habitats because the plants draw down carbon through photosynthesis and then store it within their roots and the sediment. Seagrasses are so efficient at drawing down carbon that they are estimated to store about 10% of the carbon buried in the oceans each year despite only covering 0.2% of the ocean floor (Cott et al., 2021). The actual extent of seagrass in Ireland is not yet known, but it is estimated to be at least 62km². Irish seagrasses are estimated to store 0.6 Mt carbon (Cott et al., 2021).

> "Seagrasses are marine flowering plants that grow in dense meadows on shallow, sandy seabed."

Seagrasses are also very important nurseries for a wide range of sealife. Juvenile cod, for example, are known to depend on seagrass beds (Unsworth et al., 2018) and are found there in far greater densities than over surrounding bare sand.

Seagrasses are on the decline globally. In Ireland, government bodies have failed to adequately protect seagrass in recent years. The result has been a decline in seagrass even inside existing SACs. The exact reason for *Zostera* decline is unknown and is likely a combination of many pressures, including poor water quality and presence of the invasive species *Spartina anglica* (Scally et al., 2020). It is vital that water quality and invasive alien species issues are addressed to allow recovery of seagrasses.

Cod – Gadus morhua

3.4 Commercially-exploited Species

Fish are important components of marine food webs and play vital roles in marine ecosystems. Large predatory fish such as cod and haddock are near the top of the food web, while small shoaling fish such as herring, mackerel and sprat are near the bottom, representing the main food source of many seabirds, cetaceans, sharks and tunas (MPA Advisory Group, 2020). Effective fisheries management is therefore vital if marine ecosystems are to recover from overexploitation and be resilient when faced with future pressures. However, many fish populations are currently overfished in Irish waters, with sprat even found to have been fished at five times the amount recommended by scientists.[14] The Marine Strategy Framework Directive recognises the importance of healthy commercial fish populations within the third descriptor for Good Environmental Status, while the Common Fisheries Policy legislated for an end to overfishing and discarding of certain bycatch by 2020. However, progress on this has been slow and the 2020 deadline was missed because Ireland has consistently set quotas above scientific advice.[15] Failure to properly implement such policies often leads to significant damage and loss of habitat within which these species live, and discounts the ability for natural populations to recover and be self-perpetuating were they given time and space to do so. In 2021, 11 reference stocks were still fished above maximum sustainable yield (MSY, the largest average catch or yield that can continuously be taken from a stock under existing environmental conditions), compared to 14 stocks in 2011 (Marine Institute, 2021). Species with overfished reference stocks include cod, haddock, herring, horse mackerel, plaice, saithe, sole, blue whiting and whiting, while several Nephrops stocks are below spawning stock biomass reference points (the stock size below which recruitment – the addition of young fish to the population – has a high likelihood of being 'impaired') (Marine Institute, 2021). The status of a further 28 fish populations is unknown. Fishing gear type is also an important indicator of sustainability, as bottom trawling can cause disturbance to or loss of seafloor habitats, while high bycatch rates in particularly static and mobile nets and longline fishing-gears have caused large declines in non-target species, e.g. sharks and diving seabirds (DHPLG, 2020).

3.4.1 Why fish need MPAs

The main tool by which to achieve sustainable fisheries is a permanent reduction in fishing mortality. However, other measures, such as spatial closures and gear restrictions, have also long played an important role in fisheries and habitat management. In Scotland, a three-mile bottom trawling limit existed for over a century, from the 1880s until the 1980s. After this limit was repealed following pressure from the fishing industry, bottomfish landings went into terminal decline in the Firth of Clyde (Thurstan & Roberts, 2010). The only commercial fisheries that remain in the Firth of Clyde today are for Nephrops and scallops (Thurstan & Roberts, 2010). This conversion, or simplification, of marine ecosystems from natural populations of large predatory finfish to crustacean and invertebrate-dominated communities is both ecologically and economically undesirable (Howarth et al., 2013).

Several studies have shown the effectiveness of MPAs for protecting fish populations. In an MPA in Norway, annual survival of small cod increased by 167% and 83% for large cod (Fernandez et al., 2015). Similarly, one study looking at year-round bottom

14 https://www.noteworthy.ie/net-loss-sprat-fishing-5636859-Dec2021/
15 https://ec.europa.eu/commission/presscorner/detail/en/speech_20_2477

> "There are thought to have been 30 times more Atlantic cod in the 1800s than there are now, and it is thought there would be 100 times more large fish in the North Sea in the absence of fishing pressure."
> MPA Advisory Group Report 2020

gear closures in the USA found 10 times more cod aged above 5 years inside a closed area compared to outside (Sherwood and Grabowski, 2015). While cod stocks on the east coast of the USA are still in crisis, the study showed that the cod population inside the closure is healthier compared to outside and suggested that closed areas may be the only way to achieve high numbers of older fish within a population (unlike gear modifications, which catch the larger fish and allow smaller fish to escape). Older, larger fish are crucial for a healthy population structure and to increase recruitment numbers, because larger females produce more eggs (Diego et al., 2018).

The Benyon Review into Highly Protected Marine Areas (HPMAs) describes some of the measured improvements in shellfish stocks after MPA designations in the UK (Benyon et al., 2020). For example, Lamlash Bay no-take zone has 3.7 times the scallop density 7 years post designation, as well as bigger and more abundant lobsters (Stewart et al., 2020). Lyme Bay had significantly higher numbers of scallops 3 years post designation (Sheehan et al., 2013b) and Lundy Island no-take reserve had 5 times more lobsters four years post-designation. A reserve in Spain had 20 times more female lobsters after 10 years of protection (Diaz et al., 2011). The Benyon Review highlights that the increase in shellfish populations will allow dispersal of larvae and juvenile animals beyond the boundaries of the site, known as the spillover effect.

3.4.2 Cod – *Gadus morhua*

Cod is a large predatory fish which can reach sizes above 120 cm and weigh up to 12kg. Cod feed on other fish such as herring, haddock and capelin.[16] Inshore waters around Ireland are important cod nursery habitats, especially kelp forests and seagrass beds (Lilley and Unsworth, 2014). Cod spawning areas are located on the Irish Sea coast between Strangford Lough and Dublin Bay as well as off the south coasts of Wexford, Waterford and Cork (Figure 3.4.2).[17]

Cod stocks have declined hugely and show little sign of recovery. Irish Sea cod, for example, has declined tenfold over the past 30 years, with other stocks not faring much better (Figure 35) (Marine Institute, 2021). Drastic management measures and recovery plans have failed to improve populations. The Irish Sea Cod Box, designated in 2000, introduced gear restrictions on cod spawning grounds between February and May of each year. However, bottom trawling for Nephrops is still allowed during the closed time period. Bycatch in demersal fisheries is the biggest pressure preventing the recovery of Irish cod stocks. The adoption of bycatch TACs for cod stocks within the EU to facilitate business-as-usual exploitation of target stocks, in tandem with poor monitoring and control of fishing activities, means that cod stocks are unlikely to recover without changes to conservation measures or fishing activities. The 2021 Stock Book showed 50% of all Irish Sea cod bycatch and 25% of Irish Sea cod landings come from the Nephrops fishery.

3.4.3 Herring – *Clupea harengus*

Herring is a pelagic fish species that forms large shoals which feed on zooplankton – small animals that float within the water column (Marine Institute, 2021). Herring spawn on gravelly substrate and maerl beds close inshore, with spawning areas located in estuaries and bays along the south and west coast of Ireland (see maps in Figure 37).[18] Herring are thought to be sensitive to sound pressure due to the linkage of the swim bladder with the ear.[19] Herring and their eggs are important prey for cetaceans, birds and predatory fish, including cod (Marine Institute, 2021).

Herring stocks have severely declined in recent years due to recruitment failure (MPA Advisory Group, 2021). Scientists from the International Council for the Exploration of the Sea have advised zero catch for several herring stocks in 2022.

Herring School

16 https://www.marlin.ac.uk/species/detail/2095
17 https://data.gov.ie/dataset/species-spawning-and-nursery-areas
18 https://data.gov.ie/dataset/species-spawning-and-nursery-areas
19 https://www.ices.dk/about-ICES/projects/EU-RFP/EU%20Repository/ICES%20FIshMap/ICES%20FishMap%20species%20fact-sheet-herring.pdf

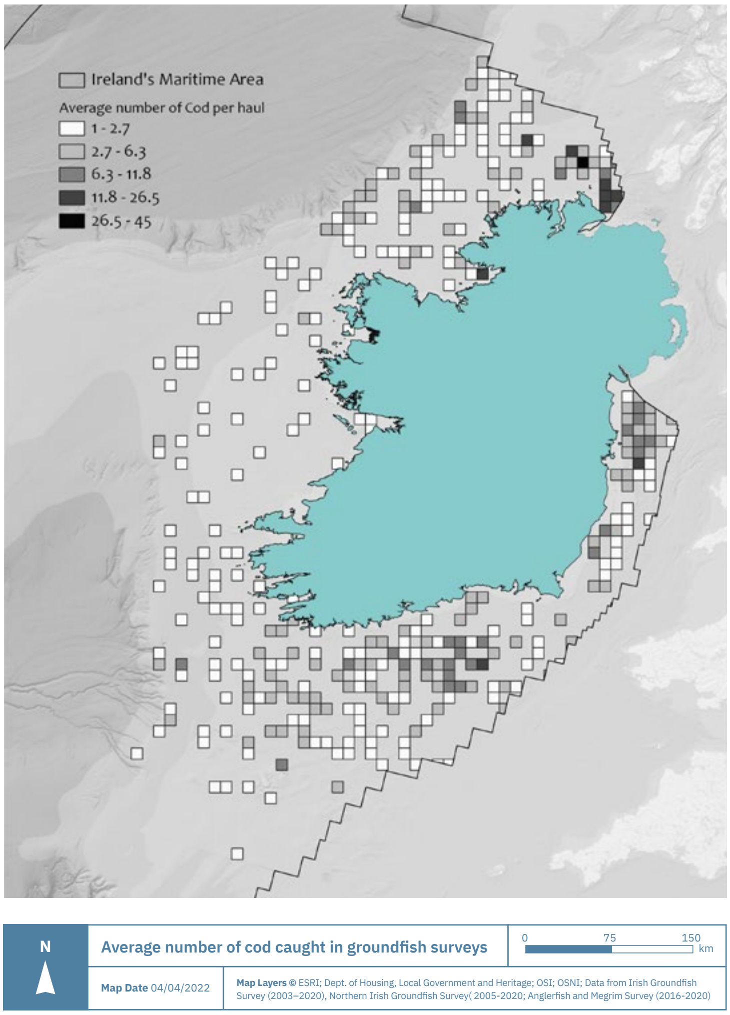


Figure 3.4.1
Average number of cod
caught in groundfish surveys

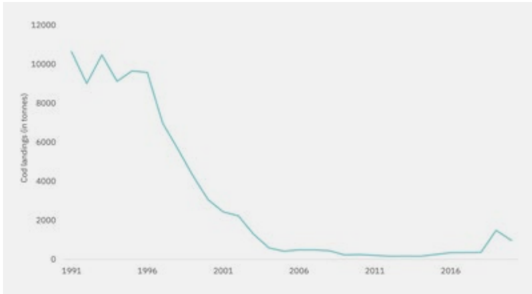


Figure 3.4.2
Irish Sea cod landings
from 1991-2020

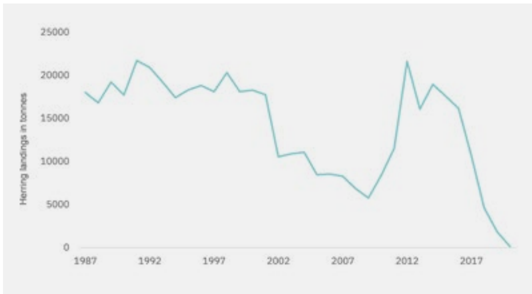


Figure 3.4.3
Celtic Sea herring
landings from 1987-2020

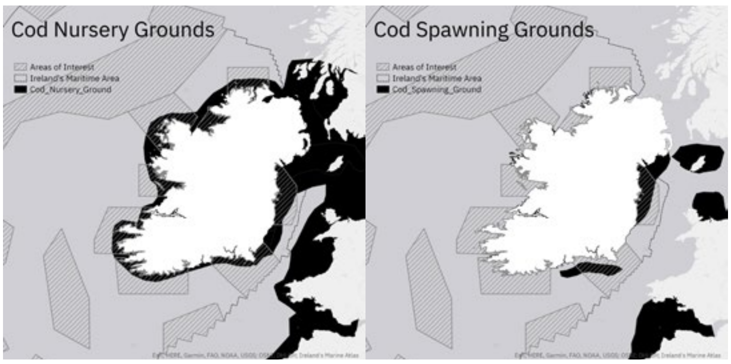


Figure 3.4.4
Cod spawning and
nursery grounds in Irish
waters. GIS layers from
Ireland's Marine Atlas

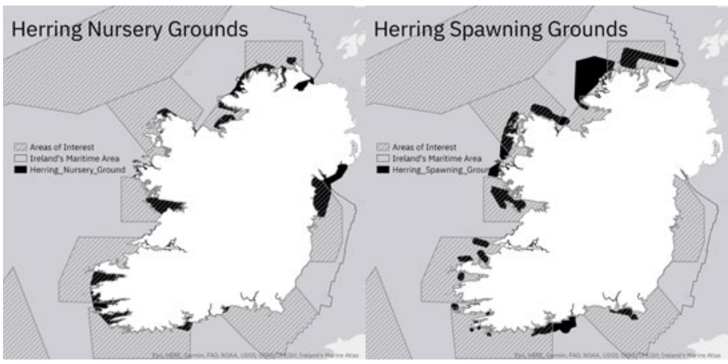
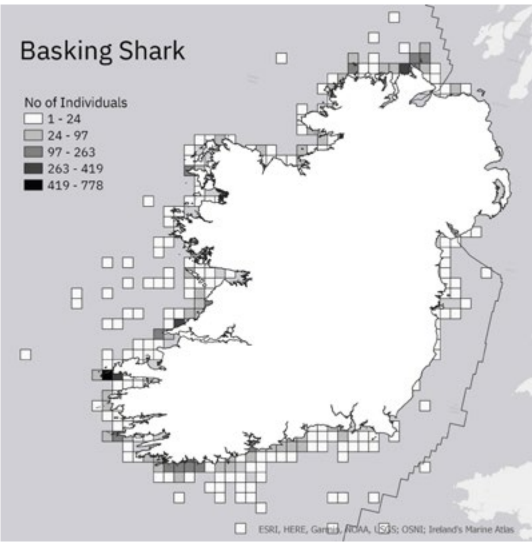


Figure 3.4.5
Herring nursery and
spawning grounds around
Ireland. Spawning and
nursery ground data
layers were created by
the Marine Institute;
Basemap by ESRI

Figure 3.5.1
Basking shark occurrences in Irish waters



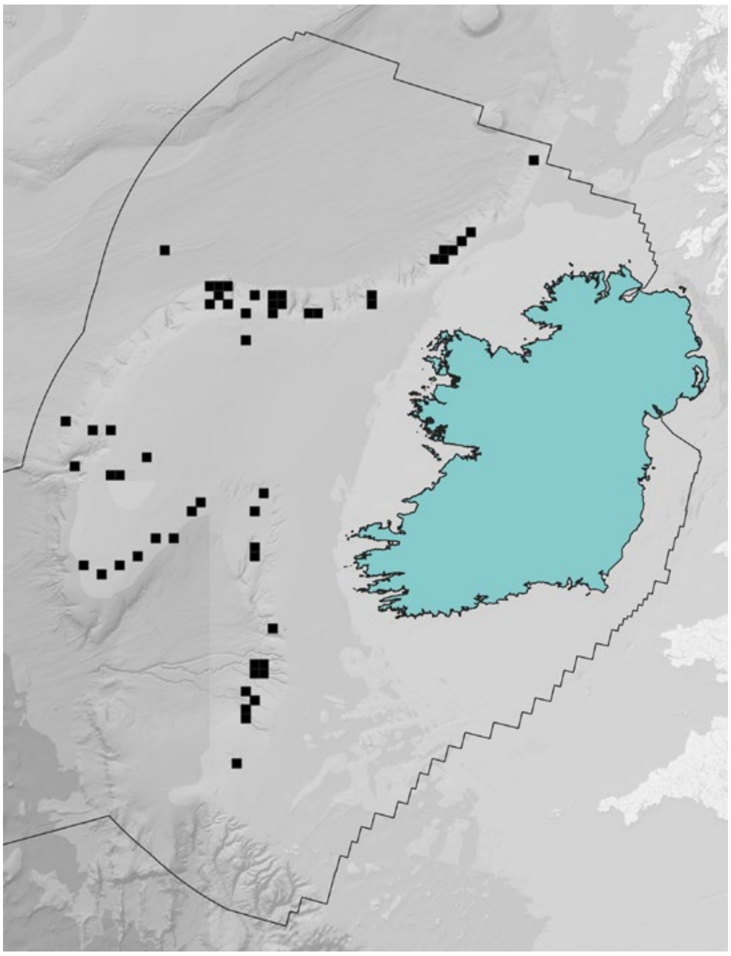


Figure 3.5.2
Portuguese dogfish occurrences in Irish waters

3.5 Sharks, Skates and Rays

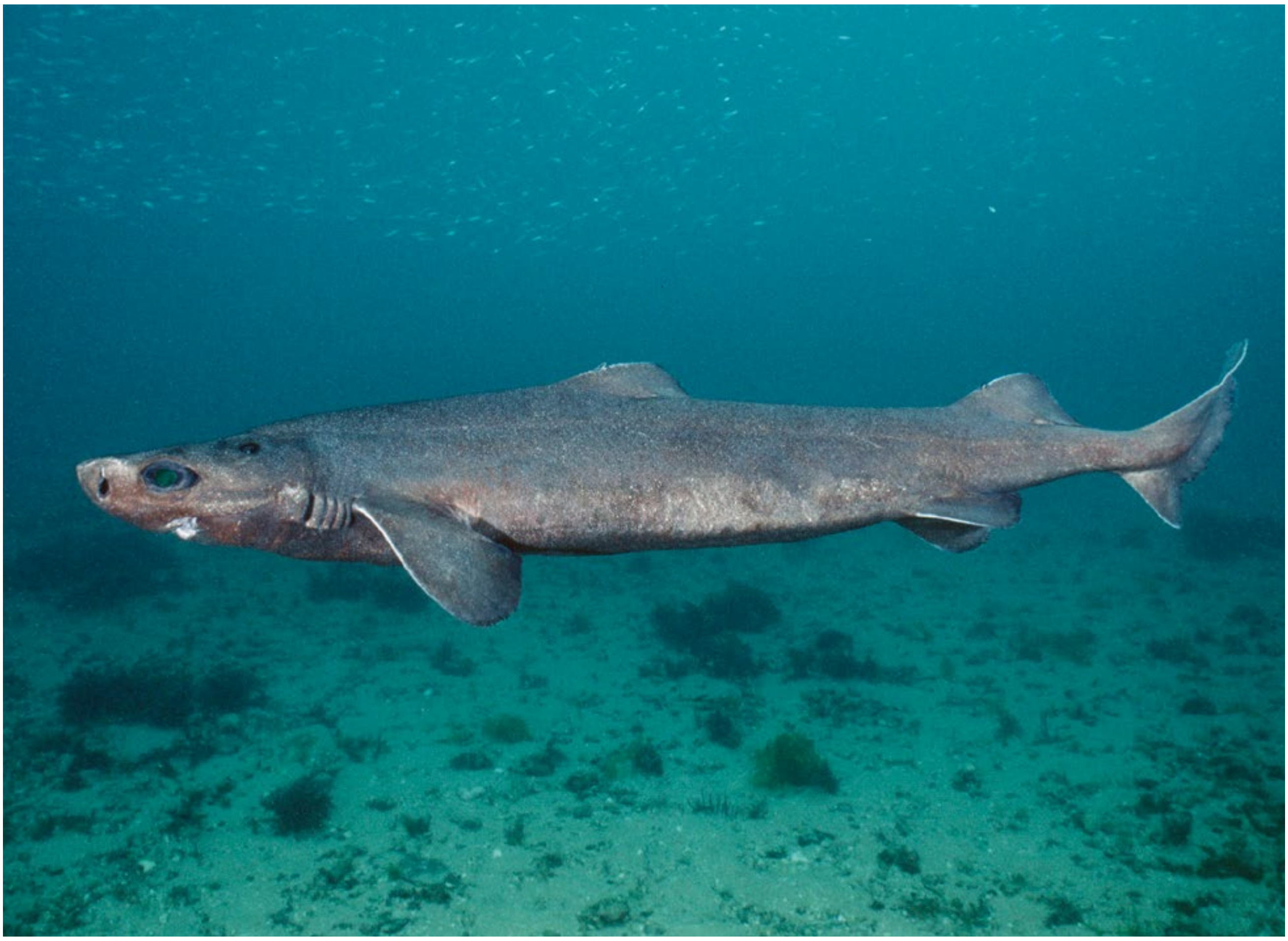
Many shark, skate and ray species are threatened with extinction in Irish waters. The Irish Red List for Cartilaginous Fish report found that out of 58 species assessed, over two thirds are in threatened or near-threatened categories (Clarke et al., 2016). Most species are protected through measures under the Common Fisheries Policy that prohibit direct targeting, but bycatch mortality is still a major threat (Clarke et al., 2016).

3.5.1 Why elasmobranchs need MPAs

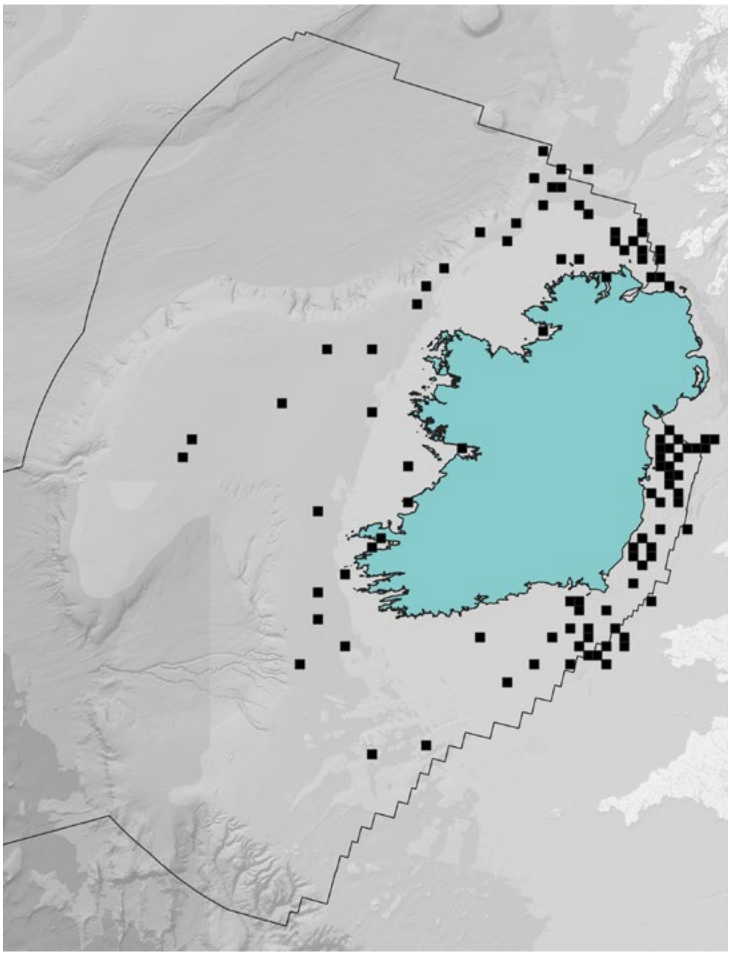
Many Critically Endangered shark, skate or ray species are found in inshore bays in Ireland, where any bycatch poses a significant threat to the survival of the species (Clarke et al., 2016). The most important remaining hotspot for several species (e.g. angel shark, white skate, common skate, flapper skate, undulate skate, common stingray) is Tralee Bay, followed by Clew Bay, Galway Bay, Donegal Bay and Lough Swilly (Clarke et al., 2016). These bays are already designated as SACs, but there are no management measures in place that would address the protection of elasmobranchs. A Marine Institute survey report on north Kerry notes that measures such as MPAs or other mitigations of the effects of fisheries where they pose a high risk to the viability of local populations need to be considered (Marine Institute, 2019). Deepwater shark species tend to overlap with cold-water coral reefs along the continental shelf edge, while others, e.g. tope, prefer the shallow sediments of the Irish Sea. Protection from fishing mortality by designating highly or fully protected areas in known shark, ray or skate hotspots is one way to help these species recover. Healthy populations of large predators are vital to ensure Ireland reaches its legal obligations under the MSFD, e.g. achieving Good Environmental Status for Foodwebs. This can only realistically be met for many of our offshore populations and MPAs by designating highly protected areas, i.e. areas that ban all forms of net and line fishing for these species.

3.5.2 Portuguese dogfish – *Centroscymnus coelolepis*

The Portuguese dogfish is a deepwater species that is critically endangered in Irish waters. Portuguese dogfish are found along the Irish continental slope at depths from 600m to at least 1,900m as well as the eastern slopes of the Rockall plateau (Clarke et al., 2016). The Portuguese dogfish is listed under OSPAR's threatened or declining species and is subject to zero total allowable catch and quota under the Common Fisheries Policy. The population is estimated to have declined by 83% between 1993 and 2007 (Clarke et al., 2016). The decline is likely ongoing because pressure of bycatch in deepwater fisheries can affect their entire reproductive cycle and survival of discarded animals is likely to be low. OSPAR has recommended that member countries should consider designating MPAs and introducing legislation to protect all life stages of the Portuguese dogfish, as well as enhancing scientific research on this species and to address threats such as bycatch from deepsea fisheries (OSPAR, 2014).



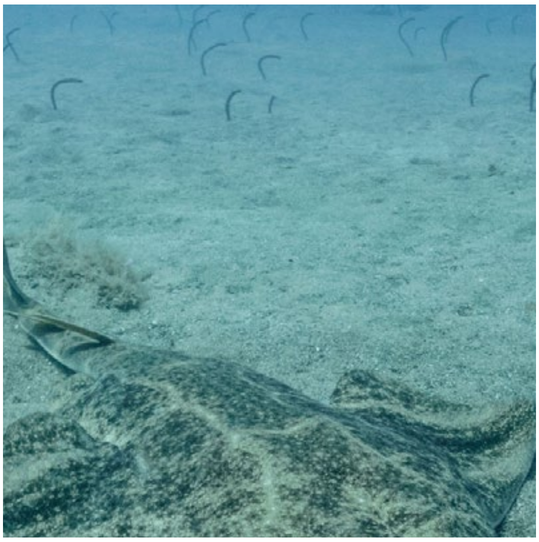
Portuguese dogfish



"Tope is a bottom dwelling species and inhabits relatively shallow seas (<200m) with a gravel or sandy bottom, making the Irish Sea its ideal habitat"

Figure 3.5.3
Occurrence map of tope along the Irish continental shelf with a cluster in the Irish Sea.

Angel Shark



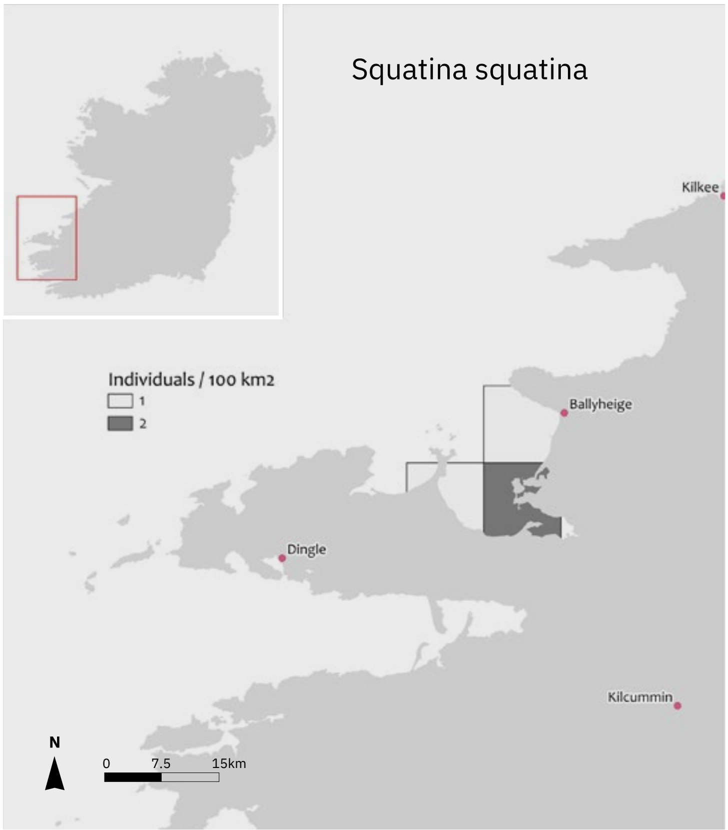


Figure 3.5.4 Angel shark catches in Tralee Bay from the north Kerry elasmobranch survey by the Marine Institute

3.5.3 Tope shark – *Galeorhinus galeus*

The tope shark is listed as Critically Endangered by the IUCN and classed as Vulnerable in Irish waters.[20] The east coast of Ireland is a hotspot for this species (see map), but it is known to be highly migratory (Clarke et al., 2016). Tope is a bottom-dwelling species and inhabits relatively shallow seas (<200m) with a gravel or sandy bottom, making the Irish Sea its ideal habitat. The Irish Red List for Cartilaginous Fish has assigned tope to the second highest research priority, because allowable catch is permitted despite evidence of its decline. The main threat to this species is therefore overexploitation.

3.5.4 Basking shark – *Cetorhinus maximus*

Basking sharks are listed as Endangered in Ireland due to large declines following centuries of commercial exploitation. They are known for their docile nature and are often observed feeding at the surface in large groups close to the coast during summer months where they filter the water for zooplankton. Satellite telemetry has shown basking sharks occur in Irish waters throughout the year but they feed at depth during winter off the shelf edge (Doherty et al., 2017). Basking sharks are the second biggest fish in the sea, with females only reaching sexual maturity at 8 to 10m length. The fish are most often spotted off the coasts of Donegal, Mayo, Cork and Kerry (Clarke et al., 2016). While they are protected from targeted fishing, their slow swimming speed while feeding makes them vulnerable to boat collisions, human disturbance, and occasional bycatch and entanglement in static fishing gear. It is hoped that basking sharks are soon due to be the first shark species to be listed as a 'protected wild animal' under the Wildlife Act, making it illegal to injure or wilfully interfere with or destroy their breeding or resting places. More research is needed to identify suitable MPAs for this species as current data heavily depends on public sightings, which are concentrated in nearshore regions. Monitoring by the Irish Basking Shark Group has, however, identified several hotspots off the coast of Donegal around Malin Head and Trawbreaga Bay,[21] west Kerry and west Clare, and off the Cork coast.

