# EUROPA OIL & GAS (IRELAND WEST) LIMITED

# KIELY EAST PROSPECT SITE SURVEY

# SCREENING FOR ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL RISK ASSESSMENT REPORT

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## Abbreviations

| | |
|---|---|
| AA | Appropriate Assessment |
| AUV | Autonomous Underwater Vehicle |
| DAHG | Department of Arts, Heritage and the Gaeltacht |
| dB | Decibel |
| DCCAE | Department for Communications, Climate Action and the Environment |
| DCHG | Department of Culture, Heritage and the Gaeltacht |
| EC | European Commission |
| EIA | Environmental Impact Assessment |
| ERA | Environmental Risk Assessment |
| EU | European Union |
| FCC | Favourable Conservation Condition |
| GWA | Greater Working Area |
| HSE | Health, Safety and Environment |
| Hz | Hertz |
| IOSEA | Irish Offshore Strategic Environmental Assessments |
| kHz | Kilohertz |
| Km | Kilometre |
| LO | Licensing Option |
| M | Metre |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MBES | Multi-beam echosounder |
| MMO | Marine Mammal Observers |
| NIS | Natura Impact Statement |
| NOOA | National Oceanic and Atmospheric Administration |
| NPWS | National Parks and Wildlife Service |
| PPL | Petroleum Prospecting License |
| PTS | Permanent Threshold Shift |
| QI | Qualifying Interests |
| RMS | Root mean square |
| ROV | Remotely Operated Vehicle |
| SAC | Special Area of Conservation |
| SAC | Special Area of Conservation |

| | |
|---|---|
| SBES | Single-beam echosounder |
| SBP | Sub-bottom profiler |
| SCI | Special Conservation Interests |
| SEL | Sound Exposure Level |
| $SEL_{cum}$ | Cumulative sound exposure level |
| SPA | Special Protection Area |
| SSS | Side Scan Sonar |
| USBL | Ultra-short baseline |

# EXECUTIVE SUMMARY

Europa Oil & Gas (Ireland West) Limited (Europa) propose to undertake geophysical and environmental site survey activities in the northwest Porcupine Basin, offshore Ireland in 2019. The name of the proposed survey is the 'Kiely East Survey' and will focus on the Kiely East prospect.

This Screening for Environmental Impact Assessment (EIA) and Environmental Risk Assessment (ERA) Report accompanies an application by Europa to the Department of Communications, Climate Action and Environment (DCCAE) for Approval to Conduct an Exploration Survey and Site Survey under Part 2 of the Department's Rules and Procedures for Offshore Petroleum Exploration and Appraisal Operations (PAD, 2007 [Draft 2014 edition]) (herein referred to as the Rules and Procedures Manual).

Specifically, this report has been prepared to fulfil survey approval requirements as set out in the Rules and Procedures Manual by the Petroleum Affairs Division (PAD) of the DCCAE and address obligations under the European Council EIA Directive 2011/92/EU of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment and amended by Directive 2014/52/EU of 16 April 2014. This report also addresses Article 12 obligations of the European Community (EC) Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (commonly known the Habitats Directive).

This report has been prepared to provide the competent authority, the Minister for the DCCAE, the information required to inform the screening determination on whether the proposed Kiely East Survey should be subject to an EIA in accordance with Annex IIA of the EIA Directive.

This assessment has identified that the only source of impact to receptors is the underwater noise generated by survey equipment. The environmental receptors of concern include Article 12 Annex IV marine mammal species.

Based on the nature and duration of the proposed site survey operations, and strict adherence to DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014) and recommendations from PAD and NPWS, in relation to the separation distance between the concurrent acoustic surveys, significant effects will occur.

The EIA Screening has concluded that there will be no significant effects on the environment from the proposed Kiely East Survey and it is therefore considered that an EIA is not required.

# 1 INTRODUCTION

## 1.1 Background