3.5.5 Angel shark – *Squatina squatina*

The angel shark is one of six Critically Endangered elasmobranchii (i.e. sharks, skates and rays) in Irish waters. Inland Fisheries Ireland tagging data suggest a decline of over 90% since the 1980s (Clarke et al., 2016). One of the last remaining hotspots of the angel shark is Tralee Bay, with Clew Bay and potentially Galway Bay also being of some importance (Clarke et al., 2016).

Angel sharks inhabit shallow sandy or muddy seafloors. They are extremely vulnerable to being caught as bycatch in the static net fishery targeting crayfish. The Marine Institute has developed management proposals for the crayfish fishery, including a multi-year closure of the fishery in order to allow recovery of crayfish and threatened elasmobranchs inside 12 nm between Mizen Head and Loop Head. The Department of Agriculture, Food and the Marine ran a public consultation on this proposal in August/September 2021.[22] Such action is badly needed to save the angel shark and related species from extinction.

20 https://www.iucnredlist.org/species/39352/2907336

21 See more information on the Irish Basking Shark Group's website here: https://www.baskingshark.ie

22 https://www.gov.ie/en/consultation/ba41c-consultation-on-the-future-management-of-the-crayfish-fishery-to-protect-critically-endangered-species/

Basking sharks
and Tope shark

"Basking sharks are the second biggest fish in the sea, with females only reaching sexual maturity at 8 to 10m length. The fish are most often spotted off the coasts of Donegal, Mayo, Cork and Kerry"

4 Opportunity for the Irish Marine Region

Increasing Irish MPA coverage from 2% to 30% in under eight years is an imperative requirement to meet our ocean targets. The targets are unreachable unless we act swiftly to designate and manage MPAs at the scale suggested here.

What may not be immediately apparent is that Ireland now has an enormous opportunity to become a world leader in marine conservation management. Ireland is in the unique position among its north east Atlantic neighbours, of beginning to expand its MPA network at a much later stage; allowing us to build the MPA network using decades' worth of international experience. Ireland is in the unique position among its neighbours of starting this process at a much later stage, but we can now build the MPA network using decades' worth of international experience. In 2020, the MPA Advisory Group produced a very thorough report on what needs to be done to expand Ireland's network of MPAs. The report's public consultation garnered more than 2,300 responses, including responses from all the major marine industries. Results show that 99% of respondents support MPAs. Furthermore, the respondents (1) strongly supported the 30% by 2030 target; (2) supported the report's key principles; (3) showed support for an ecosystem-based approach rather than the feature-based approach used in current SACs and SPAs; and (4) called for urgent action.

For perhaps the first time in Irish history, the government has committed to an ambitious environmental target and has the clear support of the public to achieve it.

What has been shown in Chapter 2 of this report is that identifying important biodiversity areas in need of protection using existing data is possible. More refinement and further analysis of these areas will be necessary given further research and vital stakeholder input over the coming months and years. The practical challenges of mapping MPAs can often be underestimated and/or oversimplified, and deliberation over boundary size and shape is potentially interminable. Regardless, adequate standards of truly effective management at chosen locations must remain the priority objective. This will determine the level and rate at which biodiversity will recover within these sites. Therefore, the quicker we begin realistic discussions about how an ecologically coherent network of well-managed MPAs will change the Irish marine landscape, the more chance we have of managing expectations and building support for such dramatic change.

For the purpose of this report we consider the following principles to be of importance:

- Under ambitious national legislation, Ireland should designate an ecologically coherent network of well-managed MPAs managed using the 'whole site approach' that not only protects, but allows nature to recover.
- Ireland should therefore focus its efforts on designating fully or highly protected areas in line with international developments by protecting large swathes of the ocean, including different complexes of habitats (Edgar et al, 2014).
- Several international good practice examples exist which Ireland can learn from.
- Only sites that have been fully implemented (i.e. have sufficient management measures in place to recover ecosystems within them) should be counted towards the 30% minimum target for 2030.
- Ireland should not wait any longer to begin the public consultation process on where new MPAs will be located and how they will be managed.
- The 16 Areas of Interest proposed in this report should form the foundation on which public engagement and consultation on expanding Ireland's MPA network should be based.
- A strategic programme of research and evidence gathering should begin immediately to fill important data gaps and support the effective delivery and management of MPAs in Irish waters.
- The recommendations of the MPA Advisory Group Report (2020) should be implemented without further delay.

Figure 4.1: Summary of feedback received to the public consultation on the MPA Advisory Group Report (2020)

> "For perhaps the first time in Irish history, the government has committed to an ambitious environmental target and has the clear support of the public to achieve it."

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Annex A—
Method Design

Introduction

A multi-taxa distribution and density study within Ireland's maritime zone was carried out using geographic information systems (GIS). The extent of Ireland's EEZ and Marine Spatial Planning Area was used for the analysis. In our analyses, we differentiate among four kinds of spatially explicit data inputs: range maps (polygons defining extent of a species occurrence and assuming presence within and absence without); density maps (based on total no. per unit area), hotspot identification (for seabirds only), and species richness maps.

List of species of conservation importance
A shortlist of marine species and habitats was developed based on the OSPAR list of Threatened and/or Declining Species and the Habitats and Birds Directive Annexes as described by step three 'defining conservation targets' in the Swedish approach to MPA Network Design & Management (Swedish Agency for Marine and Water Management, 2021). Commercially exploited species which were fished above Maximum Sustainable Yield (MSY) in 2021 were also included in the list. An initial long list of species was reduced by using the following three criteria:

1. **Conservation status of the species**
2. **Species' relevance to Ireland**
3. **Strength of available Data**

The full table of the final list of species of conservation interest can be found in Table 1. All species are also listed individually within their respective groups in annexes B, C, D, E and F.

Choosing Areas of Interest
We compared locations of species-specific core habitats, defined as areas containing the highest animal densities and hypothesised to have suitable habitat quality, with locations of species richness hotspots, defined as areas with the highest number of species, to investigate the relationship between animal density and species richness. Separate analyses were conducted for each of the five groups (described in Annexes B, C, D, E, and F) and areas of interest created for each group. We then evaluated the spatio overlap of these areas of interest. Available literature was used wherever possible to strengthen the results of the data analyses.

Creation of maps
Geographic analysis and map creation was carried out using ArcGIS Pro 2.9.0 and QGIS 3.16.16. All maps are in the projected coordinate system ETRS 1989 LAEA. Area calculations are in square kilometres and were calculated using the 'planar' option.

Overlaying spatial data for the different species groups
Annex B, C, D, E, and F explain in detail how areas of interest for each of the taxa groups were chosen and mapped. Once this was completed, a two-way overlap analysis was conducted to identify potential Areas of Interest for multiple groups. The QGIS 'clip' function was used to cut out the overlapping areas of interest for two groups at a time. This was repeated nine times to identify all ten possible two-way overlap combinations of the five groups.

Areas of Interest were then drawn around any areas where two or more groups overlapped (see figure A1). AOIs were expanded to include several small areas of overlap or to include deeper waters for which data was scarce. One AOI, the pendragon basin, was added due to the importance of the area for blue whales (see Annex c for details).

Discussion
Overall, the final AOIs cover a large amount of overlapping groups, but further negotiation was necessary to fine-tune the sites and to ensure some areas that are highly important for certain groups were not excluded due to lack of overlap, e.g. the Pendragon Basin AOI.

The large area on the porcupine bank which was highlighted in the two-way overlap analysis, above the Bríd Basin and Porcupine Bank AOI, was the result of overlap of commercially exploited sp. nephrops, blue whiting and horse mackerel with seapens. However, blue whiting and horse mackerel spawning grounds are very large and it was decided that an adequate amount of these species' spawning grounds was already covered by other AOIs. Therefore, in order to cover a wider depth range, the porcupine bank AOI was placed further south to cover the southern part of the large overlap area and part of the southern slope of the porcupine bank and some deep-sea habitat.

Future analysis should include a more precise assessment of the percentage of protection coverage necessary for each group or species of interest in order to ensure an adequate amount of each group is covered in future MPAs.

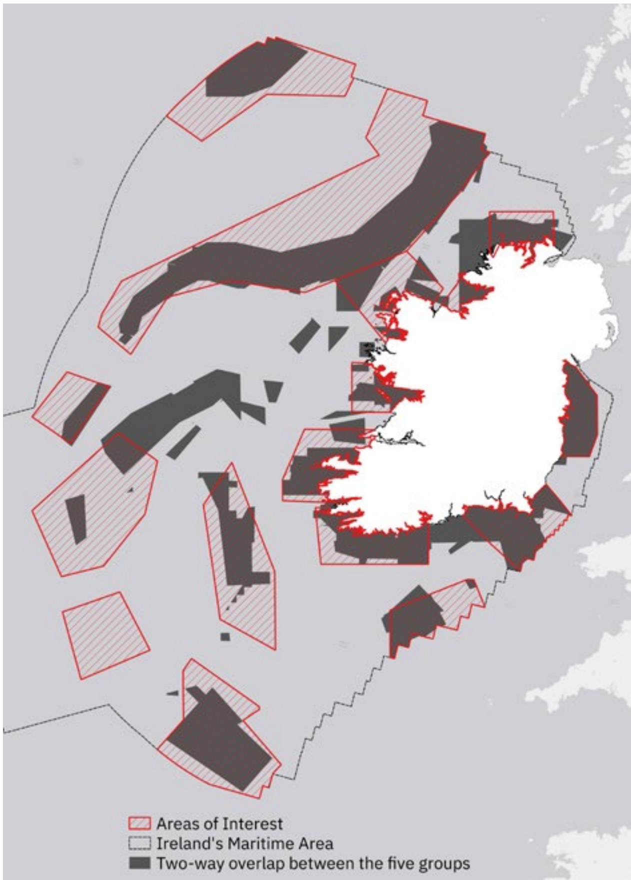


Figure A1: Two-way overlap analysis of the five groups analysed in this study. Each group's areas of interest are shown individually in annex B, C, D, E, and F. Red areas show the final Areas of Interest that were chosen to represent all five groups.

Table A1: List of species of conservation importance

Seabed Habitats	Commercially Exploited Species	Cetaceans	Elasmobranchs	Birds (Breeding)	Birds (Non-breeding)
1. Corals	1. Blue whiting (*Micromesistius poutassou*)	1. Harbour porpoise (*Phocoena phocoena*)	1. Angel shark (*Squatina squatina)*	1. Black-legged kittiwake (*Rissa tridactyla*)	1. Arctic skua (Stercorarius parasiticus)
2. Deep-sea sponges	2. Cod (*Gadus morhua*)	2. Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	2. Flapper skate (prev: common skate) (*Dipturus intermedius*)	2. Lesser black-backed gull (*Larus fuscus*)	2. Long-tailed skua (Stercorarius longicaudus)
3. Seapen and burrowing megafauna communities	3. Haddock (*Melanogrammus aeglefinus*)	3. White-beaked dolphin (*Lagenorhynchus albirostris*)	3. Undulate skate (*Raja undulata*)	3. Black-headed gull (*Larus ribibundus*)	3. Pomarine skua (Stercorarius pomarinus)
4. Horse mussel (*Modiolus modiolus)*	4. Herring (*Clupea harengus*)	4. Bottlenose dolphin (*Tursiops truncatus*)	4. White skate (*Rostroraja alba*)**	4. Mediterranean gull (*Larus melanocephalus*)	4. Balearic shearwater (Puffinus mauretanicus)
5. Ross worm (*Sabellaria spinulosa)*	5. Nephrops (*Nephrops norvegicus*)	5. Risso's dolphin (*Grampus griseus*)	5. Basking shark (*Cetorhinus maximus*)	5. Common gull (*Larus canus*)	5. Cory's shearwater (Calonectris borealis)
6. Red tubeworm (*Serpula vermicularis*)	6. Whiting (*Merlangius merlangius*)	6. Blue whale (*Balaenoptera musculus*)	6. Kitefin shark (*Dalatias licha*)	6. Great black-backed gull (*Larus marinus*)	6. Sooty shearwater (Ardenna grisea)
7. Kelp (*Laminaria spp.*.)	7. Horse Mackerel (*Trachurus trachurus*)	7. Cuvier's beaked whale (*Ziphius cavirostris*)	7. Leafscale gulper shark (*Centrophorus squamosus*)	7. European herring gull (*Larus argentatus*)	7. Great shearwater (Ardenna gravis)
8. Maerl beds		8. Sowerby's beaked whale (*Mesoplodon bidens*)	8. Porbeagle (*Lamna nasus*)**	8. Roseate tern (*Sterna dougallii*)	8. Wilson's storm-petrel (Oceanites oceanicus)
9. Seagrass (*Zostera* spp.) beds		9. Beaked whale spp.	9. Spurdog (*Squalus acanthias*)	9. Common tern (*Sterna hirundo*)	9. Little gull (Hydrocoloeus minutus)
10. Native oyster (*Ostrea edulis*)*		10. Fin whale (*Balaenoptera physalus*)	10. Longnosed skate (*Dipturus oxyrinchus*)	10. Arctic tern (*Sterna paradisaea*)	10. Yellow-legged gull (Larus michahellis)
11. Blue mussel (*Mytilus edulis*)		11. Humpback whale (*Megaptera novaeangliae*)	11. Blue skate (prev: common skate) (*Dipturus batis*)	11. Sandwich tern (*Thalasseus sandvicensis*)	11. Iceland gull (Larus glaucoides)
		12. Killer whale (*Orcinus orca*)	12. Common stingray (*Dasyatis pastinaca*)	12. Little tern (*Sternula albifrons*)	12. Black tern (Chlidonias niger)
		13. Long-finned pilot whale (*Globicephala melas*)	13. Portuguese dogfish (*Centroscymnus coelolepis*)	13. Razorbill (*Alca torda*)	13. Sabine's gull (Xema sabini)
		14. Minke whale (*Balaenoptera acutorostrata*)	14. Shagreen ray (*Leucoraja fullonica*)	14. Atlantic puffin (*Fratercula arctica*)	14. Little auk (Alle alle)
		15. Sperm whale (*Physeter macrocephalus*)	15. Thornback skate (*Raja clavata*)	15. Common guillemot (*Uria aalge*)	
			16. Tope (*Galeorhinus galeus*)	16. Black guillemot (*Cepphus grylle*)	
			17. Longnose velvet dogfish (*Centroselachus crepidater)*	17. Manx shearwater (*Puffinus puffinus*)	
			18. Cuckoo ray (*Leucoraja naevus*)	18. Northern fulmar (*Fulmarus glacialis*)	
				19. European storm-petrel (*Hydrobates pelagicus*)	
				20. Leach's storm-petrel (*Hydrobates leucorhous*)	
				21. Northern gannet (*Morus bassanus*)	
				22. European shag (*Gulosus aristotelis*)	
				23. Great cormorant (*Phalacrocorax carbo*)	
				24. Great skua (*Catharacta skua*)	

The coverage of EUNIS Level 3 habitat types was also considered, as described in section 2.2.2

***Ostrea edulis* reefs are currently very rare and confined to inshore bays within existing SACs on Ireland's west coast. Future efforts should focus on restoration of this species, e.g. on the east coast, where historical reefs have disappeared due to overexploitation.**

****Not enough available data. This species was omitted from final analysis.**

Annex B— Seabed Features

Introduction

As a partner of the Fair Seas campaign, the Irish Wildlife Trust contributed to the study through analysis of the location of Ireland's invertebrate seabed species, elasmobranchs and commercially exploited species with the aim of identifying potential Areas of Interest for MPA designation in Irish Waters.

Seabed features included in this analysis often form part of reef ecosystems, which is already a Habitats Directive Annex I habitat. Therefore, several SACs already exist for offshore coral reefs or inshore species such as Laminaria, sponge or bivalve reefs. However, offshore SACs cover only a small proportion of the full reef locations in Irish waters and further reef areas will need to be protected in future. Similarly, the Annex I habitat Large shallow inlets and bays already includes species such as Zostera and maerl. Nevertheless, the species of interest included as part of the seabed feature group are vulnerable species which need protection from physical disturbance in areas nearby as well as at their exact locations. These species are also ecosystem engineers which perform many ecosystem services as described in section three of this report and some of these species form vital habitats which other species included in this report rely on (e.g. seagrass is vital for juvenile cod)(Lilley and Unsworth, 2014). Therefore, including seabed features as part of this report was vital in order to make the case for whole-site protection for the five groups, four of which are mostly made up of large, mobile vertebrates.

Methods

To identify important areas of the seabed that would benefit from protection, the locations of eleven sessile species were mapped. In addition, the final network of AOIs was overlaid with EUNIS Level 3 seabed habitat types to test whether the chosen AOIs cover a representative amount of broad-scale seabed habitat types.

Table B1: Seabed features included in the study

Seabed Feature	OSPAR	EU Habitats Directive Annex I inclusion
Corals	y	Reefs
Deep-sea sponges	y	Reefs
Modiolus modiolus	y	Reefs
Sabellaria spinulosa	y	Reefs
Laminaria spp.	y	Reefs
Maerl	y	Large shallow inlets and bays
Zostera spp.	y	Large shallow inlets and bays
Sea-pen and burrowing megafauna communities (Pennatulacea)	y	None
Mytilus edulis	y	Reefs
Ostrea edulis	y	Reefs
Serpula vermicularis		Reefs

Table B2: Data sources used to map locations of seabed features

Coral records were derived from the following sources:
ICES VME point data filtered for 'Cold-water coral reef', 'Coral garden', Soft coral', 'Stony coral', 'Black coral', 'Gorgonian', 'Cup coral'
ICES VME Dataset 2020. ICES, Copenhagen
NPWS data request for reef point data which was then filtered for 'Biogenic reef' and any mention of 'corals' in the notes column
OSPAR habitats point data filtered for 'Lophelia pertusa reefs', 'Carbonate mounds',
Marine Institute data request for SeaRover data.
Deep-sea sponge records were derived from the following sources:
ICES VME point data filtered for 'sponge', 'Deep-sea sponge aggregations'. ICES VME Dataset 2020. ICES, Copenhagen
NPWS data request for reef point data which was then for 'Sponge'
OSPAR point data filtered for 'Deep-sea sponge aggregations'
GBIF search for 'Hexactinellida' and 'Demospongiae' with geographical restriction set to Ireland
Modiolus modiolus records were derived from the following sources:
OSPAR habitats point data filtered for 'Modiolus modiolus horse mussel beds'.
NPWS data request for reef point data which was filtered for 'Modiolus modiolus'
GBIF search for 'Modiolus modiolus' with geographical restriction set to Ireland
Serpula vermicularis records were derived from the following sources:
Marine Institute data request for macroinvertebrate data
Ostrea edulis records were derived from the following sources:
Marine Institute data request for macroinvertebrate data
Laminaria spp. records were derived from the following sources:
NPWS data request for reef point data which was filtered for 'Laminaria-dominated reef'
Maerl records were derived from the following sources:
OSPAR habitats point data filtered for 'Maerl beds' and Maerl polygon data
Sabellaria spinulosa records were derived from the following sources:
OSPAR habitats point data filtered for 'Sabellaria spinulosa reefs'
NPWS data request for reef point data which was then filtered for 'Sabellaria spinulosa'
GBIF search for 'Sabellaria spinulosa' with geographical restriction set to Ireland
Zostera spp records were derived from the following sources:
OSPAR habitats point data filtered for 'Zostera beds'
GBIF search for 'Zostera' with geographical restriction set to Ireland
Seapen records were derived from the following sources:
ICES VME point data filtered for 'Seapen fields' or 'Sea-pen'. ICES VME Dataset 2020. ICES, Copenhagen
OSPAR habitats point data filtered for 'Sea-pen and burrowing megafauna communities'
Mytilus edulis records were derived from the following sources:
Marine Institute data request for macroinvertebrate data

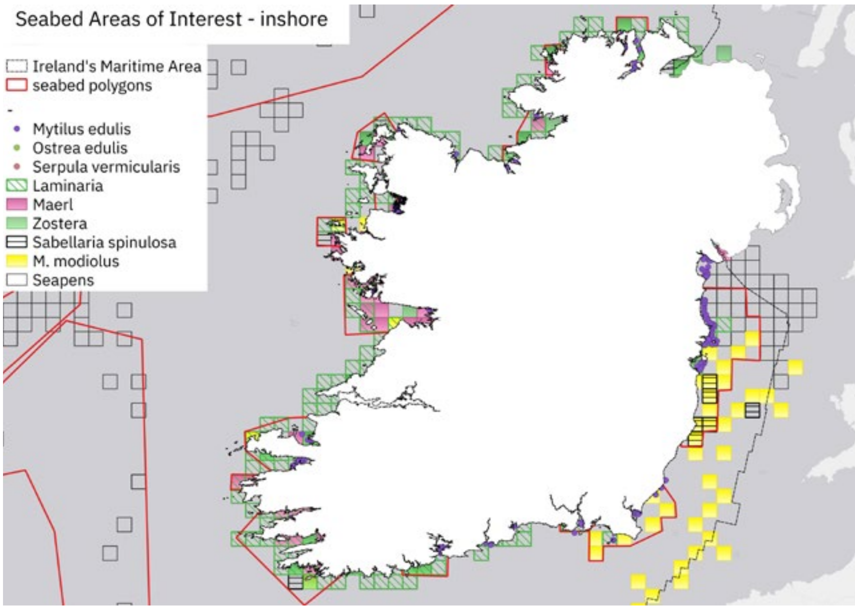


Figure B1: Seabed features in inshore areas and selected Areas of Interest for seabed features.

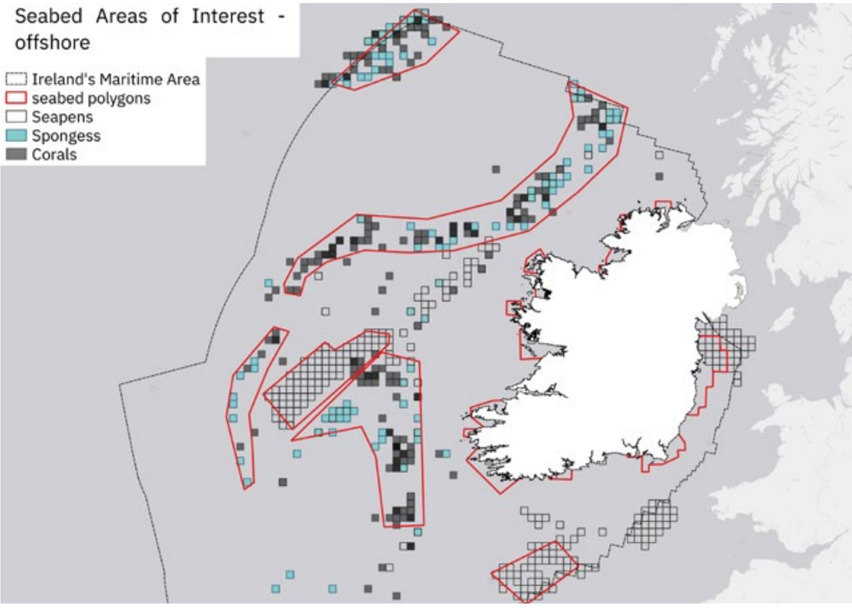


Figure B2: Seabed features in offshore areas and selected Areas of Interest for seabed features.

Step 1: Species selection
Seabed species of conservation importance were selected based on their inclusion in OSPAR lists and their contribution to Habitats Directive Annex I habitats. Due to the sensitive nature of these species to physical disturbance, the list did not undergo a shortlisting process. Of all the species listed, S. vermicularis is the only species not listed under OSPAR. For the purpose of this study, all coral records were mapped without distinguishing between reef forming and other coral species due to differences in data resolution.

Step 2: Identify existing data sources
Multiple data sources were used to collate the seabed species dataset. Primary sources were ICES Vulnerable Marine Ecosystem point data, OSPAR point data, NPWS point data for reefs, the Marine Institute and GBIF. Step 3: Map available data

All species occurrences were mapped in QGIS 3.16.16 and spatially joined to the EEA (European Environmental Agency) 10km vector polygon reference grid using the 'join attributes by location (summary)' function in QGIS.

Step 4: Selection of Areas of Interest for seabed features
Areas of interest for seabed features were selected when clusters of three or more seabed features overlapped in inshore regions, or two or more overlapped in offshore regions. The exceptions were seapen communities, which qualified on their own due to inhabiting carbon-rich muddy sediments on the continental shelf which did not overlap with any other seabed feature included in the study (but overlap with nephrops, which was included under commercial sp.).

Results
In inshore regions, the Irish Sea as well as sheltered bays along the west coast had the most variety of seabed features.

In offshore areas, the continental slope and slopes of the Rockall bank are home to coral and deep-sea sponge species, while muddy sediments in the celtic sea, irish sea and porcupine bank are home to seapens.

Discussion
The quality of data used to map seabed features was mixed. While confidence is high in the locations of deep-sea species and seapens due to availability of recent surveys, locations of M. modiolus and S. spinulosa, especially in the Irish Sea, are less certain because the underlying surveys could not be identified and records are more than ten years old. Future analysis should include species distribution models in addition to occurrence data.

Annex C— Cetaceans

Introduction

As a partner of the Fair Seas campaign the goal of The Irish Whale and Dolphin Group (IWDG) was to contribute knowledge and evidence for Ireland's cetacean species in response to the future planned expansion of Ireland's network of Marine Protected Areas (MPA). Cetacean species included in this analysis are listed as Annex II, as well as Annex IV of the EU Habitats Directive which require strict protection, as well as the creation of SACs. A small number of SACs exist for cetaceans in Irish waters however, these protected areas must be expanded.

Methods

Step 1: Identify existing data sources for cetaceans in Irish waters
Sightings of cetaceans (whales, dolphins and porpoise) were collected from over 100 datasets such as offshore scientific surveys e.g. The Marine Institute's Blue Whiting Acoustic Surveys, IWDG Sightings Scheme, IWDG Ferry Surveys, the Oil and Gas industry and dedicated cetacean abundance surveys such as SCANSII and The ObSERVE Programme. A full list of data sources can be found below in table C1. Additional datasets from 2018-2021 were not available from the data owners at the time of data collection. Missing datasets should be incorporated into further studies.

Table C1: Data sources used to map cetacean species distribution (2005-2021)

Year	Cruise	Effort	Cruise Area	IWDG Programme
2005-2021	IWDG Sightings Scheme 2005-2021	N	Ireland's EEZ	
2005-2014	IWDG Ferry Surveys	Y	Irish sea	NBDC
2005	St Andrews SCANSII	N	western European waters	N/A
2005	MI Seabed Survey Leg 17	Y	SW Shelf	ISCOPE
2005	FSS SW Herring Acoustic Survey	Y	S & SW Shelf	ISCOPE
2006	FSS Deep Water Survey	Y	Shelf Slopes	ISCOPE II
2006	FSS SW Herring Acoustic Survey	Y	S & SW Shelf	ISCOPE II
2007	St Andrews CODA	Y	Rockall Basin & Porcupine etc	N/A
2007	FSS NW Herring Acoustic Survey	Y	NW Shelf	ISCOPE II
2007	MI Oceanographic Survey	Y	Rockall Trough & Porcupine	ISCOPE II
2007	NIOZ Canyons Survey	Y	SW Shelf Slopes	ISCOPE II
2007	FSS Deep Water Survey	Y	Shelf Slopes	ISCOPE II
2007	FSS SW Herring Acoustic Survey	Y	S & SW Shelf	ISCOPE II
2008	CEFAS Plankton Survey	Y	Irish Sea	ISCOPE II
2008	FSS Blue Whiting Survey	Y	Rockall Trough	PReCAST
2008	NIOZ Coral Fish Survey	Y	Porcupine & Hatton	PReCAST
2008	AFBI Nephrops Survey	Y	Irish Sea	ISCOPE II
2008	AFBI Autumn Herring Acoustic Survey	Y	Irish Sea	ISCOPE II
2008	FSS Deep Water Survey	Y	Shelf Slopes	PReCAST
2008	FSS SW Herring Acoustic Survey	Y	S & SW Shelf	PReCAST
2008	AFBI Groundfish Survey	Y	Irish Sea	ISCOPE II

2008	CEFAS Groundfish Survey	Y	Irish & Celtic Sea	ISCOPE II
2008	IFREMER Groundfish Survey	Y	Celtic Sea	ISCOPE II
2008	NS Róisín December Patrol	Y	S & SW Shelf	PReCAST
2009	NS Niamh January Patrol	Y	S,W & E Shelf	PReCAST
2009	MI Nutrient Survey	Y	S & E Shelf	ISCOPE II
2009	AFBI Groundfish Survey	Y	Irish Sea	ISCOPE II
2009	NUIG Coralfish ROV Survey	Y	Porcupine & Celtic Shelf	PReCAST
2009	Juvenile Gadoid Survey	Y	Irish Sea	ISCOPE II
2009	FSS NW Herring Acoustic Survey	Y	NW Shelf	PReCAST
2009	AFBI Summer Herring Acoustic Survey	Y	Irish Sea	ISCOPE II
2009	AFBI Nephrops Survey	Y	Irish Sea	ISCOPE II
2009	AFBI Biological Oceanography Survey	Y	Irish & Celtic Sea	ISCOPE II
2009	IWDG/GMIT Cetaceans on the Frontier Survey	Y	Porcupine & NW Shelf Slopes	PReCAST
2009	AFBI Autumn Herring Acoustic Survey	Y	Irish Sea	ISCOPE II
2009	NPWS Geogenic Reef Habitat Mapping Survey	Y	Porcupine & Rockall Banks	PReCAST
2009	2009 Bright Sparks Survey	Y	Labadie Bank	PReCAST
2009	FSS SW Herring Acoustic Survey	Y	S & SW Shelf	PReCAST
2009	FSS Groundfish Survey	Y	S & SW Shelf	PReCAST
2009	FSS Deep Water Survey	Y	Shelf Slopes	PReCAST
2010	LE Niamh/Roisín January Patrol	Y	Irish Coastal Waters	PReCAST
2010	MI Oceanographic Survey	Y	Rockall Trough & Porcupine	PReCAST
2010	IWDG/GMIT Cetaceans on the Frontier Survey	Y	Porcupine Seabight & Whittard	PReCAST
2010	FSS Mackerel Egg Survey	Y	Celtic Sea	PReCAST
2010	Mackerel Egg Survey	Y	West of Ireland	PReCAST
2010	Mackerel Egg Survey	Y	West of Ireland	PReCAST
2010	Mackerel Egg Survey	Y	West of Ireland	PReCAST
2010	MI Oceanographic Survey	Y	S & W Shelf	PReCAST
2010	UCD Geological Survey	Y	Rockall Trough	PReCAST
2010	FSS NW Herring Acoustic Survey	Y	NW Shelf	PReCAST
2010	FSS Mackerel Egg Survey	Y	West of Ireland	PReCAST
2010	NOC Ocenaographic Survey	Y	Porcupine Seabight	PReCAST
2010	FSS Groundfish Survey	Y	NW Shelf	PReCAST
2010	FSS SW Herring Acoustic Survey	Y	Celtic Sea	PReCAST
2010	FSS Groundfish Survey	Y	Celtic Sea	PReCAST
2010	LE Orla November Patrol	Y	Celtic Sea	PRECAST
2010	FSS Groundfish Survey	Y	Celtic Sea	PReCAST
2011	PAD O&G Data	N	Porcupine etc.	N/A
2011	MI Oceanographic Survey	Y	Rockall Trough & Porcupine	PReCAST

2011	Transatlantic	Y	North Atlantic	PReCAST
2011	Transatlantic	Y	North Atlantic	PReCAST
2011	Tridens Blue Whiting Survey	Y	Rockall Trough	IWDG Ships Surveys
2011	FSS Blue Whiting Acoustic Survey	Y	Rockall Trough	PReCAST
2011	FSS NW Herring Acoustic Survey	Y	NW Shelf	PReCAST
2011	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2012	FSS Blue Whiting Acoustic Survey	Y	Rockall Trough	IWDG Ships Surveys
2012	Transatlantic	Y	North Atlantic	PReCAST
2012	Transatlantic	Y	North Atlantic	PReCAST
2012	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2013-2017	PAD O&G Data	N	Porcupine & other	N/A
2013	IWDG/GMIT Cetaceans on the Frontier	Y	Continental shelf edge	IWDG Ships Surveys
2013	FSS Blue Whiting Acoustic Survey	Y	Rockall Trough	IWDG Ships Surveys
2013	NPWS Multiple Cetacean Surveys of SACs	N		N/A
2013	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2014	FSS Blue Whiting Survey	Y	Rockall Trough	IWDG Ships Surveys
2014	Transatlantic	Y	North Atlantic	IWDG Ships Surveys
2014	IWDG/GMIT Cetaceans on the Frontier	Y	Celtic Sea, Porcupine Seabight	IWDG Ships Surveys
2014	NPWS Cetacean Survey Blaskets SAC	N	Blaskets	N/A
2014	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2015	FSS Blue Whiting Acoustic Survey	Y	Rockall Trough	IWDG Ships Surveys
2015	FSS NW Herring Acoustic Survey	Y	NW Shelf	IWDG Ships Surveys
2015	NPWS Cetacean Survey Roaringwater Bay SAC	N	Roaringwater Bay	N/A
2015	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2015-2017	DCCAE ObSERVE AERIAL/VESSEL	Y	Western Continental Shelf	N/A
2016	FSS Mackerel Egg Survey - Leg 1	Y	West of Ireland	NPWS Contract
2016	FSS Blue Whiting Acoustic Survey	Y	Rockall Trough	IWDG Ships Surveys
2016	FSS Mackerel Egg Survey - Leg 2	Y	West of Ireland	NPWS Contract
2016	FSS WESPAS Survey	Y	Western Continental Shelf	IWDG Ships Surveys
2016	NPWS Cetacean Survey Rockabill SAC	N	Rockabill	N/A
2016	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2017	FSS Blue Whiting Acoustic Survey	Y	Rockall Trough	IWDG Ships Surveys
2017	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2017	Transatlantic	Y	North Atlantic	IWDG Ships Surveys
2018	FSS SW Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys
2018	NPWS Cetacean Survey Blaskets SAC	N	Blaskets	N/A
2021	MI WESPAS	Y	Western Continental Shelf	IWDG Ships Surveys
2021	MI Celtic Sea Herring Acoustic Survey	Y	Celtic Sea	IWDG Ships Surveys

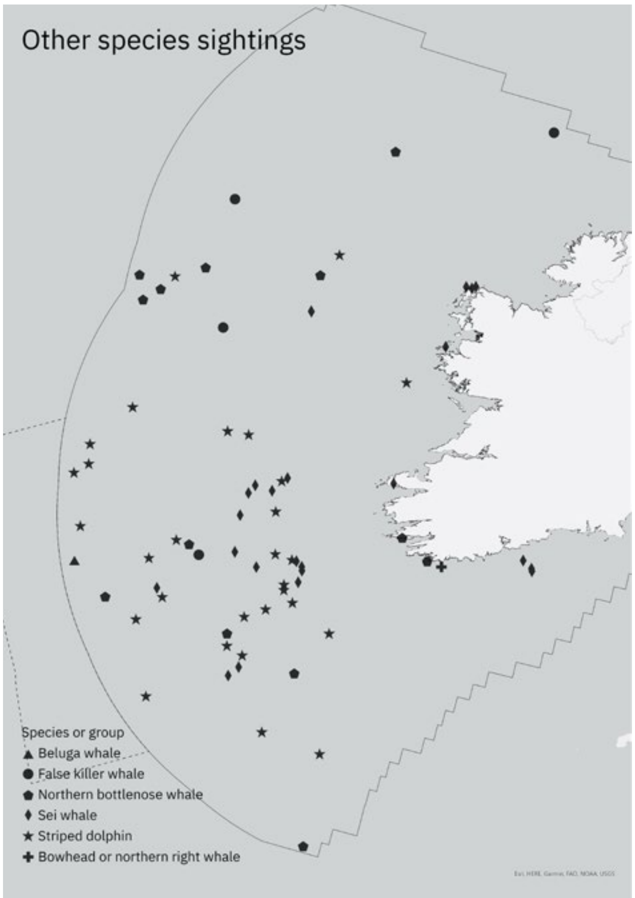


Figure C1: Sightings of other species within Ireland's Maritime Area

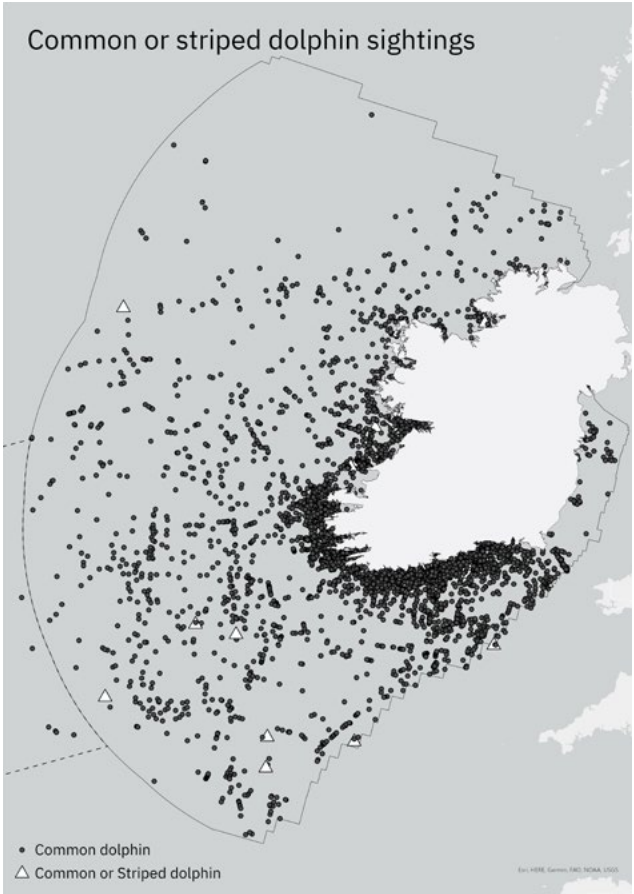
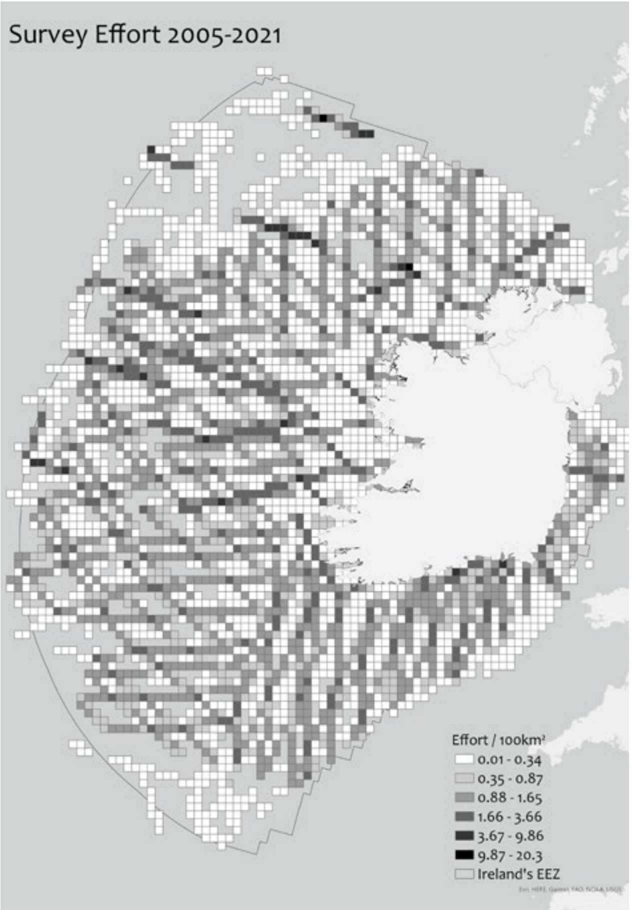


Figure C2: Common or striped dolphin sightings within Ireland's Maritime Area



Step 2: Collate data

Collated data were filtered from 2005-2021 to include the most relevant and recent data. Data were also filtered to observations solely within Ireland's EEZ. Observations of cetaceans were identified to species level with the exception of observations of beaked whales. Where observations of beaked whales were not positively identified to species level, the group 'beaked whale spp.' was included within the analysis. Analysis was not carried out on species where data was lacking, such as for sei whale, striped dolphin, beluga whale, false killer whale, Northern bottlenose whale, bowhead whale and Northern right whale (figure C1). Common dolphin densities were not carried out, however occurrence and distribution of this species was reported on (figure C2). At first, observations collected from ship and aerial surveys, which included associated monitoring effort, were explored separately from the IWDG Sightings Scheme data, which does not include associated effort. Datasets were then combined to strengthen the analysis and coverage of site selection. Mapped monitoring effort from surveys can be seen in figure C3.

Fourteen species and one species group (beaked whale spp.) were selected based on their conservation status. All cetaceans in Irish waters are protected under the EU Habitats Directive. In Ireland, harbour porpoise, blue whale and Northern Atlantic right whale are protected under the OSPAR Agreement due to their threatened and/or declining status. The IUCN Global Red List categorises cetaceans from Least Concern to Critically Endangered (Table C2).

Figure C3: Aerial and vessel survey effort for cetaceans from 2005-2021. Effort calculated as the total logged data (GPS points) per $100km^2$.

Table C2: Priority cetacean species for analysis within this study and their conservation status.

Species	Latin	EU Habitats Directive	OSPAR	IUCN Red List (Europe 2007)	IUCN Red List (Global 2020)
Harbour porpoise	*Phocoena phocoena*	Annex II & IV Species	Y	VU-Vulnerable	LC-Least Concern
Bottlenose dolphin	*Tursiops truncatus*	Annex II & IV Species		DD-Data Deficient	LC-Least Concern
Risso's dolphin	*Grampus griseus*	Annex IV Species		DD-Data Deficient	LC-Least Concern
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Annex IV Species		LC-Least Concern	LC-Least Concern
White-beaked dolphin	*Lagenorhynchus albirostris*	Annex IV Species		LC-Least Concern	LC-Least Concern
Killer whale	*Orcinus orca*	Annex IV Species		DD-Data Deficient	DD-Data Deficient
Long-finned pilot whale	*Globicephala melas*	Annex IV Species		DD-Data Deficient	LC-Least Concern
Sperm whale	*Physeter macrocephalus*	Annex IV Species		VU-Vulnerable	VU-Vulnerable
Humpback whale	*Megaptera novaeangliae*	Annex IV Species			LC-Least Concern
Blue whale	*Balaenoptera musculus*	Annex IV Species	Y	EN-Endangered	EN-Endangered
Minke whale	*Balaenoptera acutorostrata*	Annex IV Species		LC-Least Concern	LC-Least Concern
Fin whale	*Balaenoptera physalus*	Annex IV Species		NT-Near Threatened	VU-Vulnerable
Cuvier's beaked whale	*Ziphius cavirostris*	Annex IV Species		DD-Data Deficient	LC-Least Concern
Sowerby's beaked whale	*Mesoplodon bidens*	Annex IV Species		DD-Data Deficient	LC-Least Concern

Step 3: Density and distribution analysis
Total counts of each species with associated geographic coordinates were spatially joined to the EEA (European Environmental Agency) 10km vector polygon reference grid. Species densities (total individuals per 100km^2) were calculated within each grid cell. When calculating the overall density for combined priority species the distribution of this data was skewed, so a Log10 transformation was carried out to minimise skewness and map distribution to a normal one. This was also carried out as a way to standardise the legends within the maps, i.e., for values that have nonlinear distributions. Where data was available the proportion of adults to young was calculated (combining records of those animals described as juveniles or calves) for each AOI. Calculating species richness was done using PASTv.4.09 software (Hammer et al. 2001). Species richness is a measure for the total number of the species in a community.

Seventeen sites were identified as Areas of Interest for cetaceans. The number and boundaries of these sites were negotiated based on one or more contributing factors within the analysis: (i) high densities of combined priority species per 100km^2 (ii) individual species densities and distribution (iii) peer reviewed literature, and (iv) species richness to a degree.

Due to the paucity of boat based and aerial based data for offshore waters and very heterogeneously distributed sampling effort, the dimensions of the Atlantic Margin cetacean AOI polygons were created broadly based on acoustic detections and predicted relative densities of cetacean species from the ObSERVE Acoustic Programme (Berrow et al., 2018). During the ObSERVE Programme, acoustic monitoring moorings/listening stations were positioned north to south along the continental shelf, spanning a period from spring 2015 to spring 2018. Examples of detection ranges and predicted relative densities can be seen in figures C4 & C5.

Discussion
The analysis identified 17 areas of interest for cetaceans. These incorporated a broad range of habitat requirements for cetaceans. It is unknown how differing survey methods may have affected the detection rates for different cetacean species and that the distribution of animals is based upon sightings which is dependent upon effort and may not reflect the entire distribution. Furthermore, due to the relative distribution of surveys being restricted to the major basins and shelf edge, deeper water such as the NW Rockall Trough and Ireland's waters of the West European Basin could be considered a data gap for cetacean species.

It is important to note that this study considered presence-only data and thus the results do not predict overall population density or abundance of a single species, but simply highlight hotspots of high density and distribution. This may not identify critical habitats but data does highlight the importance of particular areas which need further investigation on a finer scale. Analysis of 16 years of consistent spatiotemporal data provides the most comprehensive evidence available, which is fundamental to the conservation of marine biodiversity. Overall, the results show a high level of diversity and density of cetacean species, and in the spatial and temporal use of coastal and offshore marine habitats by cetacean species in Irish waters.

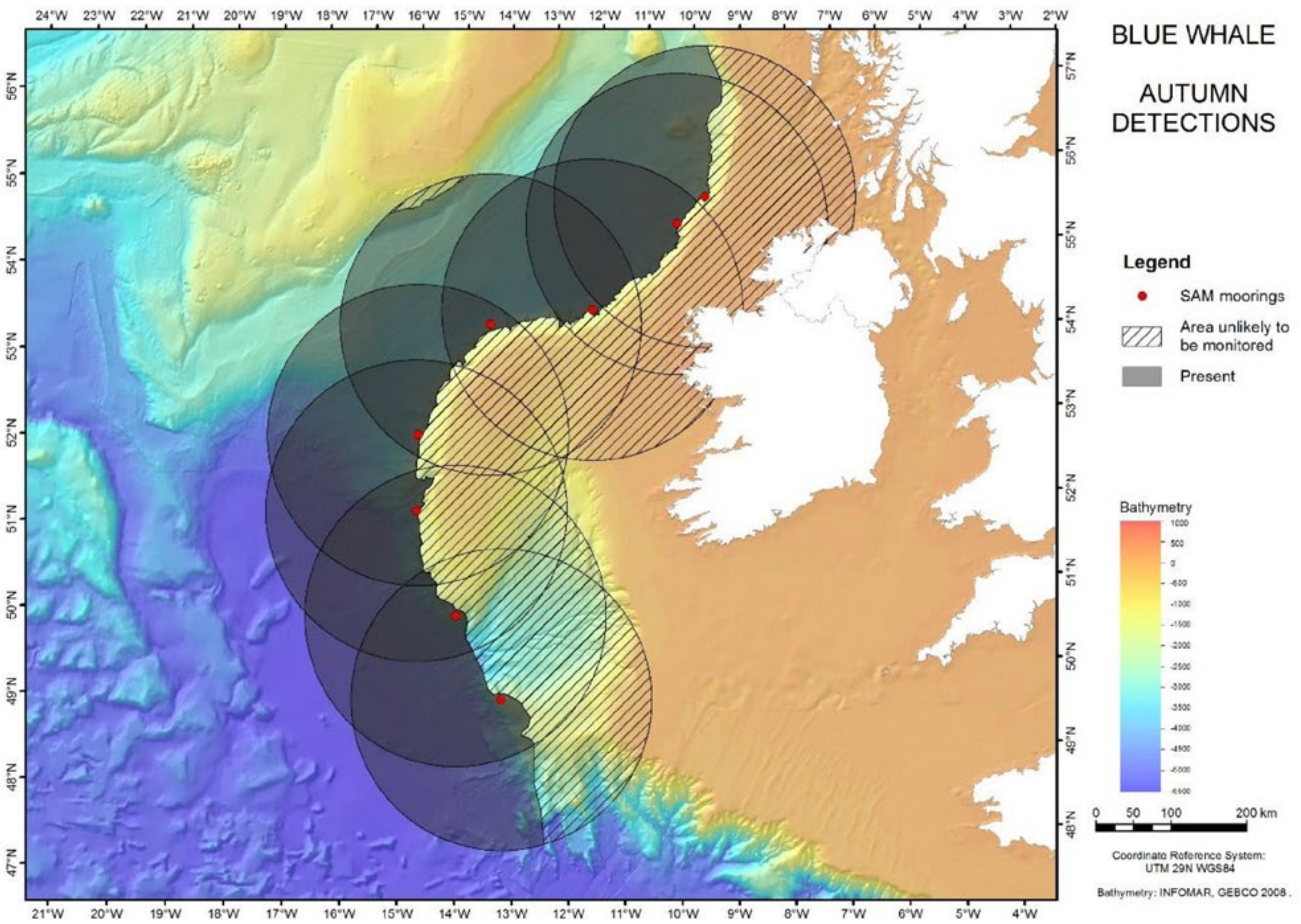


Figure C4: Presence/absence of blue whale calls during autumn (September, October). Area monitored is scaled according to the acoustic detection range (maximum 200 km for blue whales) Image from Berrow et al. (2018).

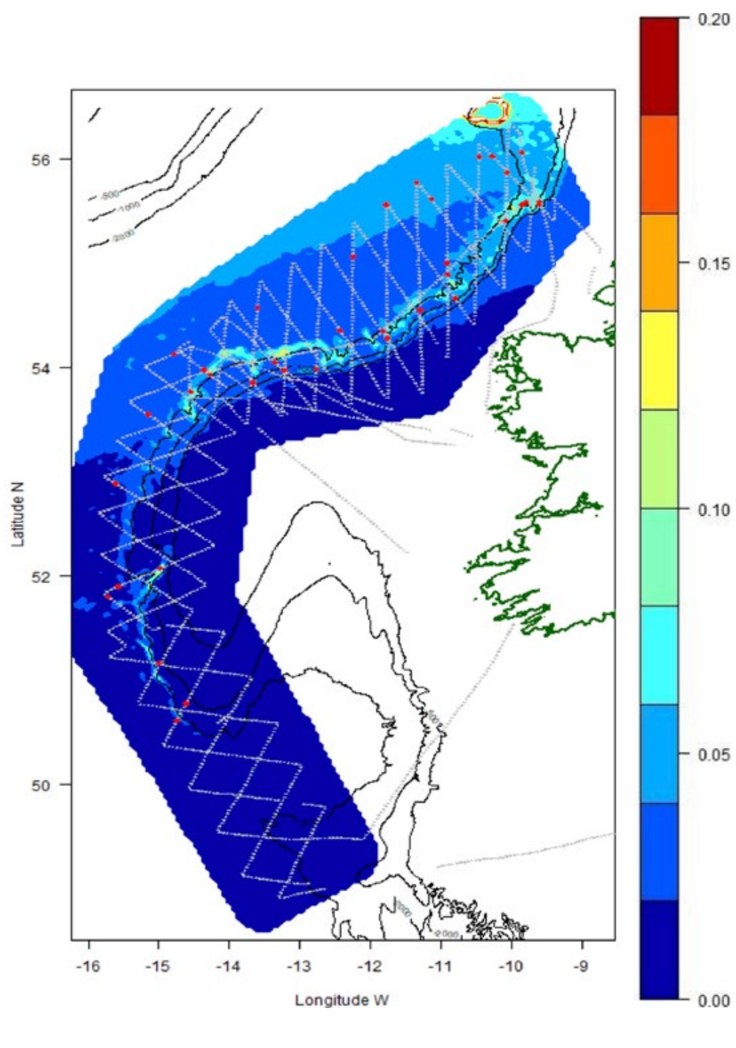


Figure C5: Predicted densities of beaked whales 70 kHz (probably Sowerby's beaked whales). The red dots indicate detections. All densities are relative values. Image from Berrow et al. (2018).

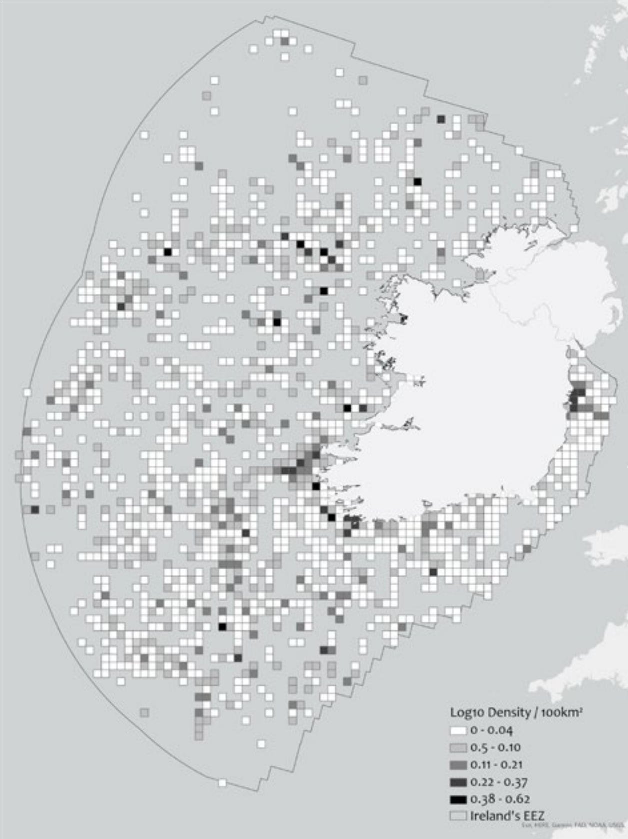


Figure C6: Combined priority species densities from aerial and ship based surveys (2005-2021) with log10 transformation to minimise skewness. Hot spots of high densities (per 100km²) are apparent particularly in areas with higher survey effort, such as Dublin Bay area, south west coast and the Porcupine seabight.

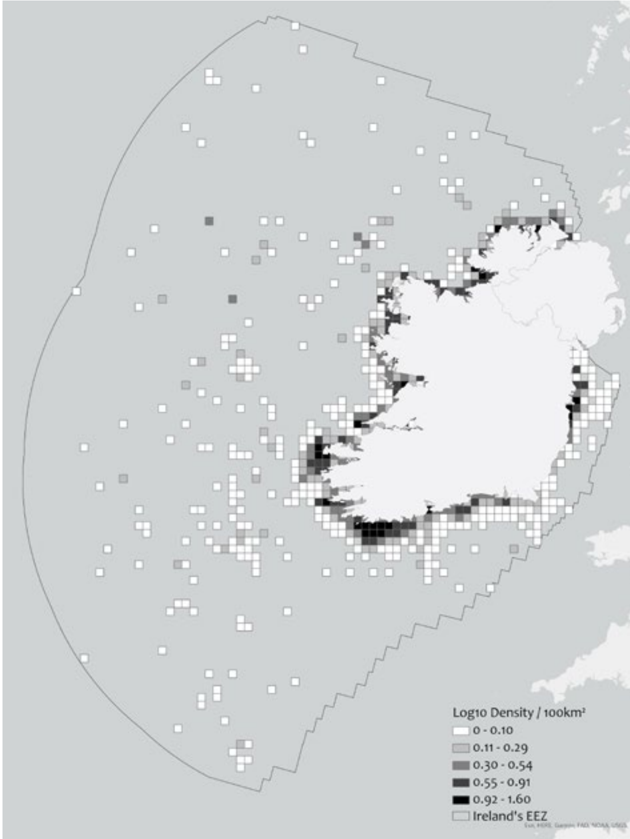


Figure C7: Combined priority species densities from IWDG Sighting Scheme (2005-2021) with log10 transformation to minimise skewness. Hot spots of high densities (per 100km²) exist in coastal areas, particularly along the south and south west coast. While monitoring effort creates a degree of bias in the map, particularly for coastal areas due to the Sightings Scheme, all densities have significance.

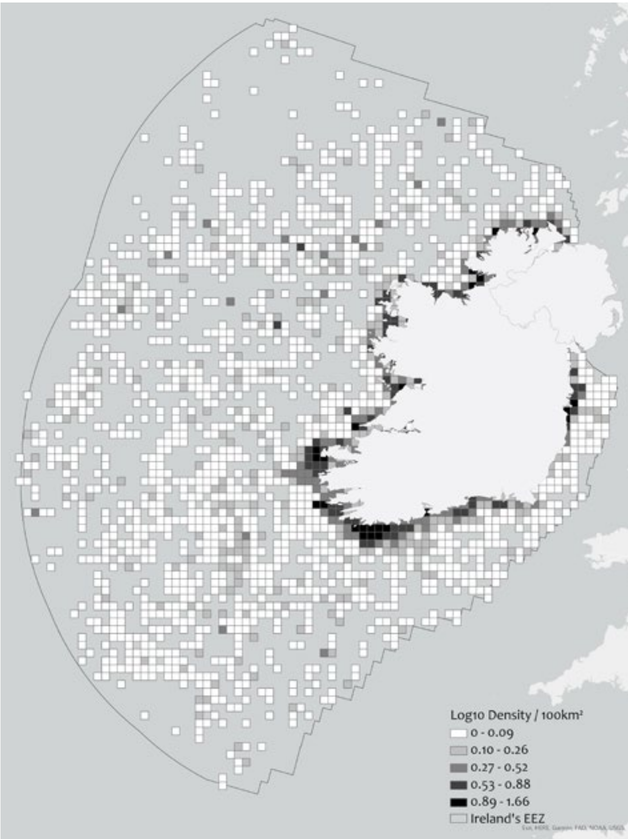


Figure C8: Combined priority species densities from aerial and ship based surveys and IWDG Sightings Scheme (2005-2021) with log10 transformation to minimise skewness. Datasets were combined to strengthen the density analysis giving further coverage throughout the study area.

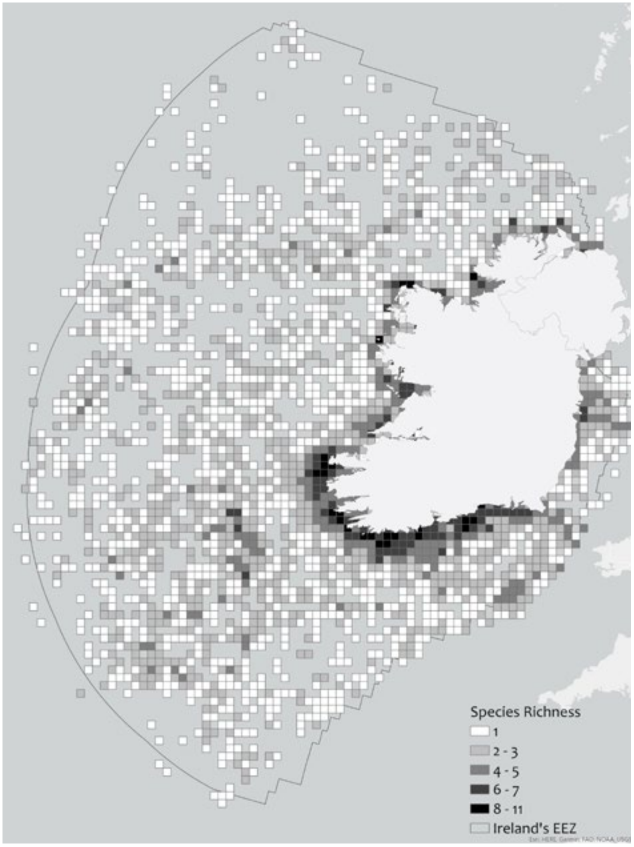


Figure C9: Cetacean species richness. Coastal areas, especially the south and southwest show the highest level of species richness, as well as the Porcupine Seabight area. While survey effort creates a degree of bias in the map, particularly for coastal areas due to the IWDG Sightings Scheme, all records of presence have significance.

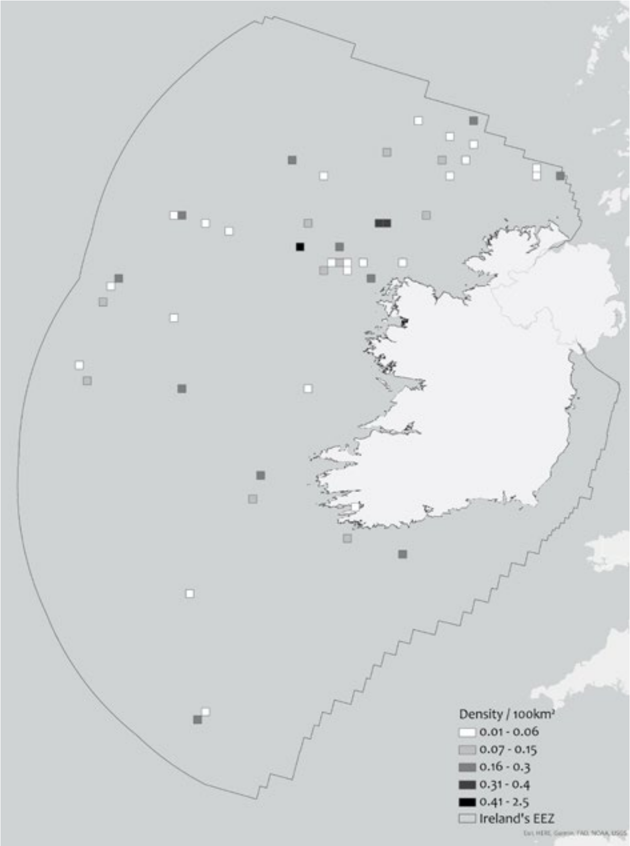


Figure C10: Atlantic white-sided dolphin density/100km2 in Ireland's EEZ across all datasets (2005-2021).

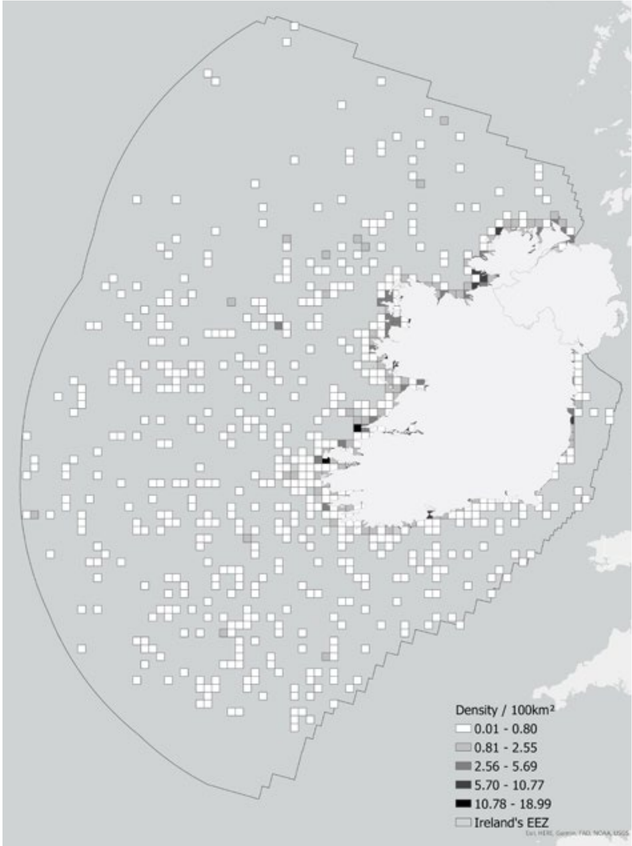


Figure C11: Bottlenose dolphin density/100km2 in Ireland's EEZ across all datasets (2005-2021).

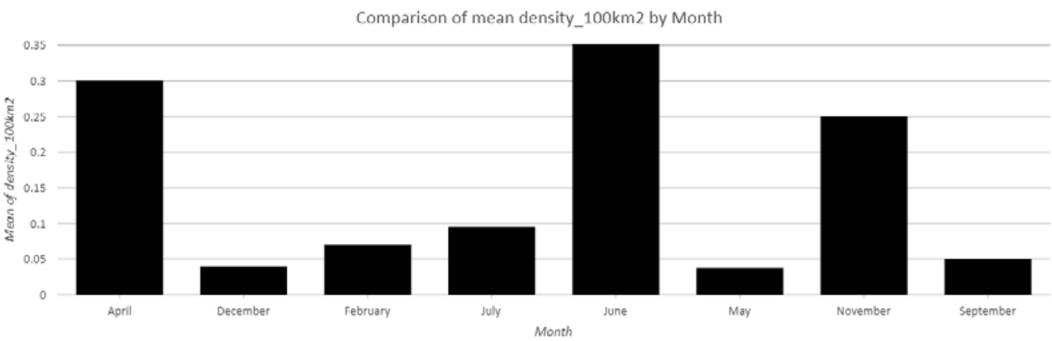


Figure C12: Mean density/100km2 per month for Atlantic white-sided dolphin across all datasets (2005-2021).

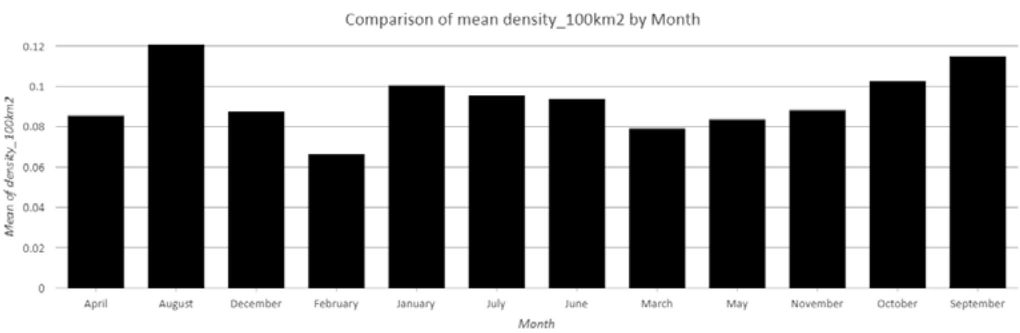


Figure C13: Mean density/100km2 per month for bottlenose dolphin across all datasets (2005-2021).

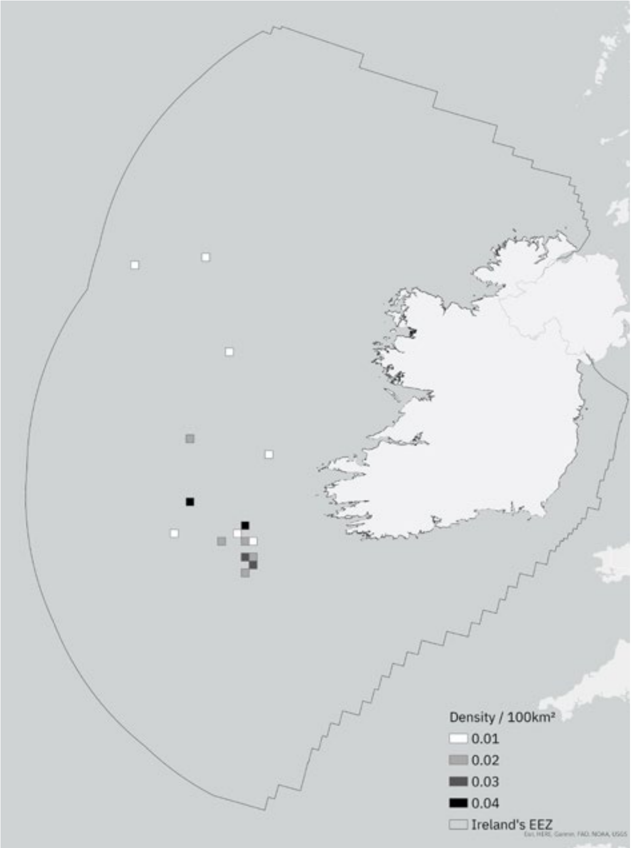


Figure C14: Blue whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

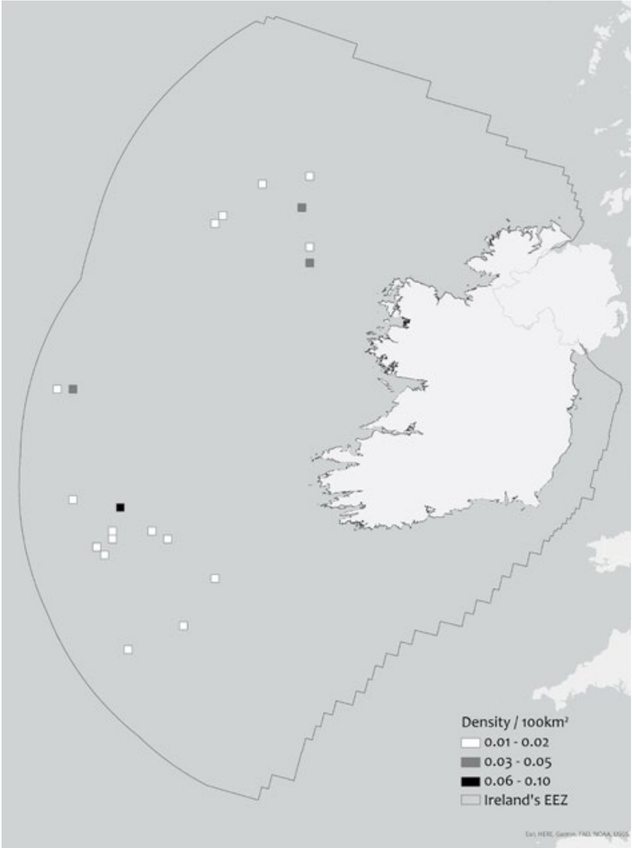


Figure C15: Cuvier's beaked whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

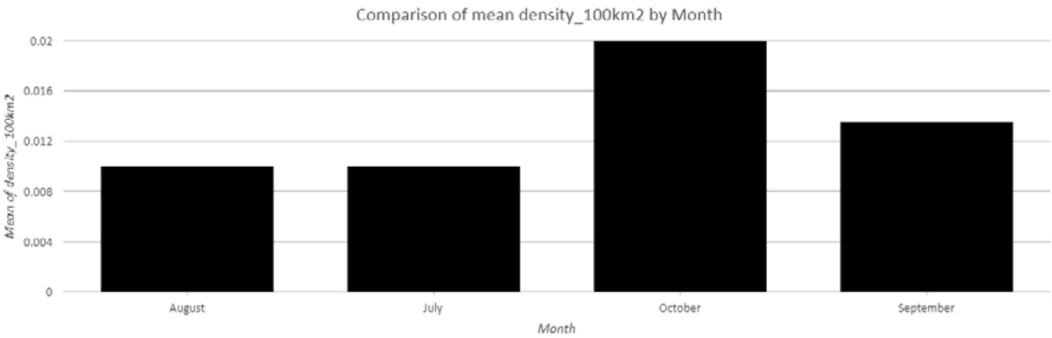


Figure C16: Mean density/100km2 per month for blue whale across all datasets (2005-2021).

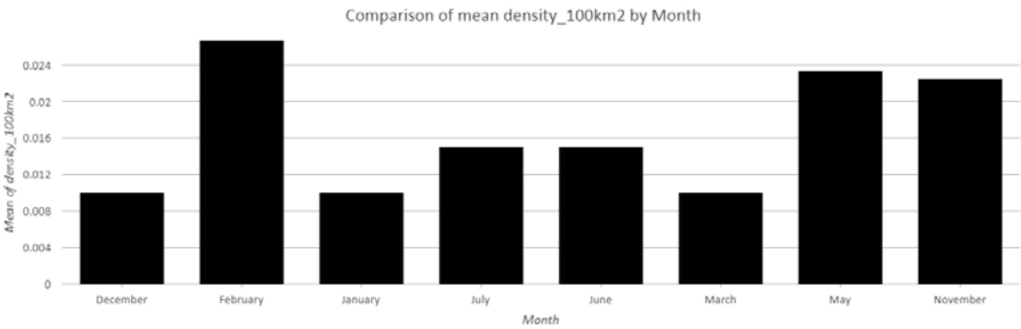


Figure C17: Mean density/100km2 per month for Cuvier's beaked whale across all datasets (2005-2021).

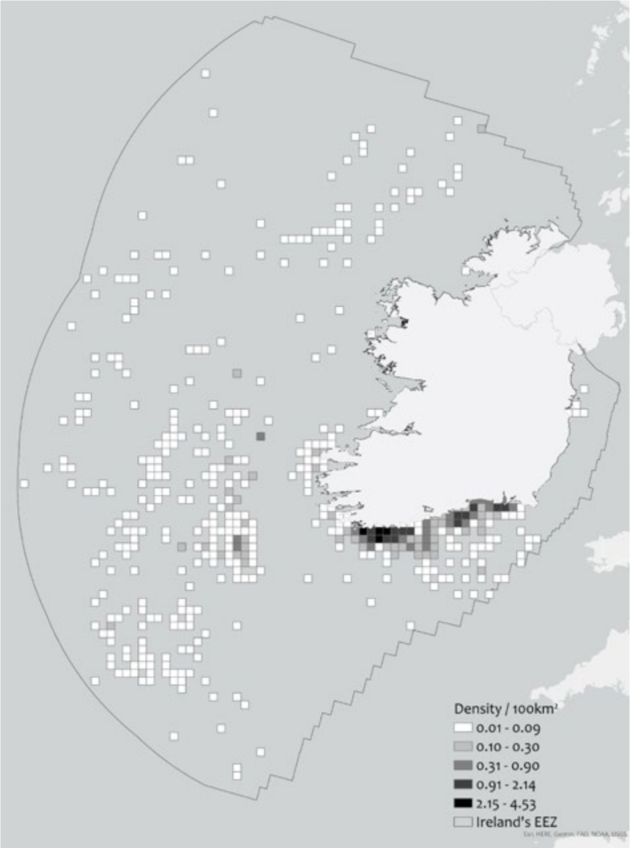


Figure C18: Fin whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

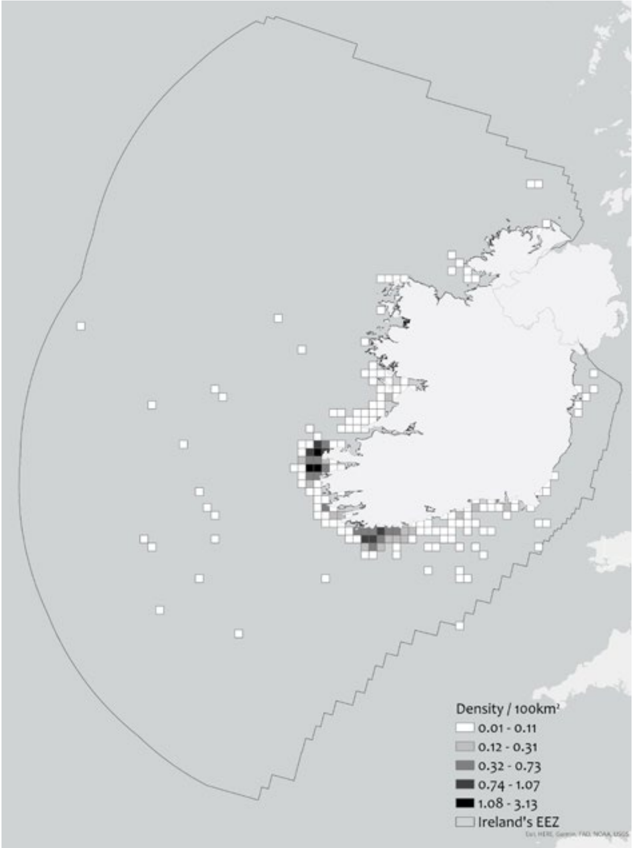


Figure C19: Humpback whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

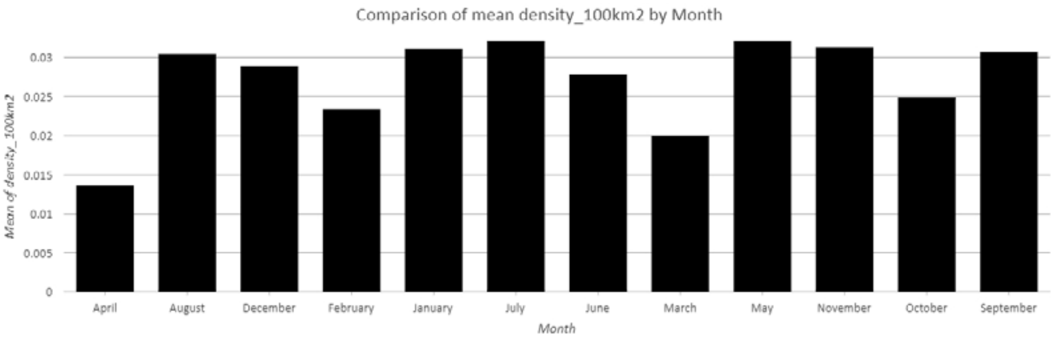


Figure C20: Mean density/100km2 per month for fin whale across all datasets (2005-2021).

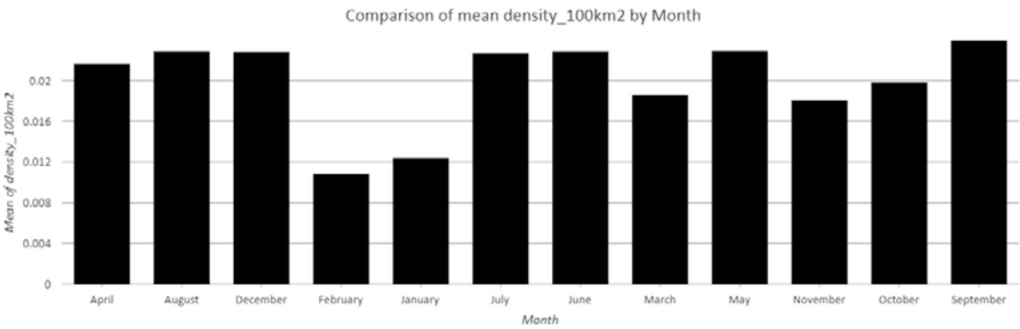


Figure C21: Mean density/100km2 per month for humpback whale across all datasets (2005-2021).

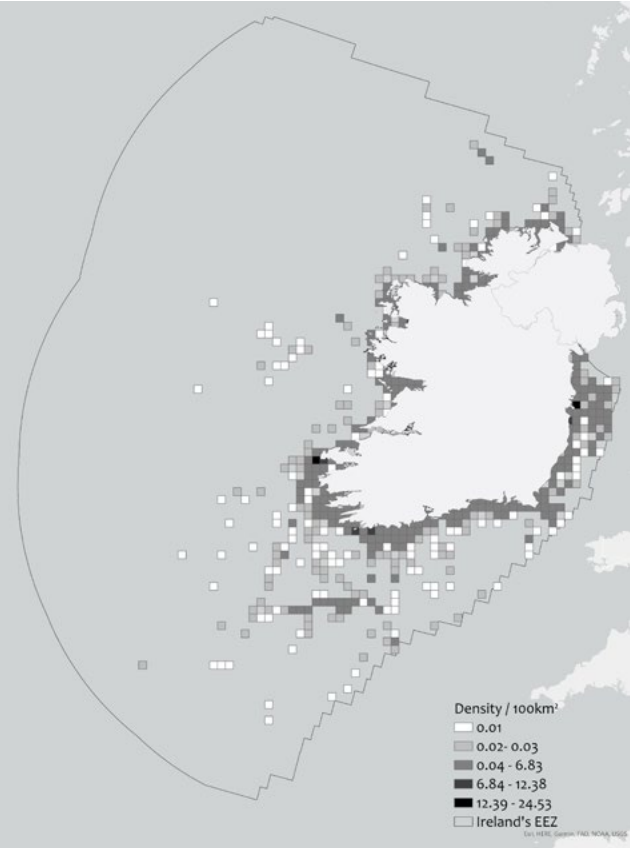


Figure C22: Harbour porpoise density/100km2 in Ireland's EEZ across all datasets (2005-2021).

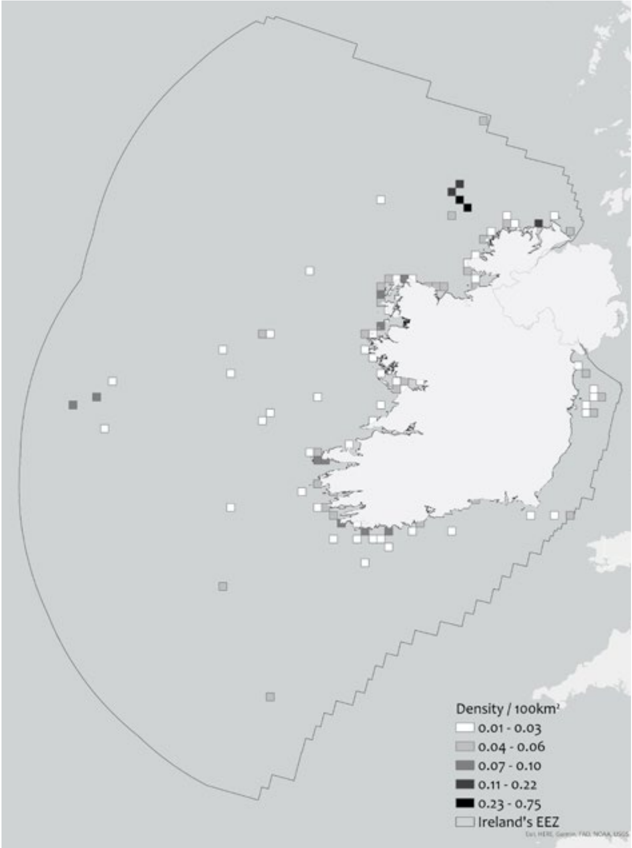


Figure C23: Killer whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

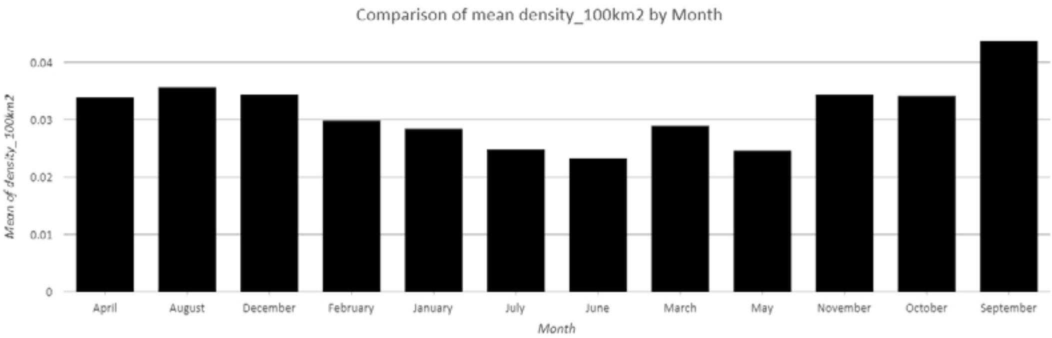


Figure C24: Mean density/100km2 per month for harbour porpoise across all datasets (2005-2021).

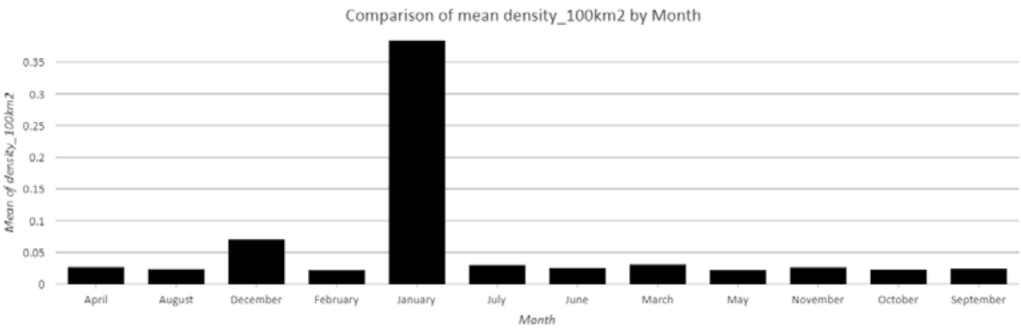
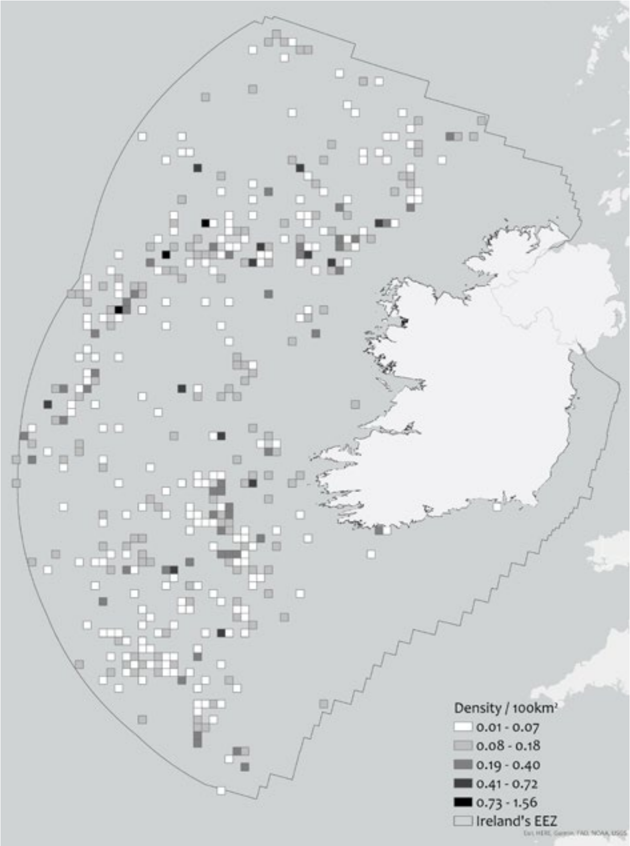


Figure C25: Mean density/100km2 per month for killer whale across all datasets (2005-2021).



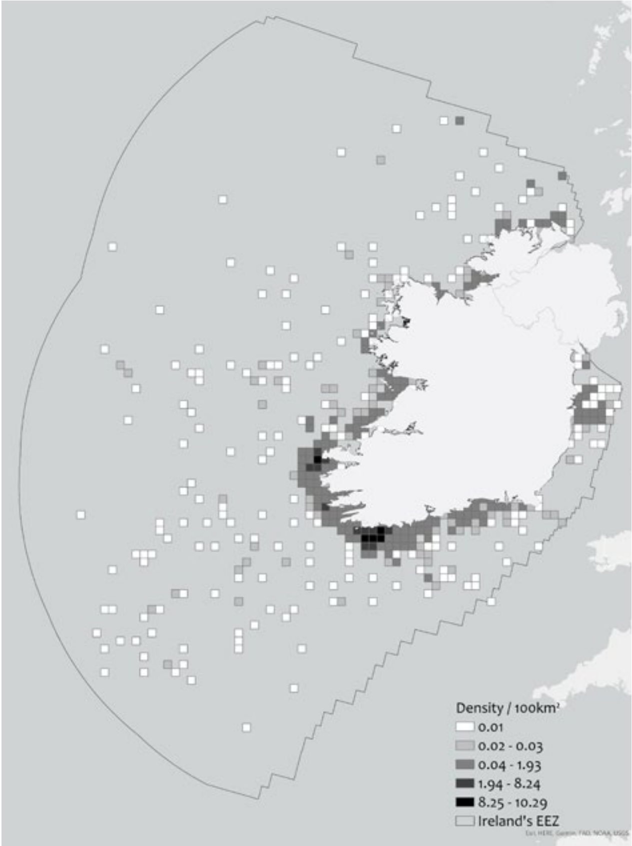


Figure C26: Long-finned pilot whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

C27: Minke whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

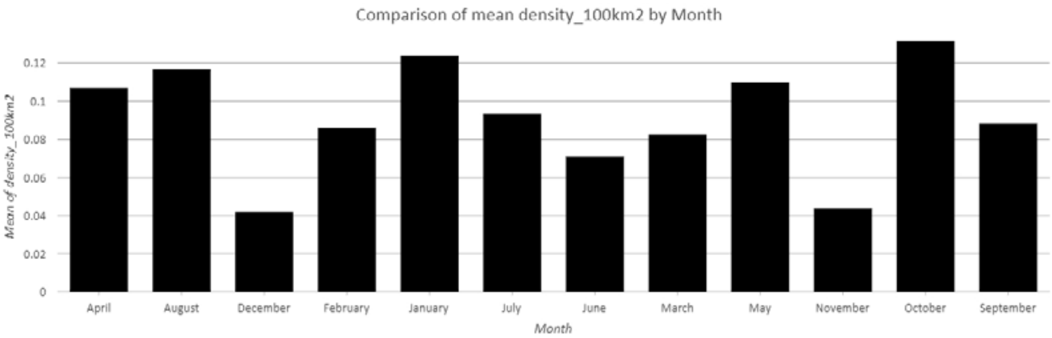
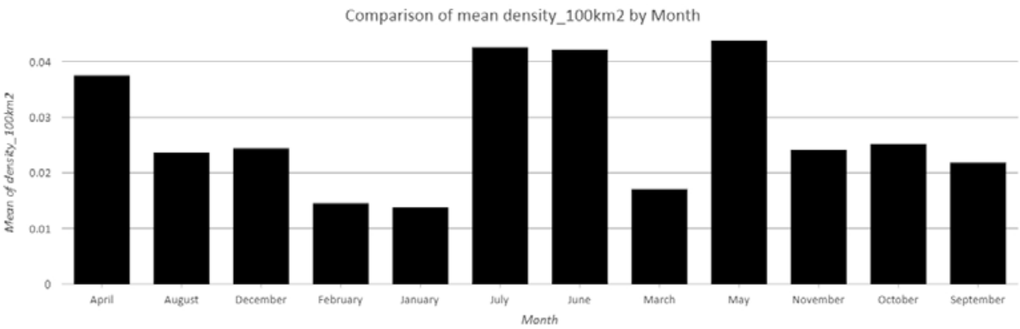
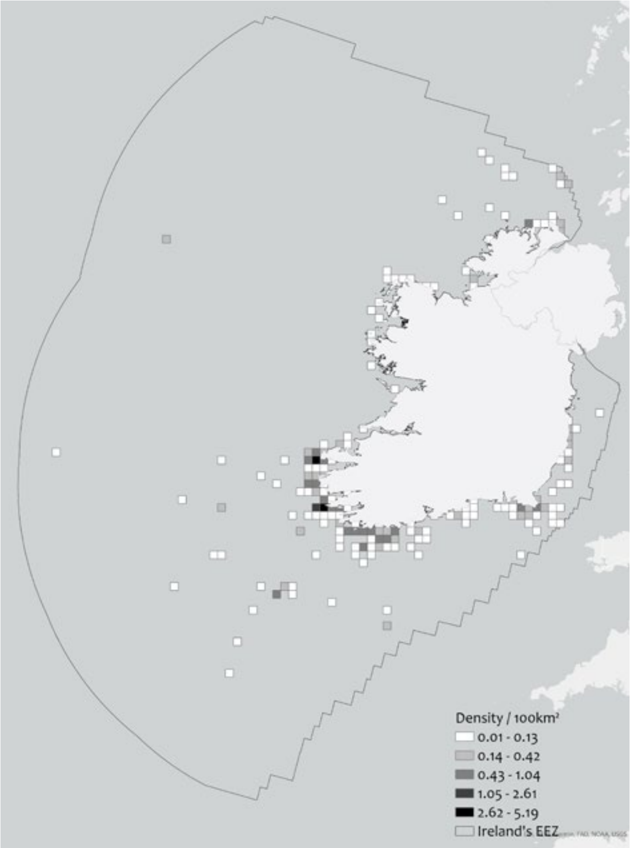


Figure C28: Mean density/100km2 per month for long-finned pilot whale across all datasets (2005-2021).



C29: Mean density/100km2 per month for minke whale across all datasets (2005-2021)



C30: Risso's dolphin density/100km2 in Ireland's EEZ across all datasets (2005-2021).

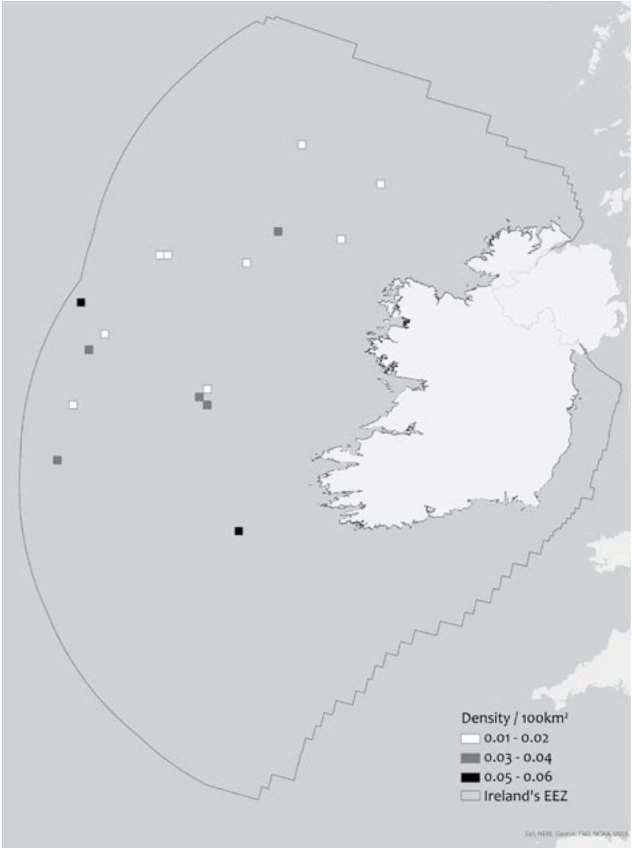


Figure C31: Sowerby's beaked whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

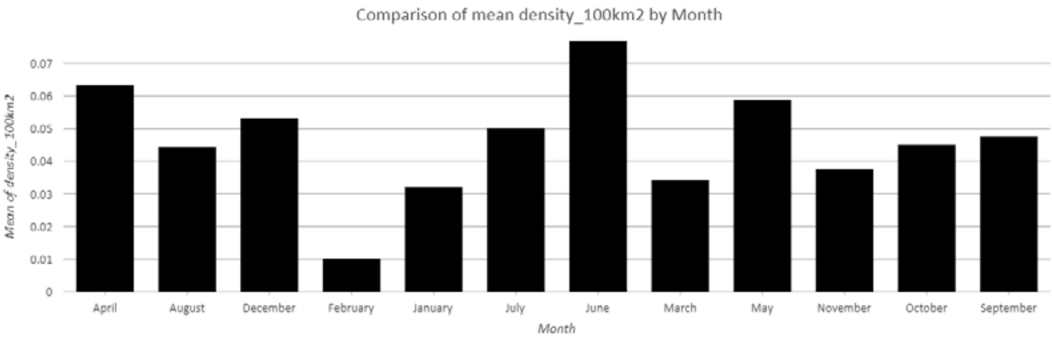


Figure C32: Mean density/100km2 per month for Risso's dolphin across all datasets (2005-2021).

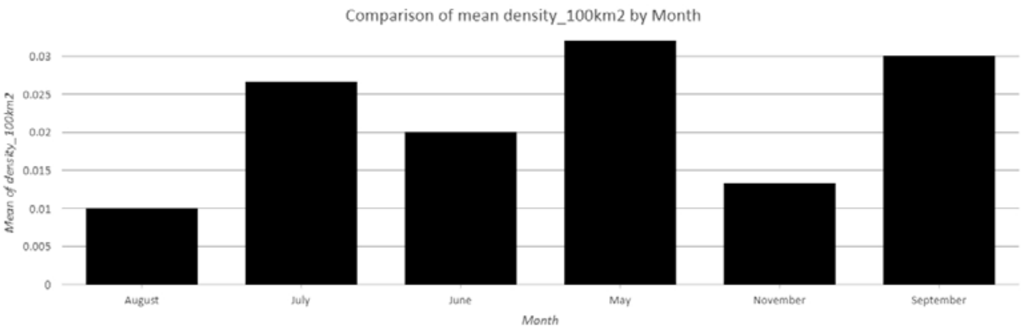


Figure C33: Mean density/100km2 per month for Sowerby's beaked whale across all datasets (2005-2021).

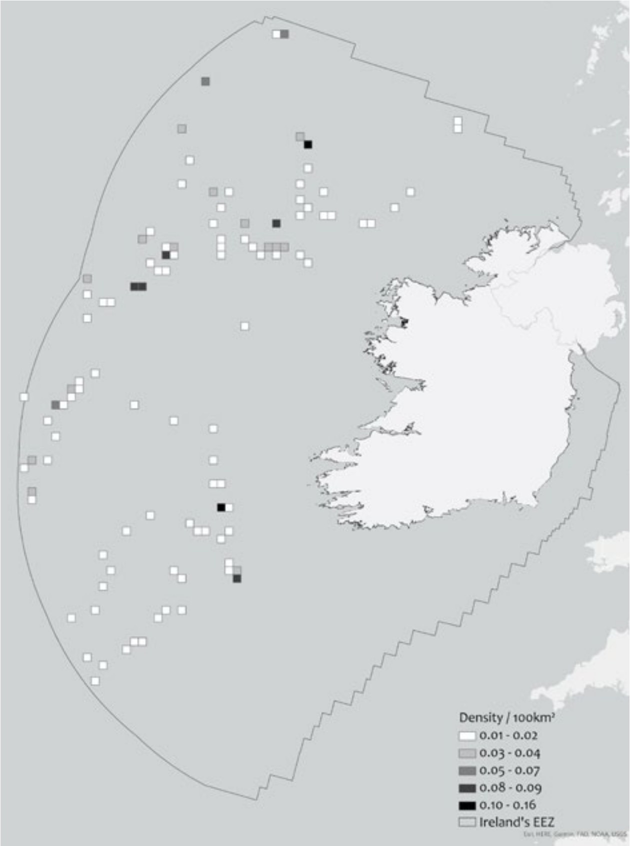


Figure C34: Sperm whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

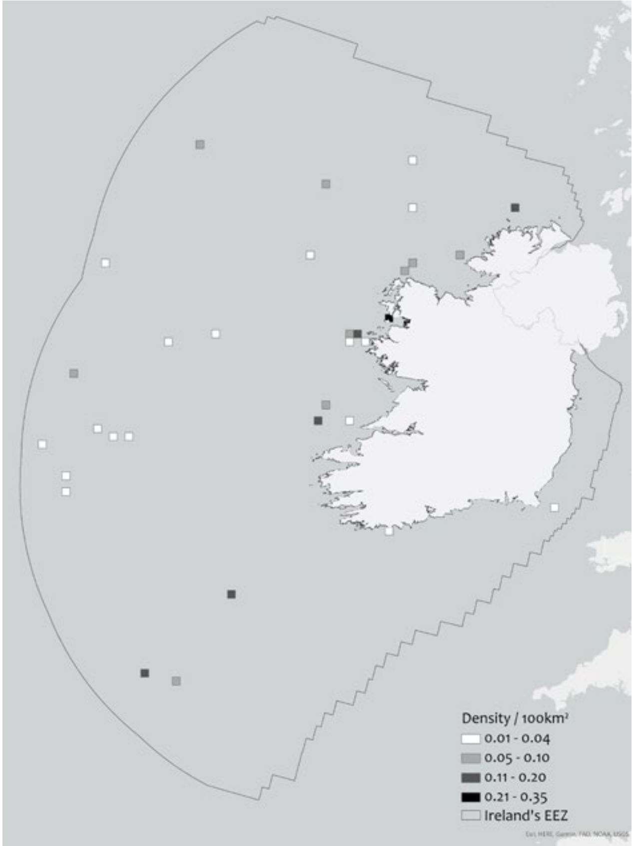


Figure C35: White-beaked dolphin density/100km2 in Ireland's EEZ across all datasets (2005-2021).

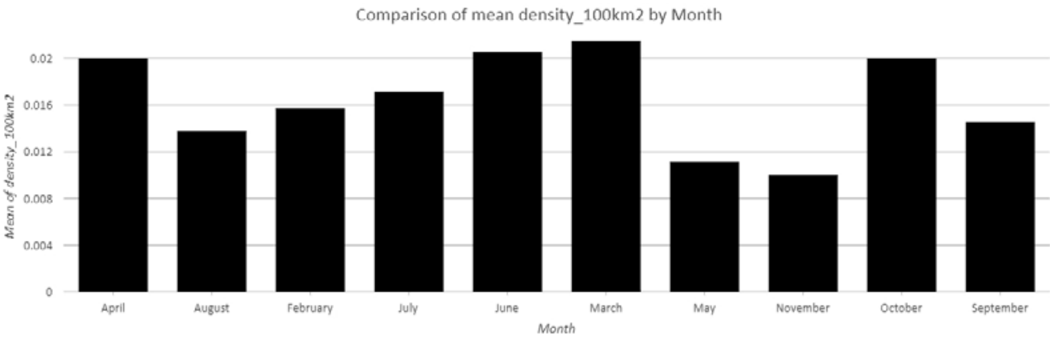


Figure C36: Mean density/100km2 per month for sperm whale across all datasets (2005-2021).

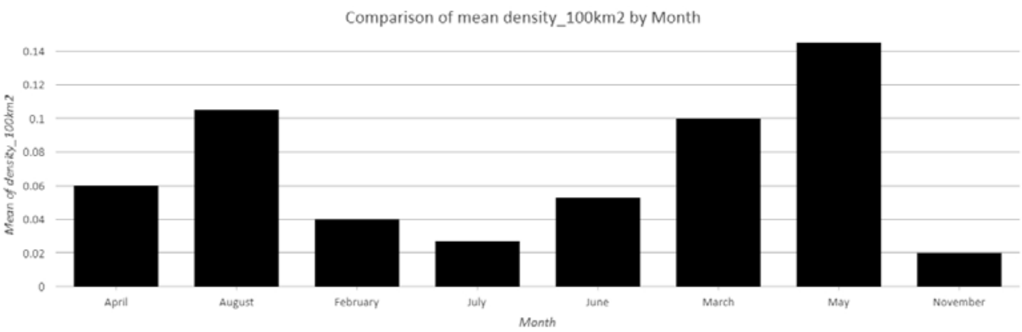


Figure C37: Mean density/100km2 per month for white-beaked dolphin across all datasets (2005-2021).

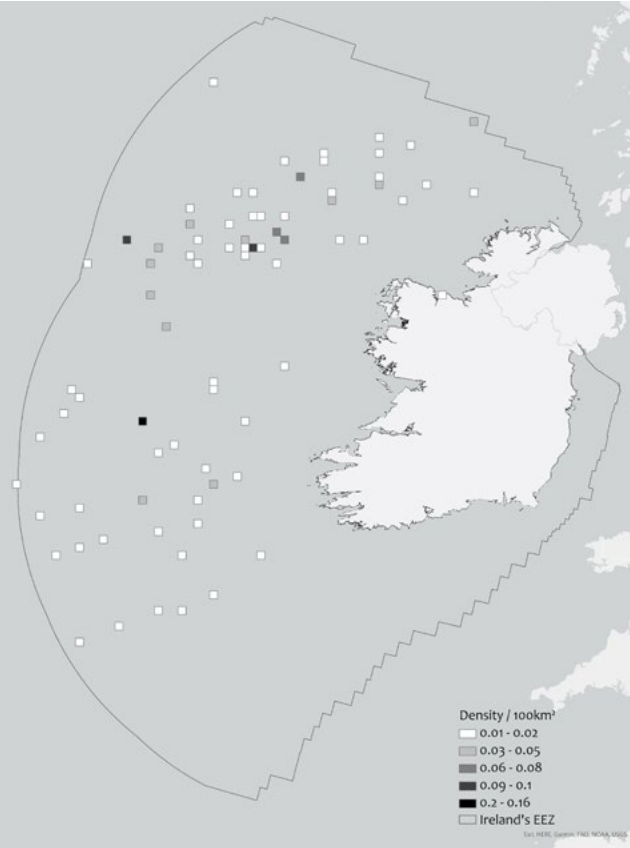


Figure C38: Beaked whale density/100km2 in Ireland's EEZ across all datasets (2005-2021).

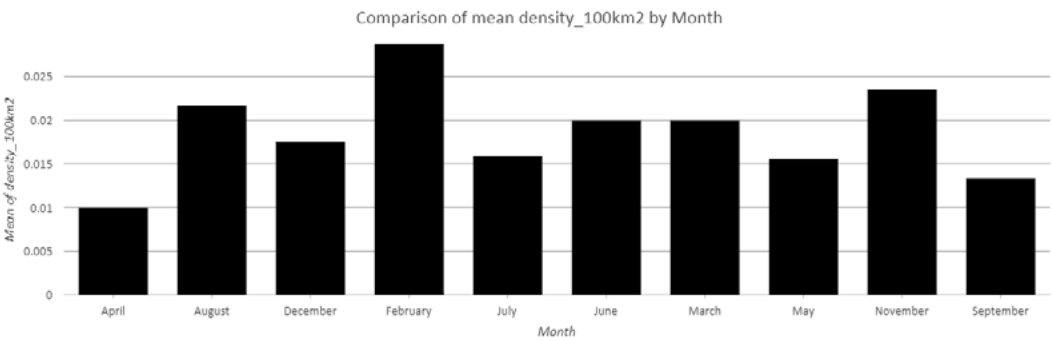


Figure C39: Mean density/100km2 per month for beaked whale species across all datasets (2005-2021).

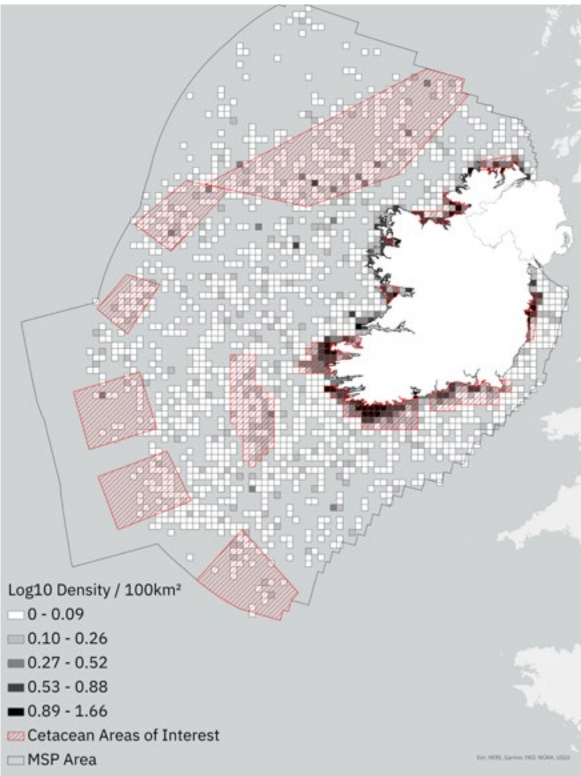


Figure C40: Cetacean Areas of Interest overlapping combined priority species densities from aerial and ship based surveys and IWDG Sightings Scheme data (2005-2021) with log10 transformation to minimise skewness.

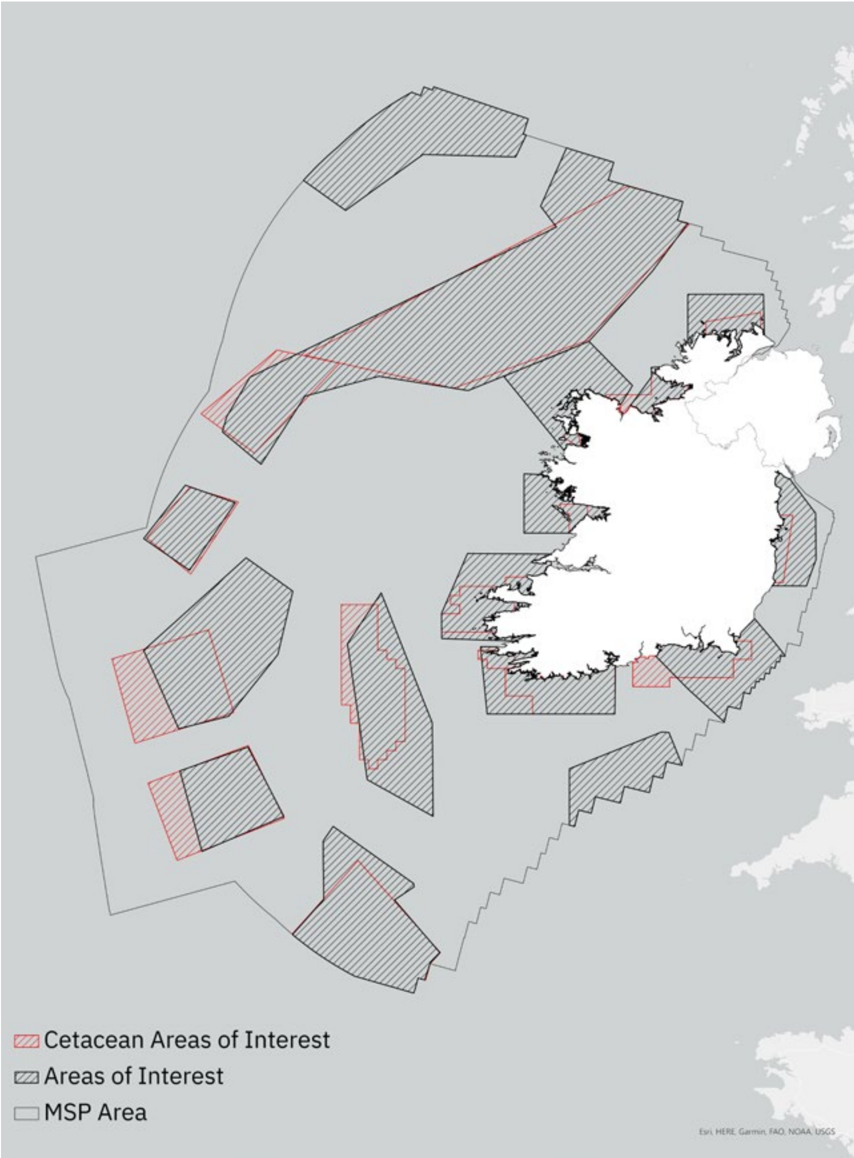


Figure C41: Cetacean Areas of Interest designed from species density analysis, distribution, species richness and evidence of species range from literature overlapping final Areas of Interest Network.

Annex D — Seabirds

Introduction

As a partner of the Fair Seas campaign the principle objective of BirdWatch Ireland was to contribute knowledge and evidence of Ireland's seabird species to support the future planned expansion of Ireland's network of Marine Protected Areas (MPA).

38 species of seabird were positively identified based on the data provided for this study. Ireland supports 24 breeding species of seabird and a number of these make up a significant proportion of the European (EU) populations, including terns, auks, shearwaters and storm-petrels. The islands, cliffs, inlets, bays and in some cases inland lakes that make up the Irish coastline are ideal breeding sites for these largely colonial birds. The locations and populations of these colonies are well documented (Mitchell et al. 2004; Newton et al. 2015; Cummins et al. 2019). In stark contrast, much less is known about seabird foraging behaviour and feeding areas in Irish waters in the months outside the breeding season, particularly in distant offshore areas. Ireland's position at the western edge of Europe, in the eastern North Atlantic means that many other species not breeding in Ireland use its extensive Exclusive Economic Zone (EEZ) on migration between more northerly, Arctic, breeding grounds and wintering areas. Some southern hemisphere breeding species also winter in the northern hemisphere (e.g. Sooty and Great Shearwaters) and a few Mediterranean species move into the northern Atlantic outside the breeding season (e.g. Balearic Shearwater). The Irish EEZ can thus be thought of as a crossroads in seabird migration systems in the North Atlantic. Seabird distribution was previously mapped in the 1990s based on data from the European Seabirds at Sea (ESAS) database (Pollock et al. 1997), then almost 20 years ago (Mackey et al. 2004), and most recently by the ObSERVE programme (2015-2017) (Rogan et al. 2018), providing information estimates of abundance. However this type of data is now being considered as a tool for identifying seabird hotspots eligible for Marine Protected Area status.

In the present study, fourteen sites were identified as Areas of Interest for seabirds. The number and boundaries of these sites were delineated based on one or more contributing factors within the analysis: (i) the presence of colonies (coastal areas only), (ii) known locations of primary and secondary migration bottlenecks, (iii) hotspots identified by semi-qualitative index for record scoring, (iv) species richness to a lesser extent.

Method

The chosen analysis had to be conducted within a short timeframe, and aimed to compliment analyses undertaken by other researchers on other taxonomic groups e.g., marine mammals, sharks, fish, sessile species, etc. To do this, several steps were followed with the aim of identifying a network of sites deemed to be essential, important, or potentially important to seabirds across all life stages.

Step 1: Identify existing data sources for seabirds in Irish waters

A search was carried out to determine what data currently existed for seabirds in Irish waters. This included colony counts, offshore vessel-based observer data, and tracking data. Some data was easily identified and downloaded through online data repositories. Others required the submission of formal requests for data not available to the general public. In some cases, data took several weeks for approval to be granted and to be received. Coastal land-based observations were not included in order to focus on the comparatively under-assessed offshore regions. Some data was not made available in its entirety because the raw data was not yet cleaned or processed sufficiently by the data managers. This applied to portions of the data collected during the independent scientific surveys carried out on the RV Celtic Explorer (Celtic Sea Herring Acoustic Survey, Blue Whiting Acoustic Survey, Western European Shelf Acoustic Survey), where in-transect sightings data was available and used in this report, but not off-transect data.

Step 2: Collate data

A database of seabird observations was compiled to contribute towards the identification of Areas of Interest for seabirds in Ireland's marine waters. It incorporated data collected in offshore areas, either observations from a vessel or aircraft. The collated database spanned forty years (1980-2020 and comprised 170,256 records available for various use in the analysis. 38 species of seabird were positively identified within the study area (Table D2). The conservation status of each species appear as assessed by the International Union for Conservation of Nature (IUCN), and the Birds of Conservation Concern for Ireland 2020-2026 (BoCCI)(Gilbert et al. 2021).

Table D1: Data sources for seabirds used in this study.

Title	Year(s)	Records	Format	Source
Offshore data:				
European Seabirds at Sea (various)	1979-2002, 2005, 2009-2010	143,651	Dataset	JNCC
Blue Whiting Acoustic Survey	2014, 2015, 2017, 2018	1,257	Dataset	Galway-Mayo Institute of Technology (Atlantic Technical University)
Celtic Sea Herring Acousitc Survey	2014, 2015, 2016, 2017, 2018	8,779	Dataset	Galway-Mayo Institute of Technology (Atlantic Technical University)
Western European Shelf Pelagic Acoustic Survey	2016, 2017, 2018 (Leg 1 & Leg 2), 2019, 2020	4,397	Dataset	Galway-MayoInstitute of Technology (Atlantic Technical University)
ObSERVE Aerial Survey	Broadscale:2015, 2016 Finescale: 2016 (Irish Sea only)	12,178	Dataset	DECC
Tracking data:				
Seatrack - seabird migration survey	2010-2013		Report	BirdWatch Ireland
FAME Seabird Tracking Project	2010-2011		Shapefile	BirdWatch Ireland
Roseate Tern tracking data (Rockabill)	2017-2018		Dataset	LIFE Project & Newcastle University
Atlantic Puffin tracking data (Little Saltee)	2017		Dataset	UCC
Colony data:				
The Status of Ireland's Seabirds: Birds Directive Article 12 Reporting	2015-2018 (& gannet census 2013/14)		Dataset	NPWS
Results of a Breeding Survey of Important Cliff-Nesting Seabird Colonies in Ireland	2015 - 2021 (a component of the above entry)		Shapefile /Report	BirdWatch Ireland
Seabird 2000	1998-2002		Dataset	BirdWatch Ireland
Tern colony counts	2016		Dataset	BirdWatch Ireland

Table D2: Seabird species recorded in Irish waters included in the report

Species Name	Common Name	IUCN (Europe)	BoCCI-4	EU Birds Directive	OSPAR
Rissa tridactyla	Black-legged Kittiwake	VU - Vulnerable	RED		Y
Hydrocoloeus minutus	Little Gull	LC - Least Concern	AMBER	Annex I	
Larus argentatus	European Herring Gull	LC - Least Concern	AMBER		
Larus canus	Common Gull	LC - Least Concern	AMBER		
Larus fuscus	Lesser Black-backed Gull	LC - Least Concern	AMBER		
Larus glaucoides	Iceland Gull	LC - Least Concern	GREEN		
Larus marinus	Great Black-backed Gull	LC - Least Concern	GREEN		
Larus melanocephalus	Mediterranean Gull	LC - Least Concern	AMBER	Annex I	
Larus ridibundus	Black-headed Gull	LC - Least Concern	AMBER		
Xema sabini	Sabine’s Gull	LC - Least Concern	GREEN		
Larus michalhellis	Yellow-legged gull	LC - Least Concern	GREEN		
Sterna dougallii	Roseate Tern	LC - Least Concern	AMBER	Annex I	Y
Sterna hirundo	Common Tern	LC - Least Concern	AMBER	Annex I	
Sterna paradisaea	Arctic Tern	LC - Least Concern	AMBER	Annex I	
Sternula albifrons	Little Tern	LC - Least Concern	AMBER	Annex I	
Thalasseus sandvicensis	Sandwich Tern	LC - Least Concern	AMBER	Annex I	
Chlidonias niger	Black Tern	LC - Least Concern	AMBER	Annex I	
Hydrobates leucorhous	Leach’s Storm-petrel	NT - Near Threatened	RED	Annex I	
Hydrobates pelagicus	European Storm-petrel	LC - Least Concern	AMBER	Annex I	
Oceanites oceanicus	Wilson’s Storm-petrel	LC - Least Concern	-		
Fratercula artica	Atlantic Puffin	EN - Endangered	RED		
Alca torda	Razorbill	LC - Least Concern	RED		
Alle alle	Little Auk	LC - Least Concern	GREEN		
Uria aalge	Common Guillemot	LC - Least Concern	AMBER		
Cepphus grylle	Black Guillemot	LC - Least Concern	AMBER		
Morus bassanus	Northern Gannet	LC - Least Concern	AMBER		
Gulosus aristotelis	European Shag	LC - Least Concern	AMBER		
Phalacrocorax carbo	Great Cormorant	LC - Least Concern	AMBER		
Fulmarus glacialis	Northern Fulmar	VU - Vulnerable	AMBER		
Catharacta skua	Great Skua	LC - Least Concern	AMBER		
Stercorarius longicaudus	Long-tailed Skua	LC - Least Concern	-		
Stercorarius parasiticus	Arctic Skua	EN - Endangered	GREEN		
Stercorarius pomarinus	Pomarine Skua	LC - Least Concern	GREEN		
Puffinus puffinus	Manx Shearwater	LC - Least Concern	AMBER		
Puffinus mauretanicus	Balearic Shearwater	CR - Critically Endangered	RED	Annex I	Y
Ardenna gravis	Great Shearwater	LC - Least Concern	GREEN		
Ardenna grisea	Sooty Shearwater	NT - Near Threatened	GREEN		
Calonectris borealis	Cory’s Shearwater	LC - Least Concern	AMBER		

Table D3: Weighted score for each grade of red and amber species. Grades beginning with 'R' refer to the Red list, and those with 'A' to the Amber list.

BoCCI weightings	
Grade	**Score**
R1	15
R2	10
R3	5
A1	15
A2	10
A3	5

Within the dataset, almost 2900 records (the majority of which were logged during the 2016 ObSERVE aerial survey of the Irish Sea) were identified as either razorbill or guillemot, with no possible further identification to species level. With such a large number of records, and as razorbill is on the BoCCI Red list, it was necessary to divide these records before carrying out analysis on the data. Where a sighting of "razorbill or guillemot" (RAGU) was listed in the records, an estimate of the proportion of each species within each 10km square was made, based on the proportion of each species across other records within that same square that positively identified to species level. As an example, if a square contained 30 records of RAGU, and the same square had 60 guillemot records and 10 razorbill records (6:1 ratio) then the 30 RAGU records were split into 25 guillemot and 5 razorbill. Therefore the new totals for each species were 85 guillemot and 15 razorbill. If only guillemot was recorded in the square, the RAGU record was changed to 'guillemot'. If neither species were recorded to species level within a square where RAGU occurred, the 8 squares surrounding that square (nearest neighbour squares) were analysed and the proportion calculated from the sum of those records.

Other records where identification to species-level was imprecise were birds belonging to the Sternidae (terns) or Hydrobatidae (storm-petrels) families. However, these records were far fewer in number and would have required a more considered approach to splitting the records, especially for terns, where more than two species would have to be considered. For this reason, these records were largely omitted from the analysis, only contributing to analysis of species diversity within 10km squares where no other Sternidae or Hydrobatidae species were recorded.

Step 3: Species selection for hotspot analysis

- Only species that were red-listed or amber listed in the Birds of Conservation Concern in Ireland 2020-2026 (BoCCI) (Gilbert et al. 2021) were considered. Green listed or unlisted species were omitted, being of lowest conservation concern.
- Three groups were chosen for hotspot mapping: red-listed species, amber-listed terns, and amber-listed gulls. It was anticipated ahead of undertaking this analysis that there would be insufficient time to incorporate all 38 species in the analysis, so the subset of red-listed and amber listed groups were selected to trial the index. Terns and gulls display similar ecological traits and distribution within their respective groups. This is not the case when grouping the red-listed species, as the species in this group vary greatly in behaviour and distribution. However, the importance of grouping these species together when identifying hotspots is to identify those areas where one or more of these species occur together, as these areas would be particularly important to identify.
- The BoCCI assessment for seabirds was adapted for the current study by grading each species within the original red and amber categories. The newly assigned grades were then used when assigning a species-specific score (Table D3, D4).

The index prioritised the most recent sightings over older records when identifying important areas. By doing so, the contribution to the score of older records is reduced. The weighted score for each species was multiplied by a record-age multiplier, giving a final score for each record within each square (Table D5). As a result, the highest scoring record was also the most recent record. The data was then filtered to remove all other lower-scoring records for each species within each 10 km square.

Scores were combined for all species within each group (1, 2 or 3) within each 10km square. By doing so, squares that were more diverse for each of these groups performed better.

When mapping the hotspots, scores were expressed as a percentile to prioritise areas with higher scores. Thresholds were decided individually for each of the 3 groups based on visual interpretation of the hotspot area coverage: 70% for red-listed species, 50% for amber-listed terns, and 50% for gulls.

Table D4: Species of seabird included in the species scoring.

		Species Weighted Score			
Group	**Category**	**Species**	**Grade**	**Justification**	**Score**
1	Red listed species	Atlantic puffin	R2	IUCN – EN, Irish population stable	10
		Razorbill	R3	Stable/increasing population	5
		Leach's storm-petrel	R3	IUCN – NT, population stable/increasing	5
		Black-legged kittiwake	R1	IUCN – VU, significant population rate of decline	15
		Balearic shearwater	R1	IUCN – CR, extinction risk	15
2	Amber listed tern species	Arctic tern	A2	Limited population size, reduced distribution	10
		Common tern	A2	Limited population size, reduced distribution	10
		Little tern	A2	Limited population size, reduced distribution	10
		Roseate tern	A2	Limited population size, reduced distribution	10
		Sandwich tern	A2	Limited population size, reduced distribution	10
		Black tern	A3	Stable/increasing population	5
3	Amber listed gull species	Lesser black-backed gull	A3	Stable/increasing population	5
		Mediterranean gull	A3	Stable/increasing population	5
		Little gull	A3	Stable/increasing population	5
		Common gull	A2	Short-term increase, long-term decrease	10
		Herring gull	A2	Short-term increase, long-term decrease	10
		Black-headed gull	A1	Reduced population and range over long-term	15

Table D5: Age multiplier criteria for prioritising more recent sightings within the dataset.

Record age range	Multiplier	Description
2016 - 2020	1	Full score
2011-2015	0.5	50% of score
Older than 10 years	0.2	20% of score
Older than 20 years	0.1	10% of score

Step 4: Foraging range of nesting seabirds
The foraging radius or range is the area of water a seabird species will regularly exploit for their food supply during the nesting and chick-rearing period. It is important to consider this in the design of areas meant for conservation, as the size of a colony can be affected by foraging range (Jovani et al. 2015), and success of breeding has been shown to be affected by the parent's foraging habits (Berrow & Croxall, 1999). Foraging ranges are influenced by whether a species has a generalist diet or specialist diet. By ensuring a sufficient area of water is included in conservation spatial planning, the aim is to protect not only the target species, but the food supply of all species that occur within that area.

BirdWatch Ireland conducted a study that identified the maximum foraging range of several seabird species from colony locations using GPS tracking data (Baer & Newton, 2012) and previously determined distances for additional species (Thaxter et al. 2012). Birds were only tagged at one site (Lambay Island), and several other Special Protection Area (SPA) sites were selected around the Irish coast, known for high diversity of breeding seabirds, to map the results of the analysis for each species present there.

In total, the mean and maximum foraging radii for 12 breeding seabird species were mapped. All 5 tern species that breed in Ireland were represented, 3 gull species, 2 auk species, cormorant and shag (Table D6). For the present study, only the maximum radius boundaries were mapped, to show the full extent of potentially important feeding grounds for breeding seabirds during the nesting season.

Step 5: Colonies of breeding seabirds
Colony locations and counts for seabirds were sourced from BirdWatch Ireland (Newton et al. 2015) and the National Parks and Wildlife Service as part of the Article 12 reporting requirements under the EU Birds Directive (Cummins et al. 2019). All colony counts were combined in one database, with the most recent and reliable count for each species present at each major colony included. These counts were mostly recorded between 2014 and 2019, across various surveys. Counts were compared to the national and European populations estimates published by BirdLife International (BirdLife International, 2015) and used to calculate the percentage that each colony represented.

Only coastal and island colonies that represented at least 5% of the national breeding population were mapped for the present study. However, it is important to note that there are many other colonies of national importance in Ireland, as they exceed the 1% threshold for flyaway populations often applied to waterbirds (Ramsar, Criterion 6). In-land colonies such as those located in lake habitats were omitted. General locations were mapped based on approximate colony occurrence within the 10km x 10km fishnet area and are not exact locations. Maps displaying colony locations for a selection of coastal Areas of Interest are shown throughout the report.

Step 6: Migration bottlenecks
Seabird migration bottlenecks (also known as migration corridors or hotspots) are locations such as pronounced coastal projections that experience large densities of a variety of species during autumn migration and post-breeding dispersal. Locations mapped in the present study represent migration bottlenecks derived from a study by BirdWatch Ireland that surveyed 20 coastal sites around Ireland over a four-year period (Keogh et al. 2014). The areas mapped for this report are roughly those sites identified as having the highest bird counts and level of activity over that period, as well as secondary sites worthy of inclusion.

Discussion
Fourteen sites were identified as areas of interest for seabirds. Across all survey data, the methods varied greatly in survey design, duration, and time of year. The winter months were particularly underrepresented across the entire study period. The collated data also showed areas in Ireland's EEZ where far fewer surveys have been undertaken such as the Rockall Basin and southern Porcupine Basin. Sites that border Ireland's coast have a stronger evidence base than those in offshore regions due to this higher level of targeted and/or incidental surveying, but since the commencement of surveys on board the RV Celtic Explorer in particular, the coverage has greatly improved in offshore waters.

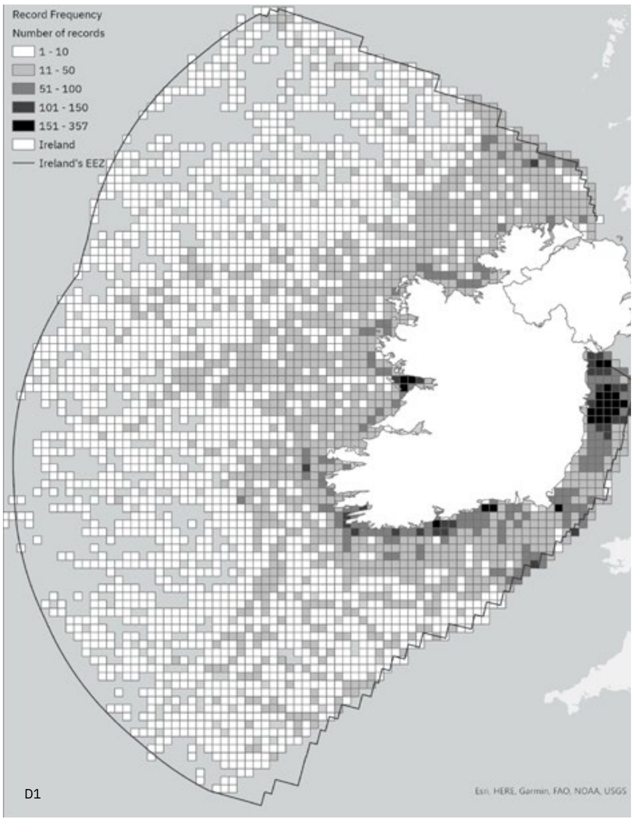
This is the first study of its kind to collate at-sea vessel observer data for the offshore waters of Ireland to identify potential areas for Marine Protected Area designation. The study only considered seabird occurrence records as a means of identifying hotspots. It did not consider seabird abundance or complex environmental factors such as temperature, bathymetry, or patterns in supply of prey, which would require much deeper analysis and a substantial amount of time beyond the remit of this report.

The present study only included presence data, and data that records absence as well as presence is preferable (Lascelles et al. 2012). However, presence data does identify those areas of interest for further analysis. Four decades of presence data shows habitual use of certain areas by seabirds year after year. These were the areas prioritised for site selection. This study also did not apply tracking data as part of the analysis, even though a certain amount of data is available, and this is data that future analysis should incorporate.

A number of species omitted from the study such as common scoter, red-throated diver and great northern diver, while not seabird species per-se, are important inhabitants of Ireland's marine waters. Future research should endeavour to include these species in marine spatial conservation exploration.

Table D6: Foraging distances for each species, derived from Baer & Newton (2012) and Thaxter et al. (2012)

	Foraging distance (km)	
Species	Mean	Maximum
Kittiwake	30	40
Common gull	25	50
Black-headed gull	11	40
Little tern	2	11
Sandwich tern	11.5	45
Common tern	4.5	30
Arctic tern	7	30
Roseate tern	12	30
Guillemot	29	45
Razorbill	31	40
Shag	15	32
Cormorant	5	35

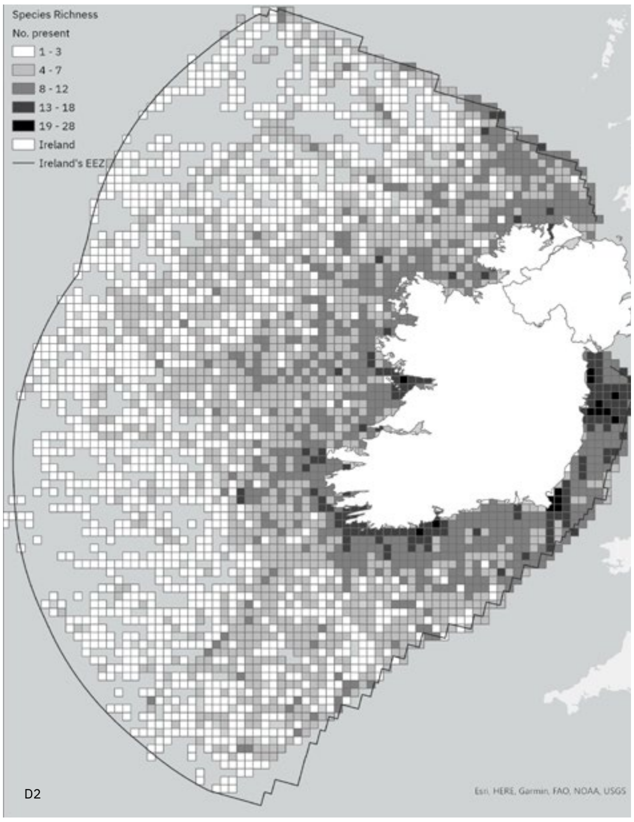


N

Lighter squares have fewer records over the full study period. Darker areas reflect higher frequency of record events.

0 50 100 km

Data Sources Fair Seas | **Map Date** 23/05/2022

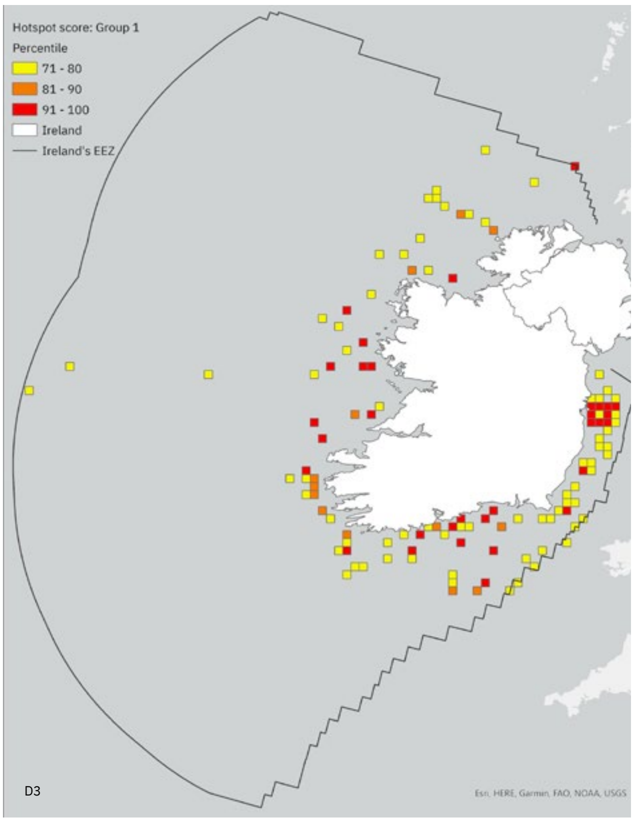


N

Species richness/diversity within the survey area covering the entire study period (1980—2020)

0 50 100 km

Data Sources Fair Seas | **Map Date** 23/05/2022



N

Areas of interest for seabirds with 70% or higher hotspot scores for BoCCI red-listed species (AE, AF, BJ, CN, RS, TE).

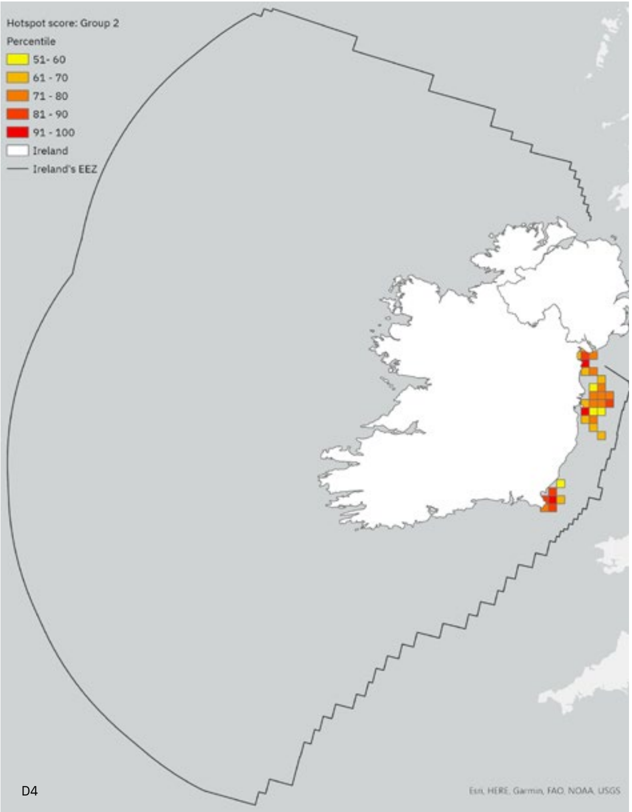
0 50 100 km

Data Sources Fair Seas | **Map Date** 22/05/2022

Figure D1: Total records collected in 10 km each square. The Irish Sea has the highest number of logged sightings within the study period. This is mainly as a result of data collected as part of the 2016 ObSERVE aerial survey, exclusively carried out in the Irish Sea. This was a fine scale survey where observations of birds were logged every minute. Data from other surveys were mostly recorded at 5- minute or 10-minute intervals. Other areas, such as the busier ports at Cork Harbour and Galway Bay, also reflect higher frequency of recordings. This is attributed to the fact that surveys often commence from these locations, resulting in concentrated sighting events at these locations.

Figure D2: Species Richness. The Irish Sea shows the highest level of species richness, as well as south-east Wexford and southwest Cork. While survey effort creates a degree of bias in the map, all records of presence have significance.

Figure D3: Hotspot areas for BoCCI red-listed species, scoring in the 70th percentile or higher in the record-scoring index. Hotspots occur mainly closer to the coast, where colonies are located and where there are recent records. A few offshore hotspots occur to the west and north. The Irish Sea shows a large area where the occurrence of these at-risk species is important.



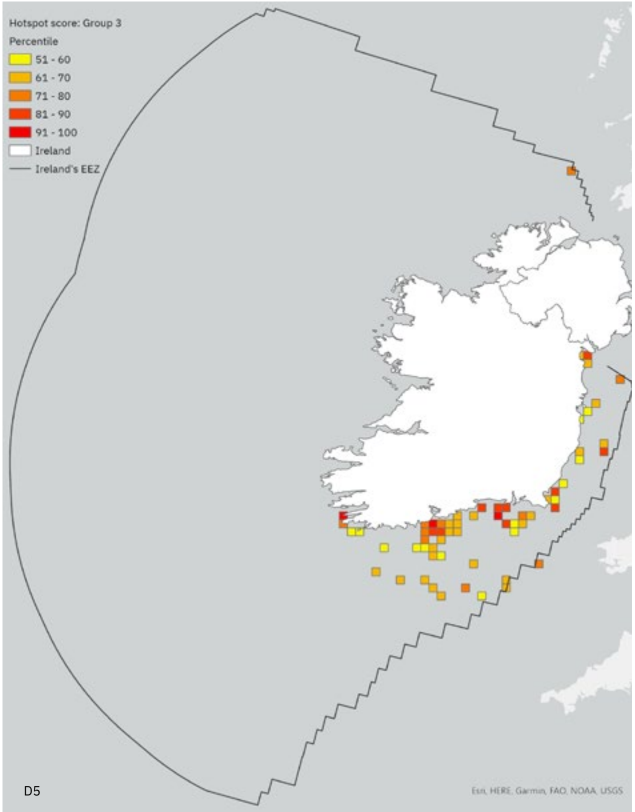
N

Areas of Interest for seabirds with 50% or higher hotspot scores for BoCCI amber listed terns (AE, AF, BJ, CN, RS, TE).

Data Sources Fair Seas | **Map Date** 23/05/2022

0 50 100 km

Figure D4: Records for BOCCI amber-listed terns that scored in the 50th percentile or higher in the record-scoring index were mapped. Hotspots were identified in the Irish Sea only. This is where records were most recent and where there are colonies with significant proportions of tern populations.



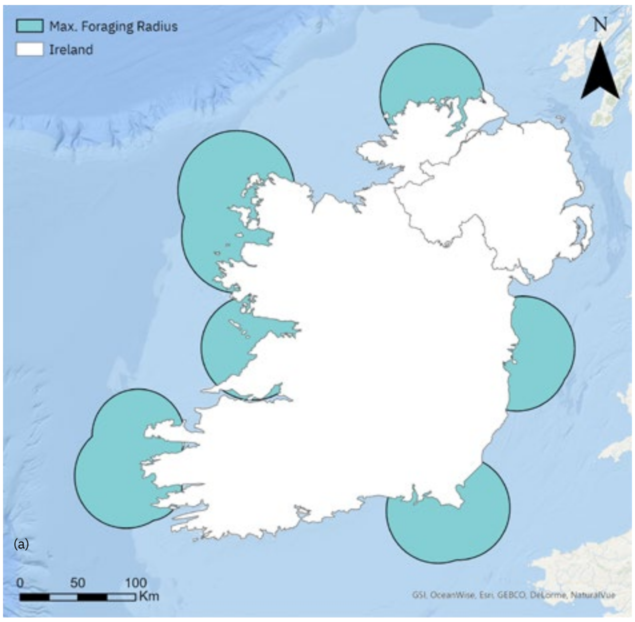
N

Areas of Interest for seabirds with 50% or higher hotspot scores for BoCCI amber listed gulls (BH, CM, LB, LU, MU).

Data Sources Fair Seas | **Map Date** 23/05/2022

0 50 100 km

Figure D5: Records for BOCCI amber-listed gulls that scored in the 50th percentile or higher in the record-scoring index were mapped. Hotspots were identified in the Irish Sea and Celtic Sea. Large clusters are identified extending from Cork Harbour, as well as Waterford and Wexford.



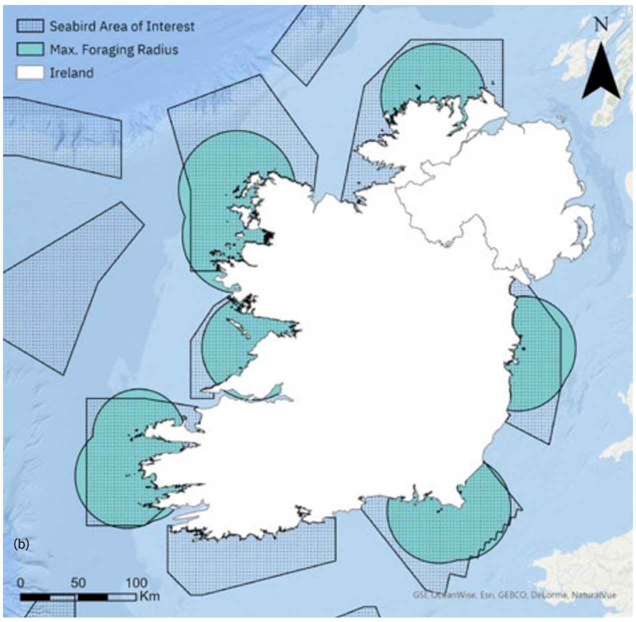


Figure D6 (a, b): Foraging range of major colony locations. a) The map focuses on foraging ranges extending from coastal areas where key colonies for seabirds are located. These foraging ranges are specific to the breeding season only. b) The map shows how foraging ranges influenced the limits of coastal Areas of Interest.

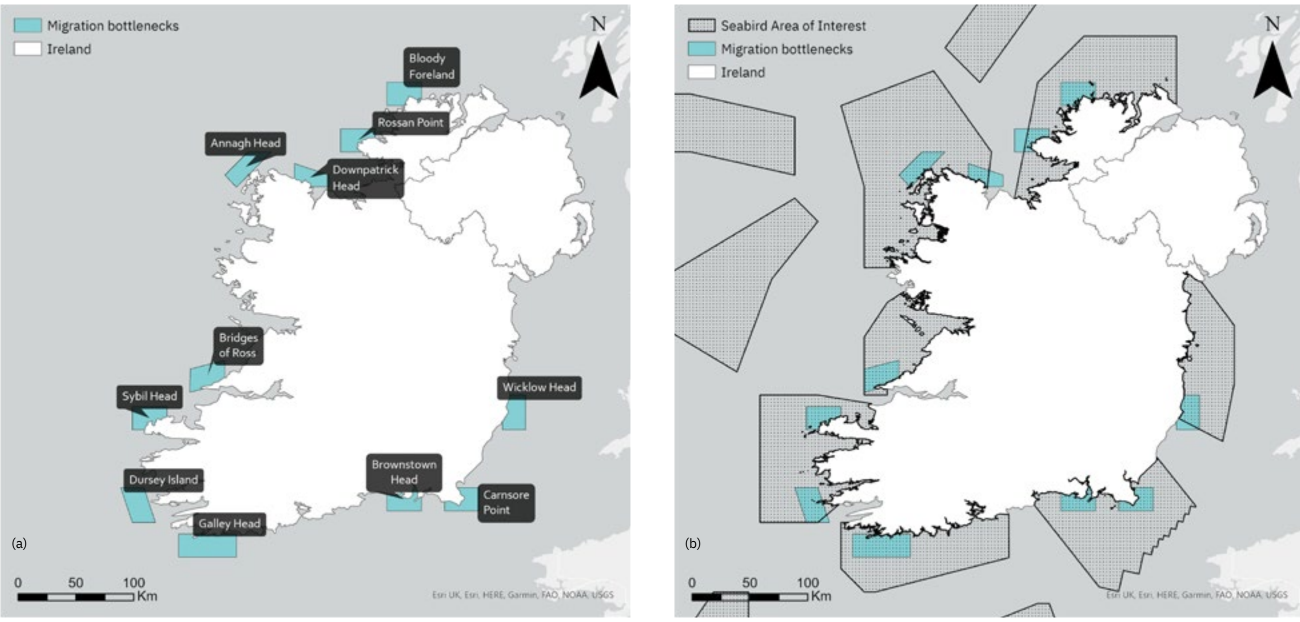


Figure D7 (a, b): Migration bottlenecks. The maps focus on coastal waters only, as migration bottlenecks are identified on often protruding geographical features around Ireland such as peninsulas or points. All bottlenecks areas occur either completely or partially within seabird Areas of Interest.

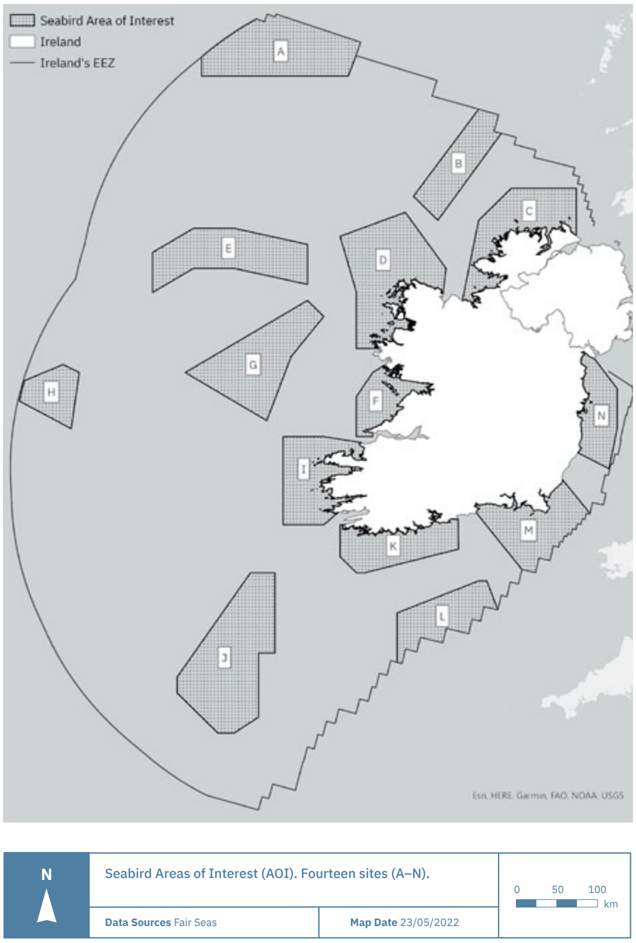
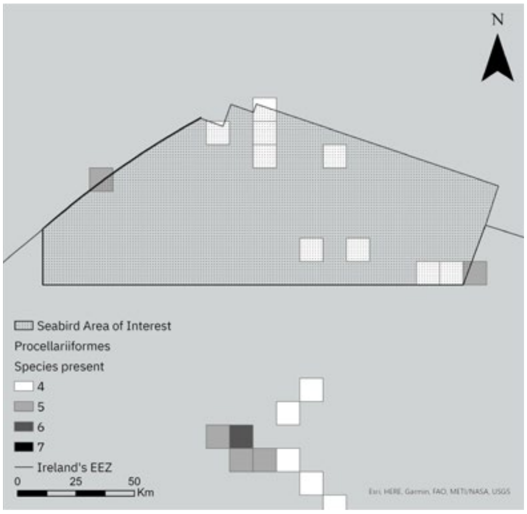
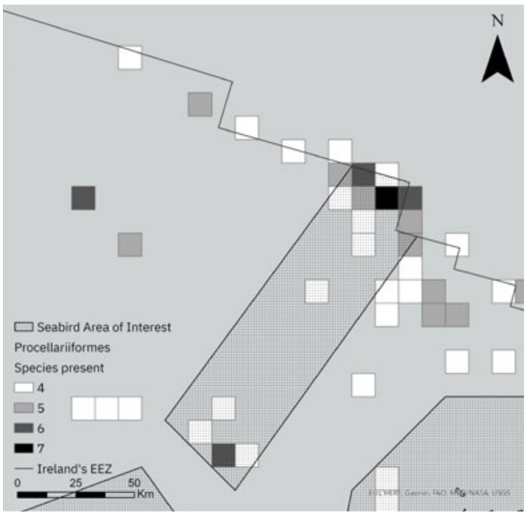


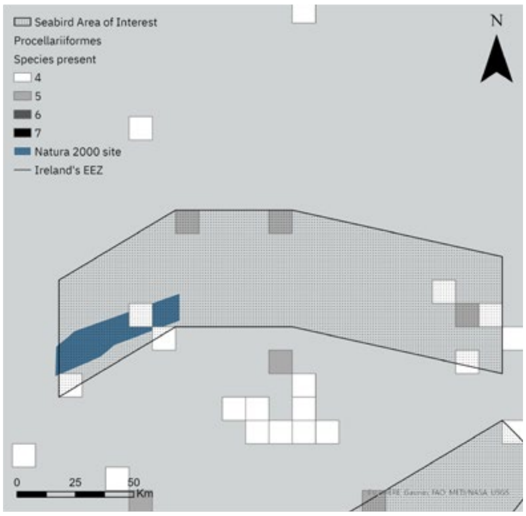
Figure D8: A total of fourteen seabird Areas of Interest were identified based on hotspot mapping, foraging ranges from colonies, migration bottlenecks, species richness, and presence of tubenoses in offshore areas.



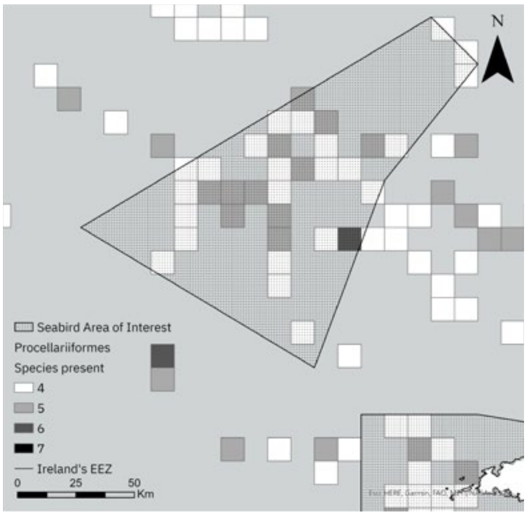
a) Seabird AOI—A



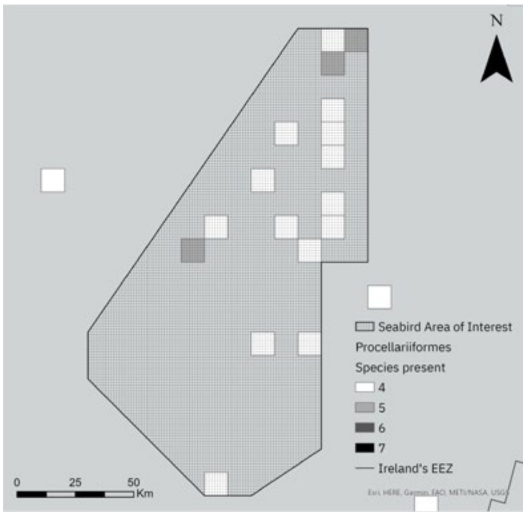
b) Seabird AOI—B



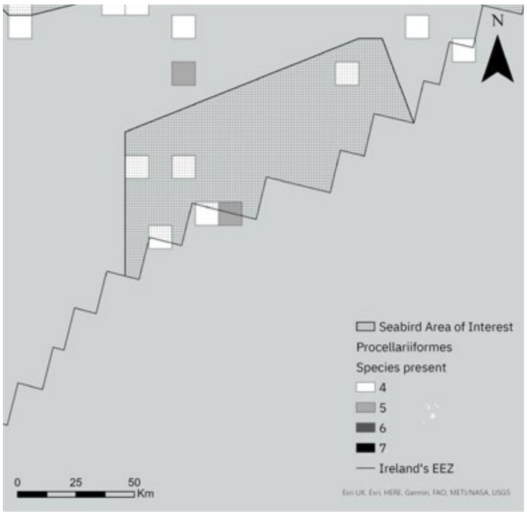
c) Seabird AOI—E



d) Seabird AOI—G



e) Seabird AOI—J



f) Seabird AOI—L

Figure D9 (a - f): Presence of Procellariiformes (tubenoses). Areas of higher diversity for seabird species of the Order Procellariiformes which include fulmar, Manx shearwater, Cory's shearwater, great shearwater, sooty shearwater, Balearic shearwater, Leach's storm-petrel, and European storm-petrel.

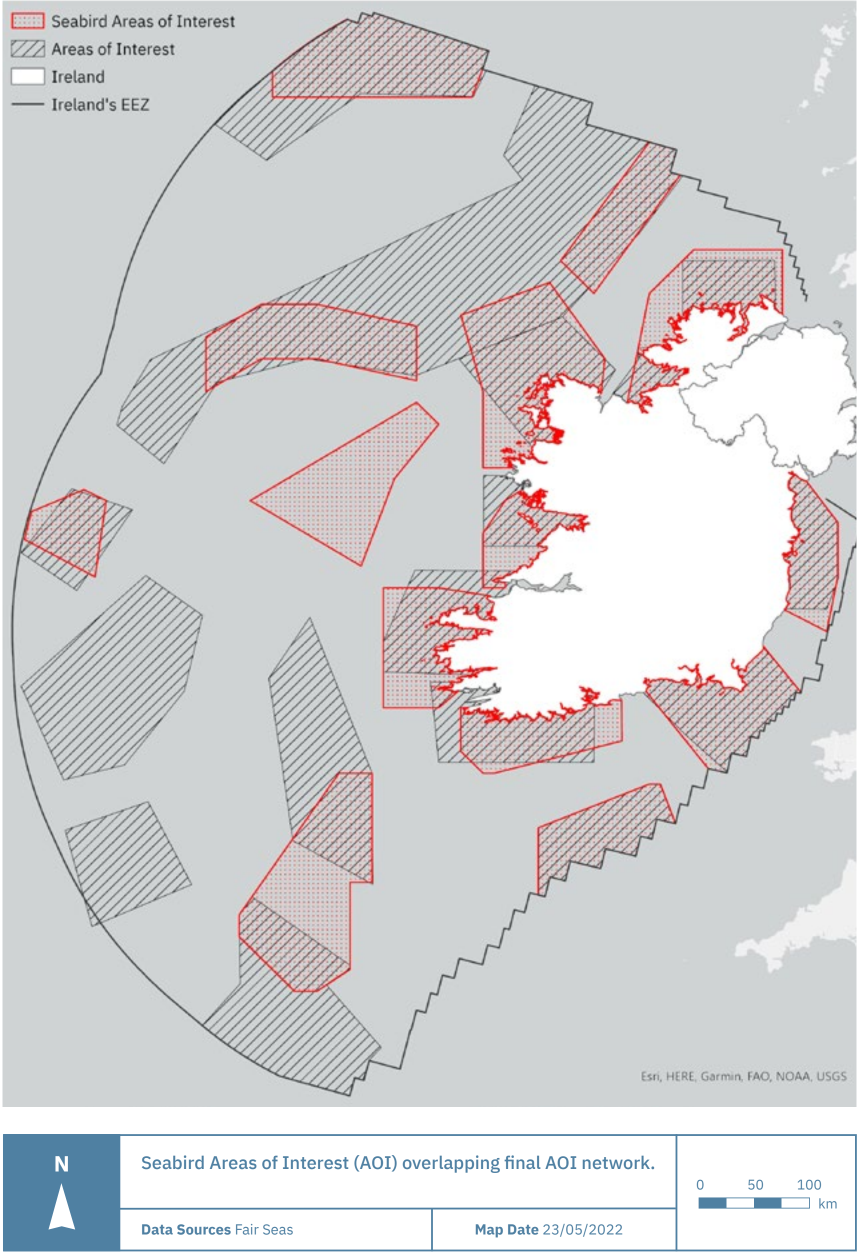


Figure D10: Seabird Areas of Interest overlapping final Areas of Interest Network.

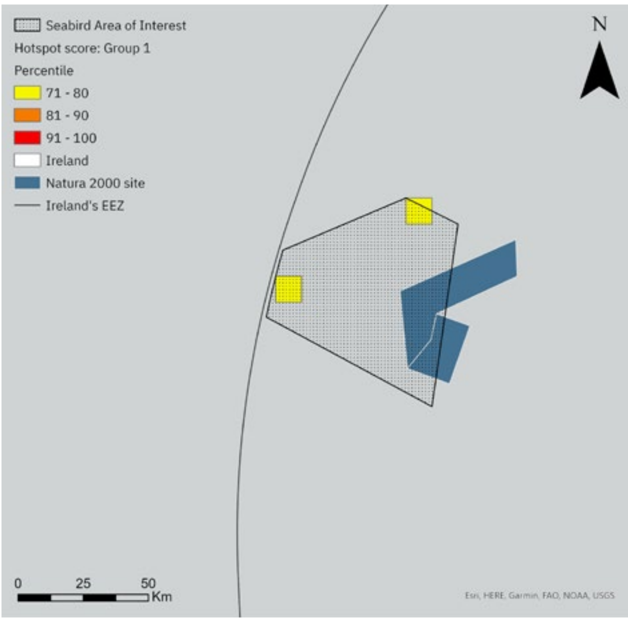


Figure D11: Seabird AOI - H boundary was guided by hotspot scores for BoCCI red listed species and seafloor bathymetry but was also found to incorporate sections of existing Natura 2000 sites.

Annex E— Commercially Exploited Species

Introduction

As a partner of the Fair Seas campaign, the Irish Wildlife Trust contributed evidence of Ireland's invertebrate seabed species, elasmobranchs and commercially exploited species with the aim of identifying potential Areas of Interest for MPA designation in Irish Waters.

The aim of the inclusion of commercially exploited species was to introduce an element of the Marine Strategy Framework Directive and the Common Fisheries Policy requirements into the MPA conversation.

Methods

Step 1: Species selection
All species that were fished above MSY or whose spawning stock biomass was below MSYbtrigger were included in the analysis, except for mackerel. After consultation with the Marine Institute, mackerel was eliminated due to outdated spawning ground data.

Step 2: Identify existing data sources
For this analysis, known locations of spawning grounds were considered sufficient for the scope of this report. Existing polygons created by the International Council for the Exploration of the Sea (ICES, 2009) were downloaded from Ireland's Marine Atlas.

Step 3: Mapping and overlapping of existing polygons
Spawning ground polygons of the seven commercially exploited species were mapped in QGIS 3.16.16 and rasterized. The rasters were overlaid using the raster calculator. A new shapefile was created in order to draw polygons around any areas where between 2-4 species' spawning grounds overlapped, depending on the size of the spawning grounds (e.g. horse mackerel and blue whiting spawning grounds have a large spatial overlap, but the polygon was restricted to areas where horse mackerel and blue whiting also overlap with nephrops, in order to reduce spatial coverage of the polygons).

Results
The Irish Sea and parts along the south coast had the highest overlap of spawning grounds, with up to four of the seven included species spawning in those areas. Other important areas were outer Galway bay, the Donegal coastline and the porcupine bank.

Table E1: Commercially exploited species included in the study

Species	Scientific name	2021 Stock Book Sustainability Assessment
Nephrops	*Nephrops norvegicus*	Biomass was below MSY Btrigger in 2021
Blue Whiting	*Micromesistius poutassou*	Fishing mortality was above MSY in 2021
Cod	*Gadus morhua*	Fishing mortality was above FMSY and MSYbtrigger for at least one stock in 2021
Haddock	*Melanogrammus aeglefinus*	Fishing mortality was above FMSY and MSYbtrigger for at least one stock in 2021
Herring	*Clupea harengus*	Fishing mortality was above FMSY and MSYbtrigger for at least one stock in 2021
Horse Mackerel	*Trachurus trachurus*	Fishing mortality was above FMSY and MSYbtrigger for at least one stock in 2021
Whiting	*Merlangius merlangius*	Fishing mortality was above FMSY and MSYbtrigger for at least one stock in 2021

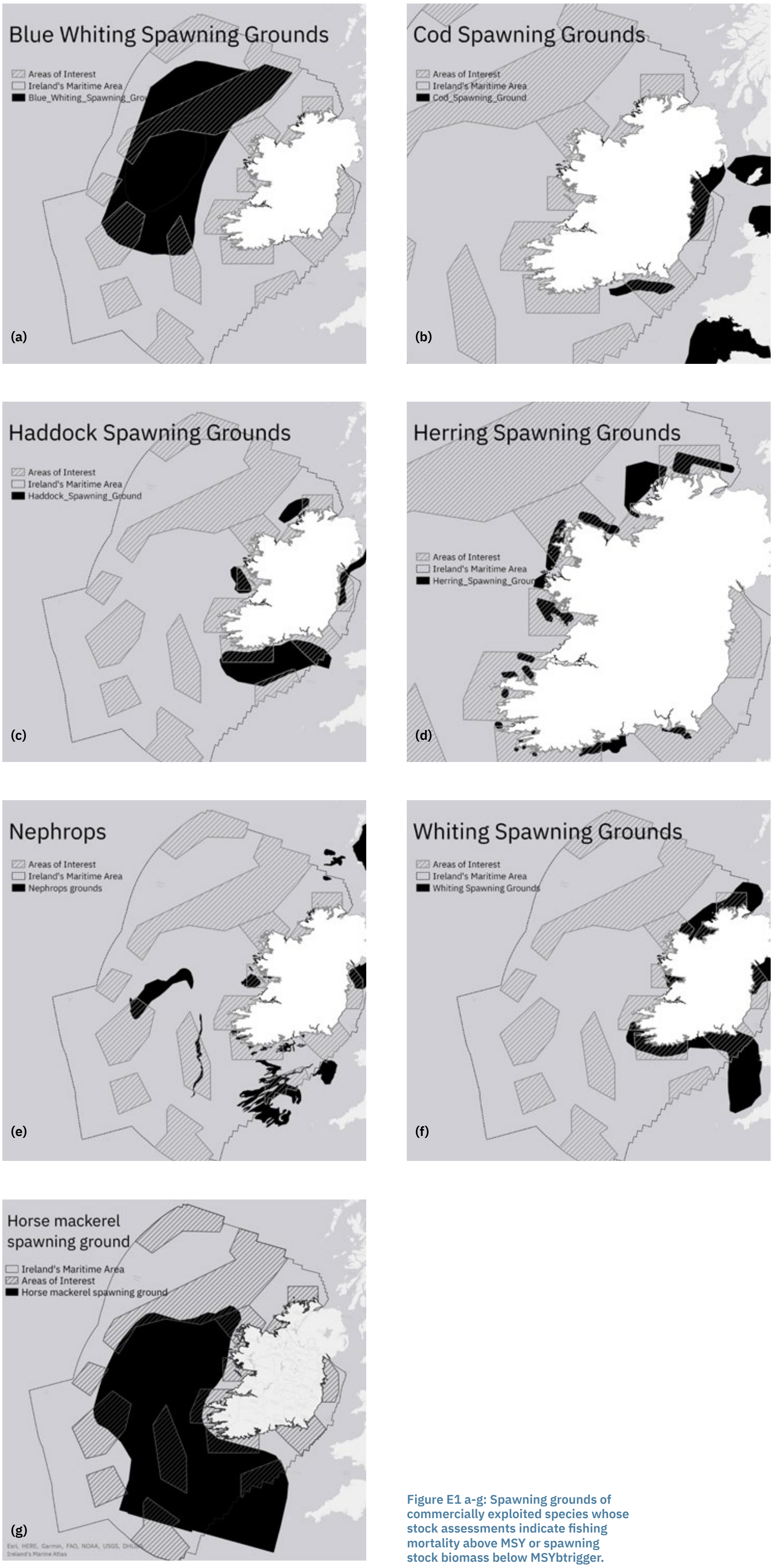


Figure E1 a-g: Spawning grounds of commercially exploited species whose stock assessments indicate fishing mortality above MSY or spawning stock biomass below MSYbtrigger.

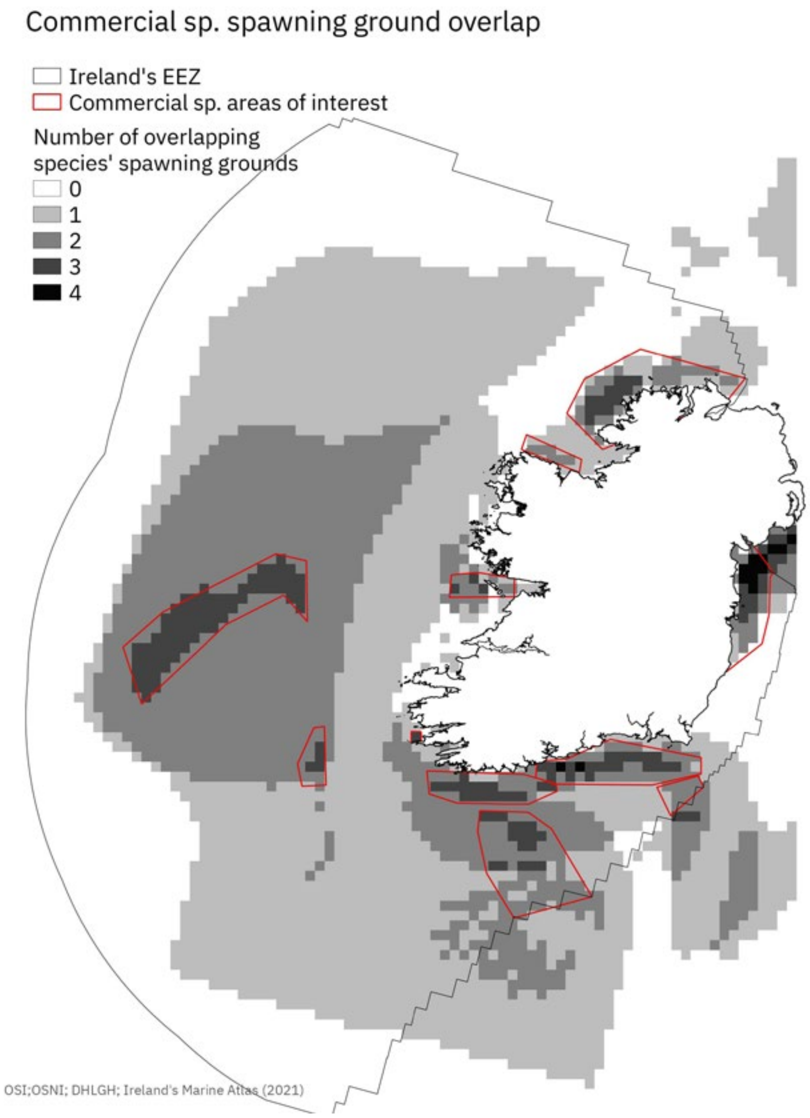


Figure E2: Raster of overlapping spawning grounds with chosen areas of interest for commercially exploited species.

Discussion

The locations of spawning grounds used in this study were developed in 2009. It is likely that some of the spawning grounds are outdated or may shift in future due to climate change (Sandø et al., 2020). It is therefore important to apply the precautionary approach when setting MPA boundaries. Future analysis could include modelling studies to predict how spawning grounds may change in response to warming or other factors.

The study included only species fished above MSY or below MSYbtrigger where locations of spawning grounds are known. This has excluded species from the analysis that lack evidence of spawning site fidelity, e.g. sprat and species with unknown stock statuses. Future analyses should include all commercially exploited species and a weighting system could be applied to species with a poor sustainability assessment, similar to the bird scoring system applied in this study.

Fish distributions and spawning grounds should form an important part in the design of Ireland's future MPA network in order to fulfil the requirements of EU nature laws (e.g. MSFD, CFP). This study represents one possible way this could be achieved using simple GIS analysis.

Several anadromous fish species were initially considered as part of this analysis (salmon, sea trout, allis shad). However, suitable data sources could not be identified to help discover potentially important areas for these species in the marine. Estuaries of important salmon rivers, for example, should be considered as part of the future MPA network, because salmon are currently not protected throughout their marine life stages.

Annex F — Elasmobranchs

Introduction

As a partner of the Fair Seas campaign, the Irish Wildlife Trust contributed evidence of Ireland's invertebrate seabed species, elasmobranchs and commercially exploited species with the aim of identifying potential Areas of Interest for MPA designation in Irish Waters.

Methods

Step 1: Species selection
The elasmobranchs that were included in this study were chosen based on their IUCN Red List Status in Ireland (Clarke et al., 2016) and their inclusion under OSPAR.

Step 2: Identify existing data sources
Initially, the National Biodiversity Data Centre was consulted to identify potential sources for elasmobranch data. The GBIF database was also searched for Irish elasmobranch datasets. It was found that a high degree of overlap existed between the datasets and that they contained a high number of older records and were not up-to-date. Because trawl surveys made up the majority of the GBIF and NBDC datasets, it was decided to source all trawl survey data directly from the Database of Trawl Surveys (Datras). The four trawl surveys used in this study are shown in table F2. Fishery trawl survey datasets lacked records for several near-shore and critically endangered species, e.g. angel shark, or white skate. For these species, angling records would have been a good resource. However, angling records were not made available for use in this study, therefore the study relied on literature (Clarke et al., 2016) to identify suitable areas for these data poor species. In addition, the Marine Institute's north Kerry elasmobranch survey records were included to provide evidence for the importance of the Tralee, Brandon and Dingle Bay areas for threatened species. For basking sharks, ObSERVE aerial survey records and the IWDG database, which includes 23 surveys and public sightings data, was used. Porbeagle and white skate were the only species completely eliminated from final analysis due to lack of data.

Step 3: Filter the Datras datasets for elasmobranchs
All elasmobranch records from the four surveys were combined and male/female records and different length classes combined to produce a single dataset that would show (1) the unique ID of the survey haul (survey+quarter+StNo+HaulNo+year), (2) species name, (3) haul latitude, (4) haul longitude, (5) total number (for density analysis) and (6) presence (for sp. richness analysis).

Table F1: Elasmobranchs included in the final analysis

Species	Scientific name	OSPAR	IUCN Red List Status (North-East Atlantic)
Angel shark	*Squatina squatina*	y	CR
Basking shark	*Cetorhinus maximus*	y	EN
Blue Skate	*Dipturus batis*	y	CR
Flapper Skate	*Dipturus intermedia*		CR
Kitefin shark	*Dalatias licha*		VU
Leafscale gulper shark	*Centrophorus squamosus*	y	EN
Longnosed skate	*Dipturus oxyrinchus*		VU
Porbeagle	*Lamna nasus*	y	CR
Portuguese dogfish	*Centroscymnus coelolepis*	y	CR
Shagreen ray	*Leucoraja fullonica*		VU
Spurdog	*Squalus acanthias*	y	EN
Stingray	*Dasyatis pastinaca*		EN
Thornback Ray	*Raja clavata*	y	NT
Tope	*Galeorhinus galeus*		VU
Undulate ray	*Raja undulata*		EN
White skate	*Rostroraja alba*	y	CR
Cuckoo ray	*Leucoraja naevus*		VU
Longnose velvet dogfish	*Centroselachus crepidater*		VU
Birdbeak dogfish	*Deadnia calcea*		*NT*

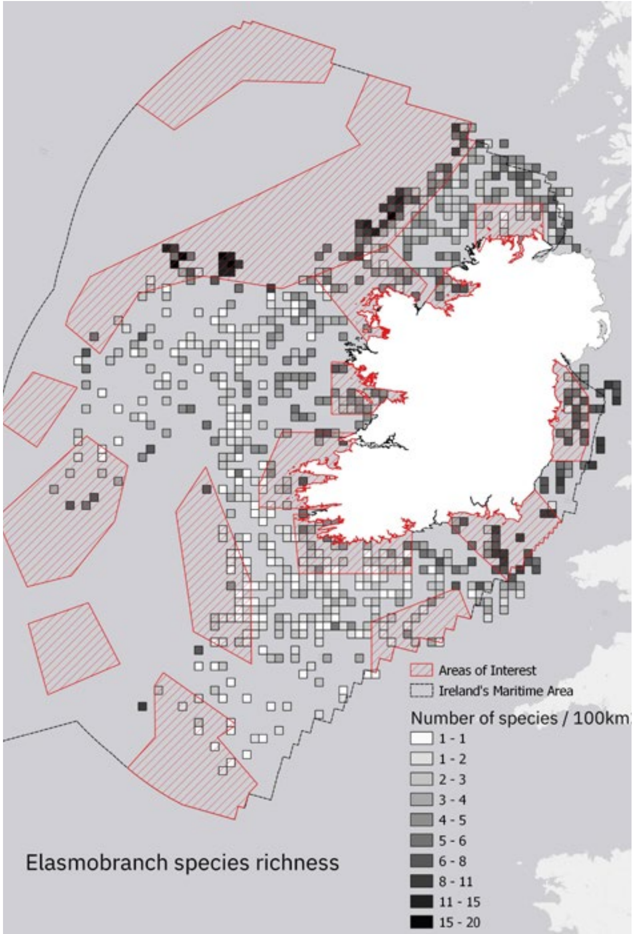


Figure F1: Total elasmobranch species richness from the Northern Irish Groundfish Surveys (2011-2020), Irish Groundfish Surveys (2011-2020) and Anglerfish, Megrim surveys (2011-2020) and the Deepwater Survey (2006-2009). The north Kerry survey data was analysed separately.

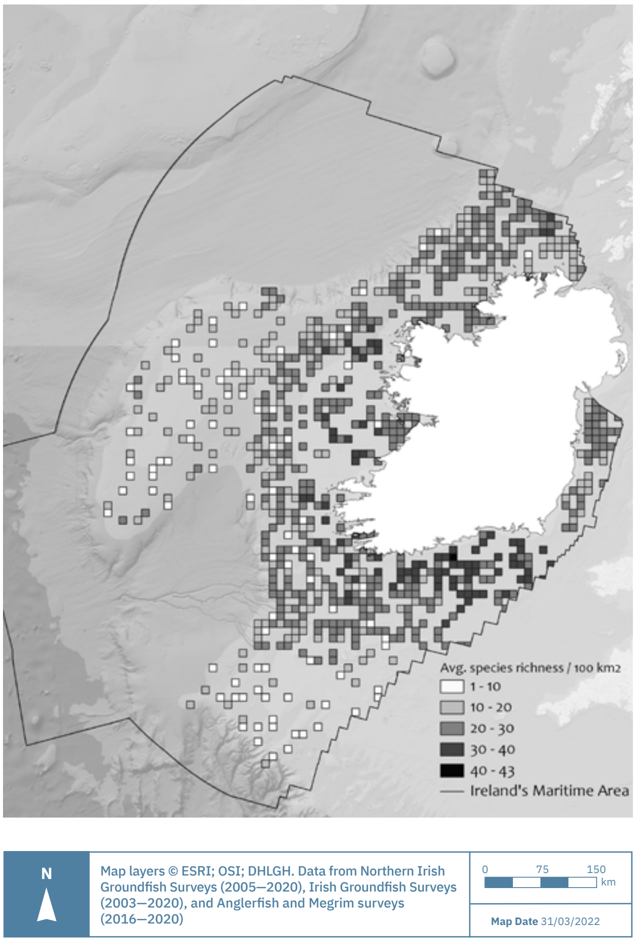


Figure F2: Average species richness per survey haul within 100 km2 grid cells from the Northern Irish Groundfish Surveys (2005-2020), Irish Groundfish Surveys (2003-2020) and Anglerfish and Megrim surveys (2016-2020).

Step 4: Map species occurrences, richness and density
The haul latitude and longitude of elasmobranch occurrences was mapped and reprojected to ETRS89-extended / LAEA Europe, in line with the EEA Grid projection. The total number of each species with associated geographic coordinates were then spatially joined to the EEA (European Environmental Agency) 10km vector polygon reference grid using the 'join attributes by location (summary)' function in QGIS.

For species richness, the following method was applied within the QGIS function 'join attributes by location (summary)': Input layer: EEA 10km grid; Join layer: Elasmobranch records; Geometric predicate: 'contains'; Fields to summarise: 'species name'; Summaries to calculate: 'unique'; tick box 'discard records which could not be joined'; run.

For species density, the following method was applied within the QGIS function 'join attributes by location (summary)': Input layer: EEA 10km grid; Join layer: Elasmobranch records (with single species selected); Geometric predicate: 'contains'; Fields to summarise: 'total number'; Summaries to calculate: 'sum'; tick box 'discard records which could not be joined'; run. For density analysis, only species records from 2011 onwards were used. In addition to total numbers present within a grid cell, mean numbers were also calculated to check for effort bias.

When showing the overall density for elasmobranch species, the distribution of this data was skewed, so a Log10 +1 transformation was carried out to minimise skewness.

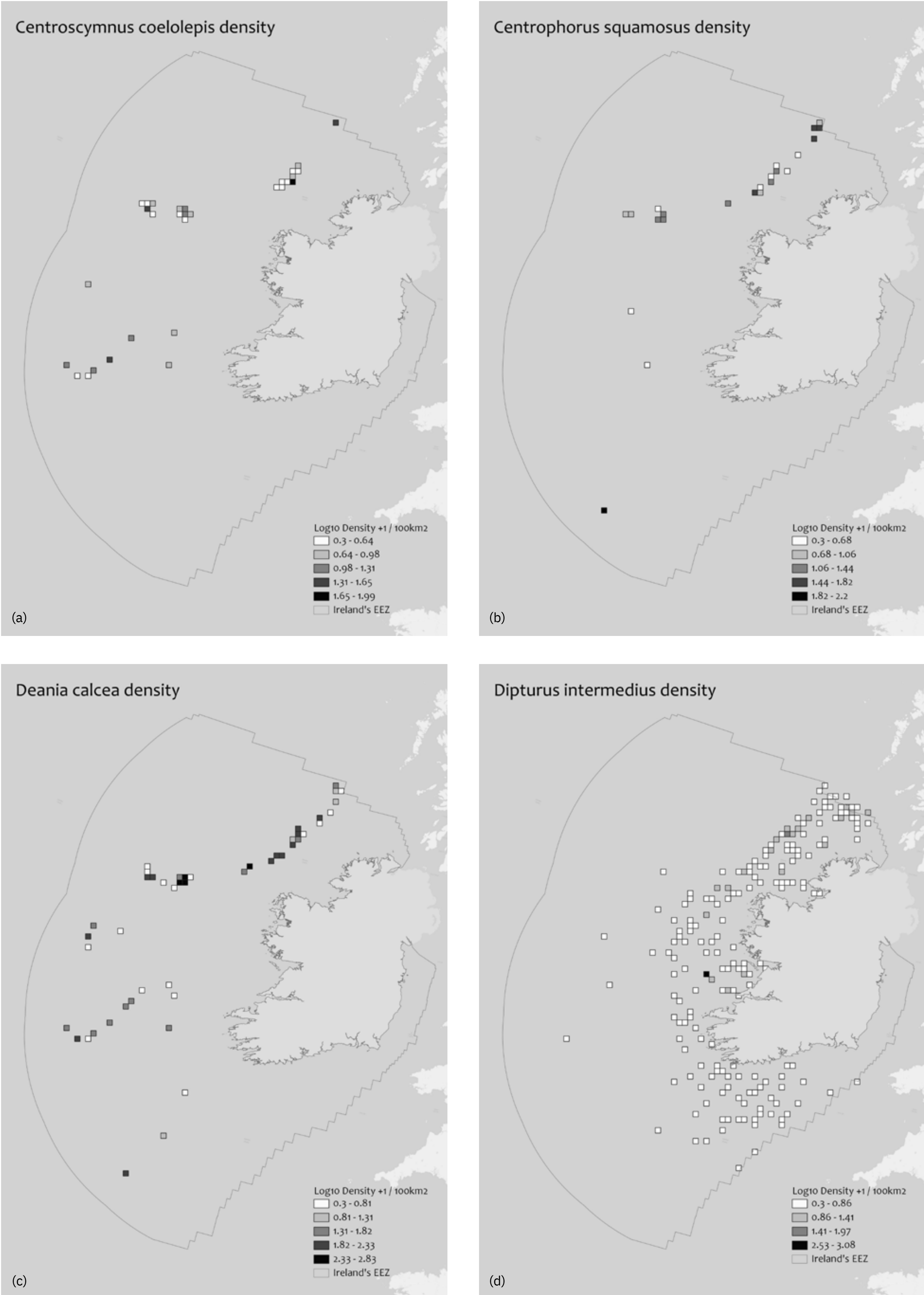
Step 5: Create polygons for important elasmobranch areas
Following the creation of shapefiles showing (1) density of threatened species and (2) total elasmobranch species richness (i.e. all elasmobranchs found in Irish waters, threatened and non-threatened), a new polygon shapefile was created and polygons were drawn around any 100 km grid cell with more than 6 elasmobranch species found within and around any grid cell that had high densities for threatened elasmobranch species, if available data allowed. High density thresholds changed depending on the amount of records per species. A polygon was also drawn around Tralee due to evidence from the literature of the importance of Tralee for several threatened species.

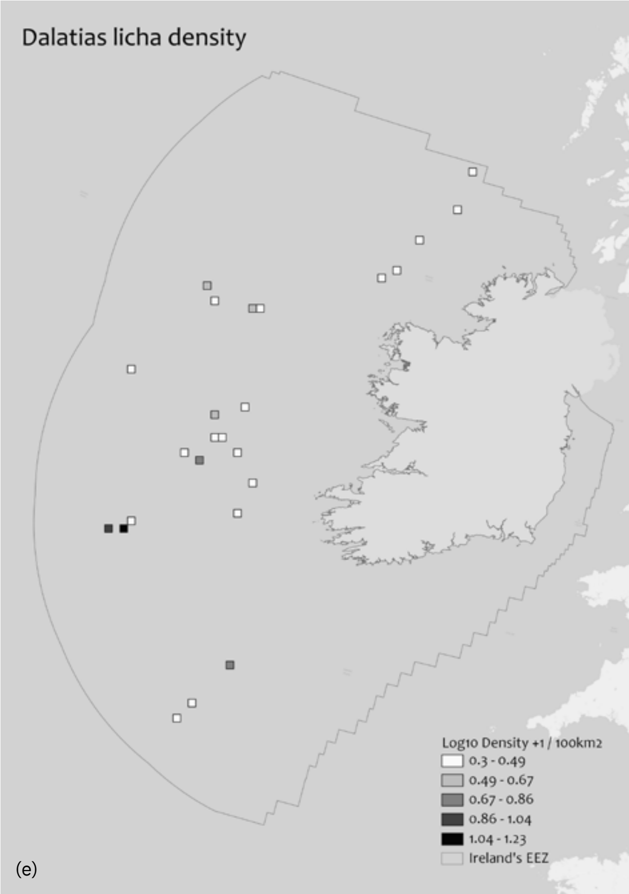
Results
Analysis of elasmobranch species richness (i.e. of all elasmobranchs found in surveys, not just those listed under the species of conservation importance) revealed a total of 53 species found in the four surveys (IGFS, NIGFS, AMS records from 2011-2020, DWS records from 2006-2009). Highest richness was found along the northern slope of the porcupine bank and the western continental slope, the Irish Sea, south of the Waterford estuary and north of Donegal. However, because total species counts were used instead of averages, absence of effort bias cannot be guaranteed.

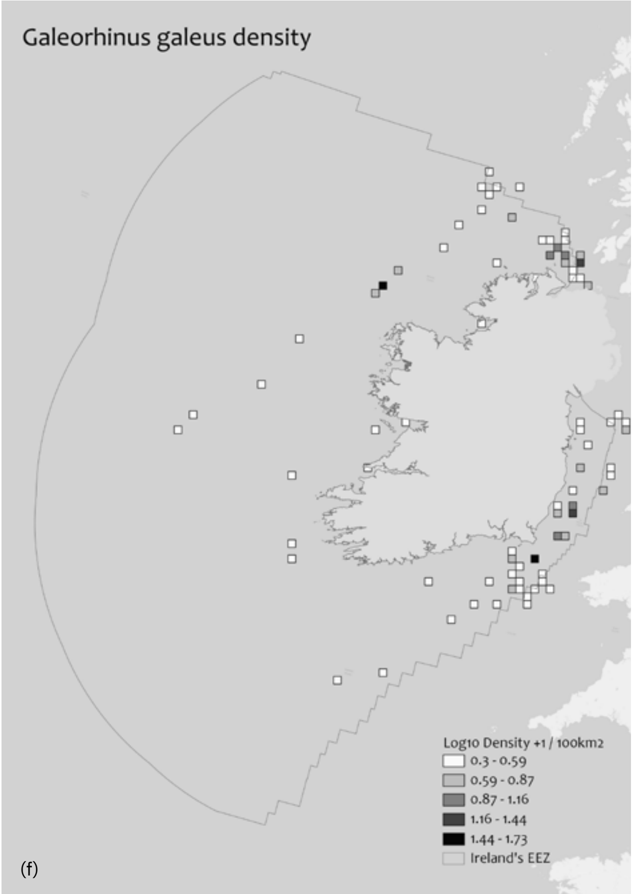
Data on threatened elasmobranch occurrences is very poor. For this reason, additional species richness analyses of the entire trawl survey data was undertaken in order to identify potential groundfish hotspots in addition to elasmobranch hotspots. This was particularly useful in order to identify Areas of Interest on the Irish continental shelf. For this analysis, average richness over the 100 km2 cell was used instead of total richness. This revealed the highest species richness along the south coast, which is covered by the Irish Groundfish Survey. The Anglerfish and Megrim Survey richness was highest on the western Porcupine Bank and the southern Porcupine Bank. The Irish Sea is surveyed by the Northern Irish Groundfish Survey, which revealed highest richness between Wicklow and the Northern Irish border.

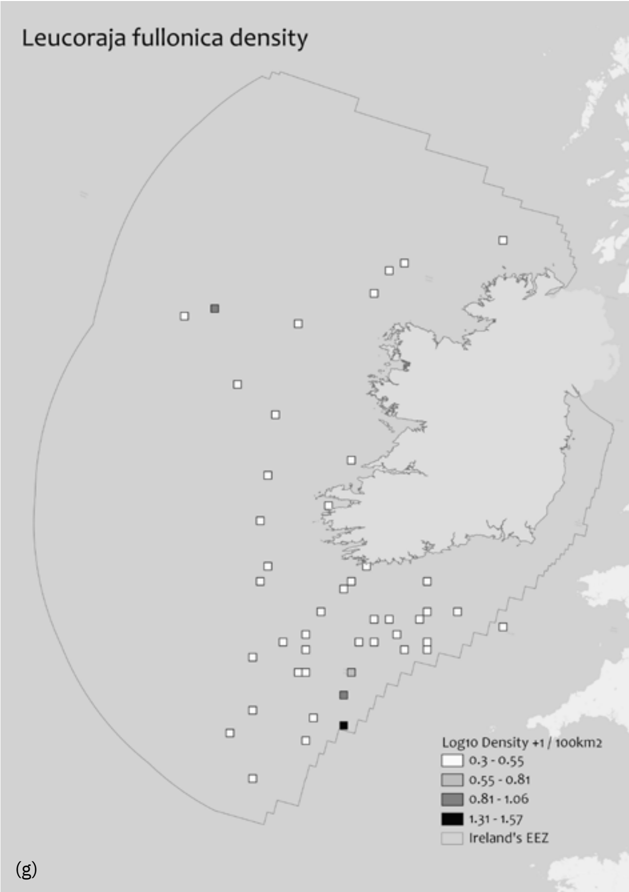
Table F2: Sources of elasmobranch records used in this study

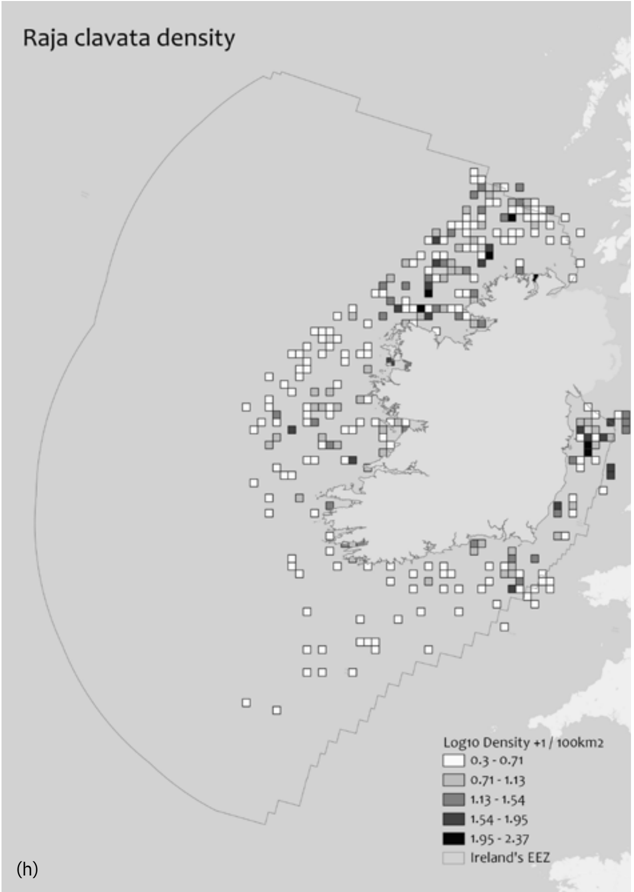
Year	Survey	Survey Area	Survey description	Data Source
2003-2020	Irish Groundfish Survey (IGFS)	Irish shelf sediment areas (excl. the Irish Sea since 2005; excl. The Porcupine Bank)	Demersal trawl survey (GOV trawl) operating at 30 minute long tows at 170 stations annually in Q4 over the course of six weeks .	Database of Trawl Surveys 2022 https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx
2005-2020	Northern Irish Groundfish Survey (NIGFS)	Irish Sea	Rock-hopper otter trawl survey carried out in March and October of each year.	Database of Trawl Surveys 2022 https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx
2016-2020	Irish Anglerfish and Megrim Survey (IAMS)	Irish shelf sediment areas (including Porcupine Bank)	Trawl survey operating at depths from around 150m to 1000m. The survey operates 24 hours per day with 1-hour tows in Q1 of each year.	Database of Trawl Surveys 2022 https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx
2006-2009	Deepwater Survey	Preselected locations on the continental slope	Two-hour fishing trawls (time on bottom) took place in three locations on the continental slope to the north and west of Ireland, and on the Porcupine Bank each September from 2006-2008 from the RV Celtic Explorer using BT184 deepwater nets with type-D ground gear. Fish, benthic and hydrographic data were collected.	Database of Trawl Surveys 2022 https://www.ices.dk/data/data-portals/Pages/DATRAS.aspx
2018-2019	Marine Institute North Kerry elasmobranch survey	Tralee, Brandon and Dingle bays	Net surveys conducted monthly on commercial fishing vessels. Total survey effort included 158 net deployments involving 79nm of net and given an average soak time of 5hrs	Marine Institute data request (Tully et al., 2021 - The Distribution and Abundance of Elasmobranch Fish in Tralee, Brandon and Dingle Bays in 2018-2019)
2015-2016	ObSERVE aerial	Ireland's EEZ	Surveys followed standard line-transect methodology for aerial surveys.	Rogan, E., Breen, P., Mackey, M., Cañadas, A., Scheidat, M., Geelhoed, S. & Jessopp, M. (2018). Aerial surveys of cetaceans and seabirds in Irish waters: Occurrence, distribution and abundance in 2015-2017. Department of Communications, Climate Action & Environment and National Parks and Wildlife Service (NPWS), Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland. 297pp.
2005-2021	IWDG dataset for basking shark sightings. See table C1 for details of surveys included within this dataset.	Ireland's EEZ		IWDG dataset for basking shark sightings. See table C1 for details of surveys included within this dataset.

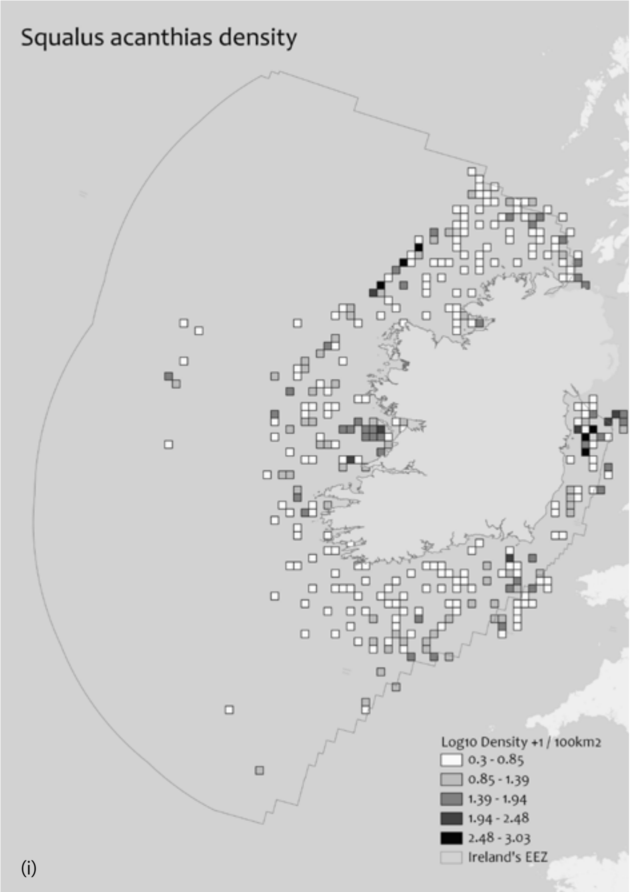

Centroscymnus coelolepis density
Log10 Density +1 / 100km2
0.3 - 0.64
0.64 - 0.98
0.98 - 1.31
1.31 - 1.65
1.65 - 1.99
Ireland's EEZ
(a)
Centrophorus squamosus density
Log10 Density +1 / 100km2
0.3 - 0.68
0.68 - 1.06
1.06 - 1.44
1.44 - 1.82
1.82 - 2.2
Ireland's EEZ
(b)
Deania calcea density
Log10 Density +1 / 100km2
0.3 - 0.81
0.81 - 1.31
1.31 - 1.82
1.82 - 2.33
2.33 - 2.83
Ireland's EEZ
(c)
Dipturus intermedius density
Log10 Density +1 / 100km2
0.3 - 0.86
0.86 - 1.41
1.41 - 1.97
2.53 - 3.08
Ireland's EEZ
(d)

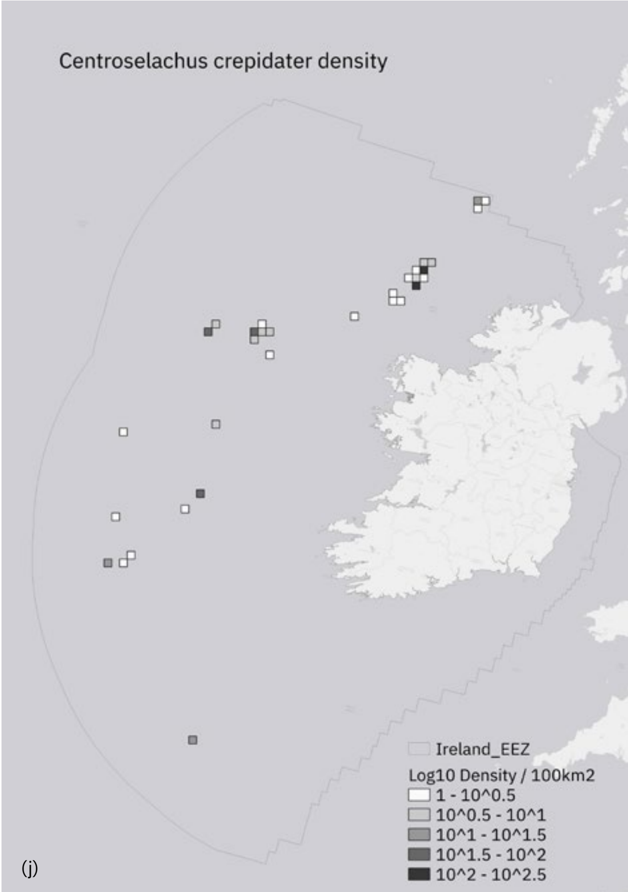

Dalatias licha density
Log10 Density +1 / 100km2
0.3 - 0.49
0.49 - 0.67
0.67 - 0.86
0.86 - 1.04
1.04 - 1.23
Ireland's EEZ
(e)


Galeorhinus galeus density
Log10 Density +1 / 100km2
0.3 - 0.59
0.59 - 0.87
0.87 - 1.16
1.16 - 1.44
1.44 - 1.73
Ireland's EEZ
(f)


Leucoraja fullonica density
Log10 Density +1 / 100km2
0.3 - 0.55
0.55 - 0.81
0.81 - 1.06
1.31 - 1.57
Ireland's EEZ
(g)


Raja clavata density
Log10 Density +1 / 100km2
0.3 - 0.71
0.71 - 1.13
1.13 - 1.54
1.54 - 1.95
1.95 - 2.37
Ireland's EEZ
(h)





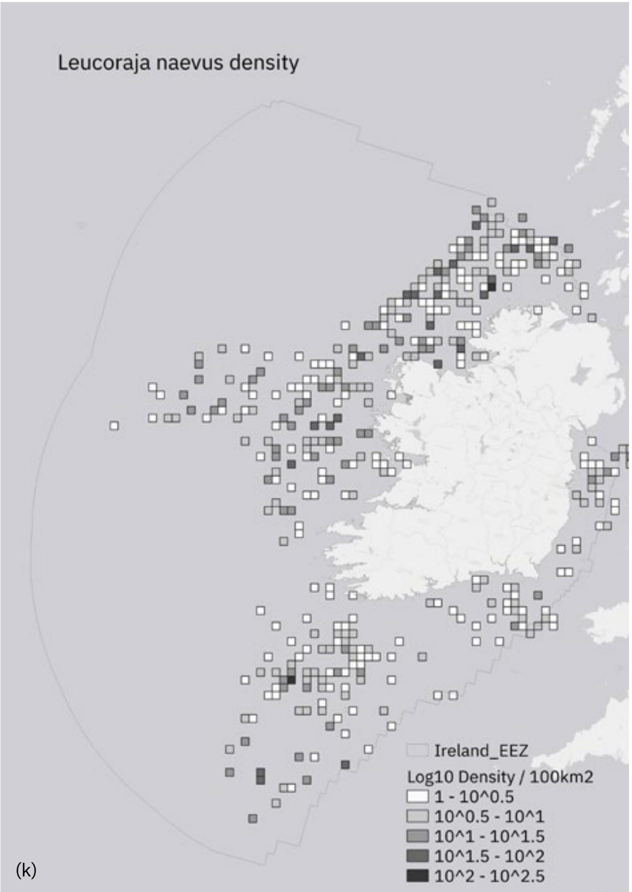
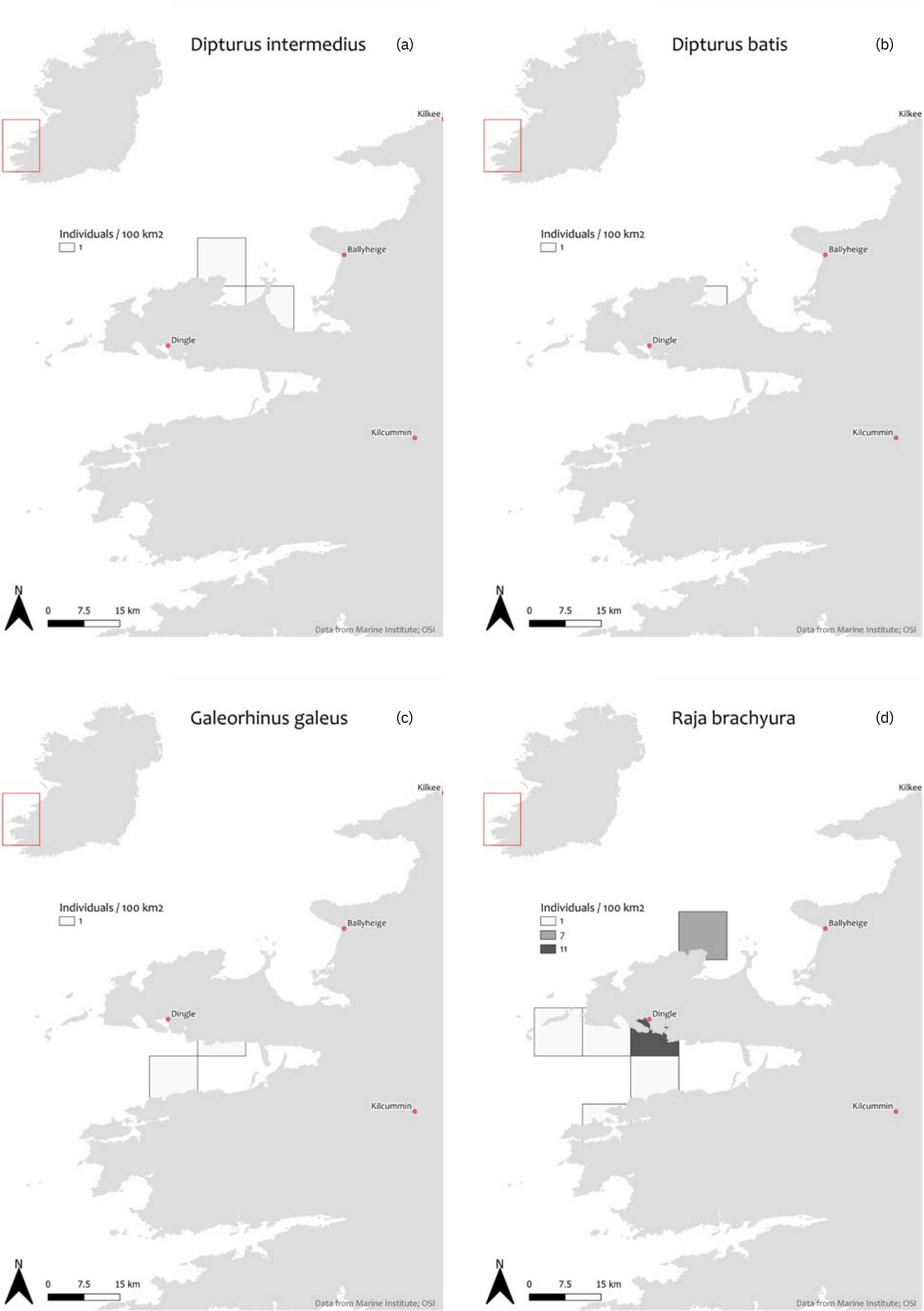


Figure F3 a–k: Density of threatened elasmobranchs in Irish waters where available data was sufficient to allow density analysis.


Dipturus intermedius
(a)
Individuals / 100 km2
1
Kilkee
Ballyheige
Dingle
Kilcummin
N
0
7.5
15 km
Data from Marine Institute; OSI
Dipturus batis
(b)
Individuals / 100 km2
1
Kilkee
Ballyheige
Dingle
Kilcummin
N
0
7.5
15 km
Data from Marine Institute; OSI
Galeorhinus galeus
(c)
Individuals / 100 km2
1
Kilkee
Ballyheige
Dingle
Kilcummin
N
0
7.5
15 km
Data from Marine Institute; OSI
Raja brachyura
(d)
Individuals / 100 km2
1
7
11
Kilkee
Ballyheige
Dingle
Kilcummin
N
0
7.5
15 km
Data from Marine Institute; OSI

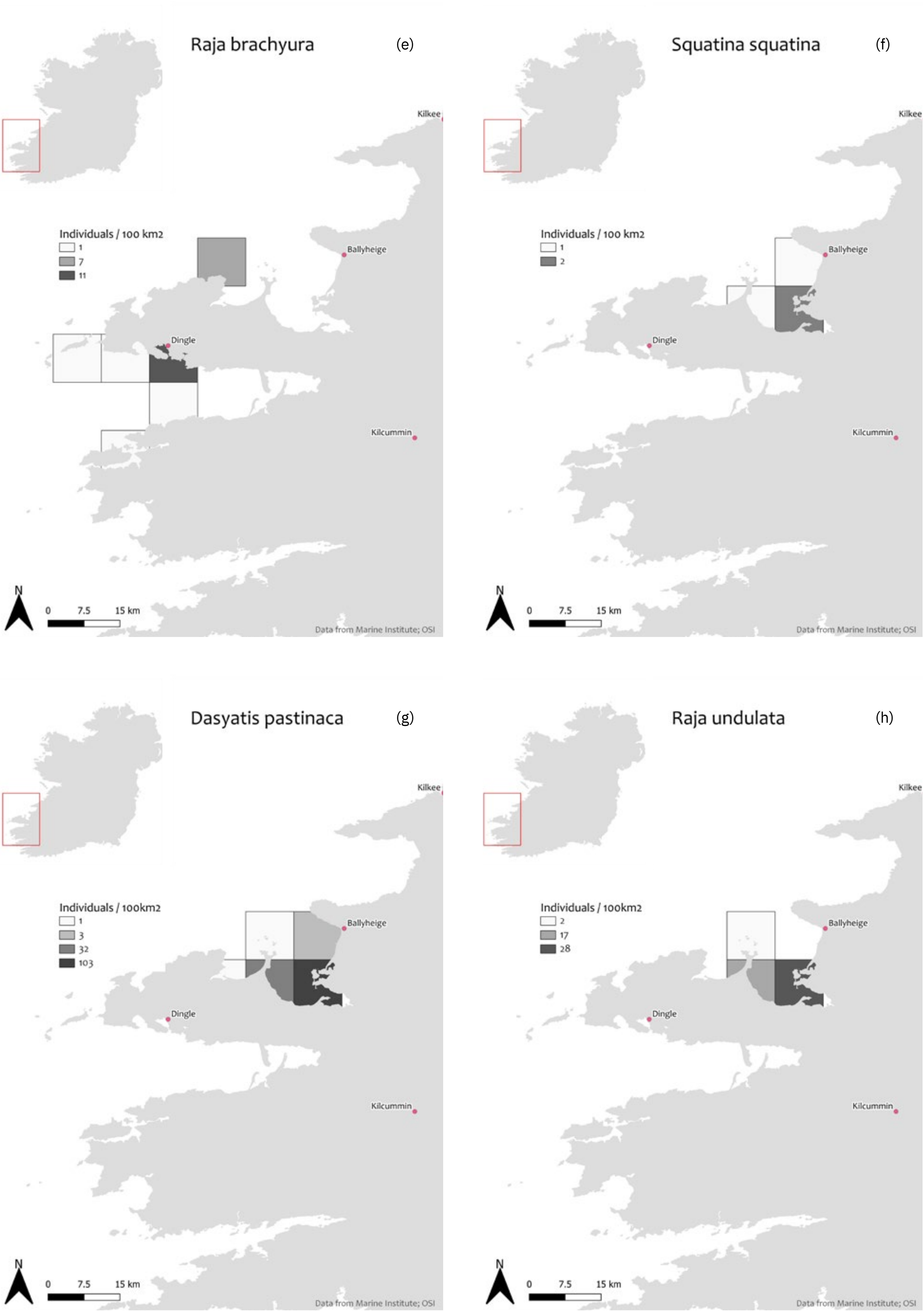


Figure F4 (a–h: Species found in the north Kerry elasmobranch survey

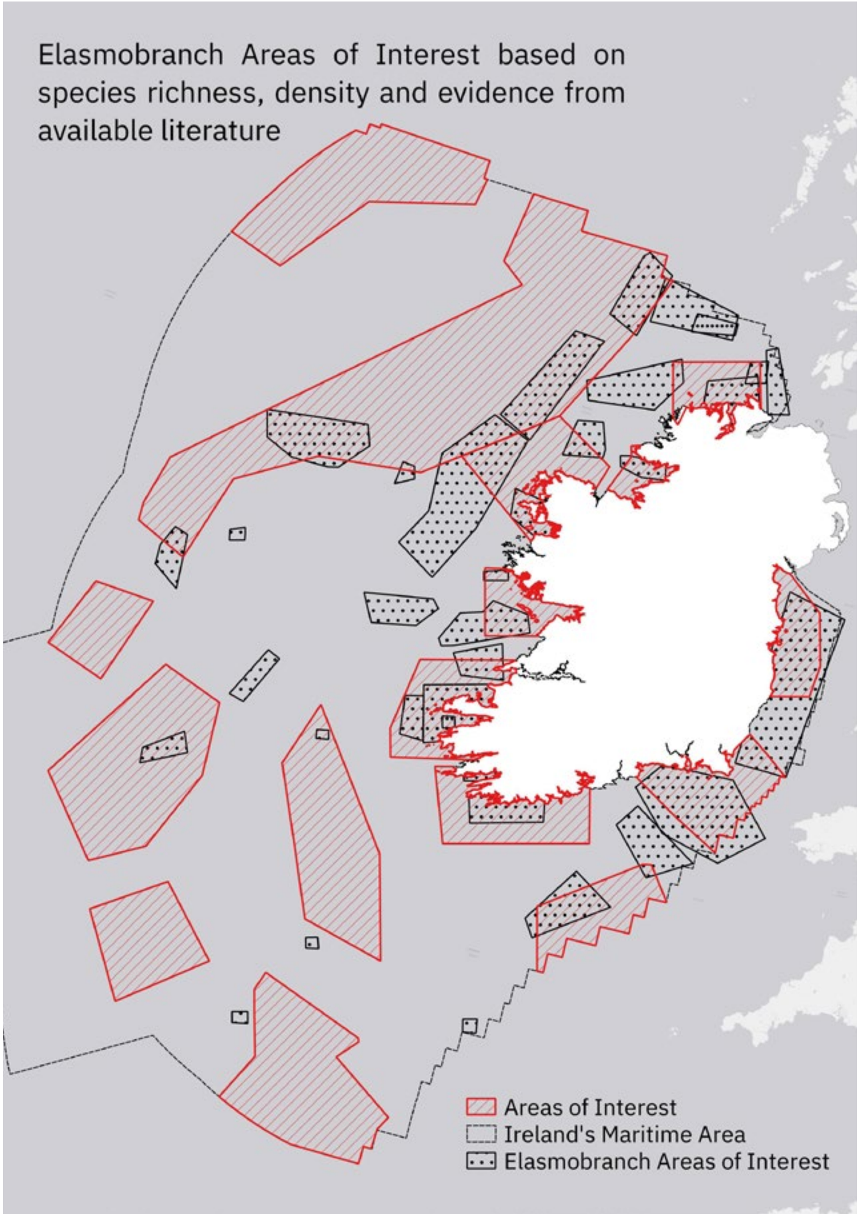


Figure F5: Elasmobranch AOI overlap with the final AOIs.

Discussion

It is worth noting that different trawl surveys use different gear types. Therefore, the results must be interpreted with caution. An area that appeared to be higher in richness compared to other areas was only interpreted to be actually higher than other areas if the data was from the same survey. For example, the deepwater survey along the northern half of the continental slope identified the highest species richness for sharks, which is likely because it was a dedicated survey for deepwater species and therefore a high number of deepwater sharks were recorded. However, due to the importance of the area to coral reefs and evidence of shark nurseries from benthic surveys, the area is assumed to be an important hotspot for deepwater species.

Some threatened elasmobranchs were not represented at all in fisheries trawl surveys. Angel Shark, Stingray, and Blue Skate data was therefore limited to the north Kerry survey conducted by the Marine Institute in 2017-2019. Available literature was key to identify additional Areas of Interest for these species. Angling data was not used in the present study but should be included in future analyses to increase records for inshore species.

Future research and analysis should also focus on identifying elasmobranch migration routes and breeding grounds to ensure any potential MPA network adequately protects all life stages of elasmobranchs.

Furthermore, the majority of elasmobranch records were derived from trawl survey data. Pelagic fishery surveys were not analysed at this point. Pelagic shark records such as porbeagle or basking shark were therefore limited in this study. For basking sharks a large dataset was held by the Irish Whale and Dolphin Group which was included in this study. However, porbeagle sharks were eliminated from the study due to lack of data.

This study represents an initial analysis of elasmobranch occurrence data using mostly fisheries survey data. Main caveats of the study are the unavailability of data for rare or critically endangered inshore species and porbeagles. Nevertheless several highly important areas have been identified that would greatly benefit from full protection in order to reduce bycatch of elasmobranch species in commercial fisheries.

List of Acronyms

BoCCI	Birds of Conservation Concern Ireland
DHLGH	Department of Housing, Local Government and Heritage
DHPLG	Department of Housing, Planning and Local Government
EEZ	Exclusive Economic Zone
EUNIS	European Nature Information System
GES	Good Environmental Status (MSFD)
JNCC	Joint Nature Conservation Committee
MPA	Marine Protected Area
MSP	Marine Spatial Planning
MSFD	Marine Strategy Framework Directive
NGO	Non-Governmental Organisation
NPWS	National Parks and Wildlife Service
SAC	Special Area of Conservation
SPA	Special Protection Area

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FAIR SEAS

The Fair Seas campaign is led by a coalition of Ireland's leading environmental non-governmental organisations and networks.

- **BirdWatch Ireland**
- **Coastwatch**
- **Coomhola Salmon Trust**
- **Friends of the Irish Environment**
- **Irish Environmental Network**
- **Irish Whale and Dolphin Group**
- **Irish Wildlife Trust**
- **SWAN–Sustainable Water Network**

At Fair Seas, we seek to protect, conserve and restore Ireland's unique marine environment. Our ambition is to see Ireland become a world leader in marine protection, giving our species, habitats and coastal communities the opportunity to thrive.

Fair Seas aims to build a movement of ocean stewardship across Ireland that energises and empowers people, to advocate for ambitious and robust legislation, provide impartial scientific data and research, and propose a network of effective well-managed marine protected areas.

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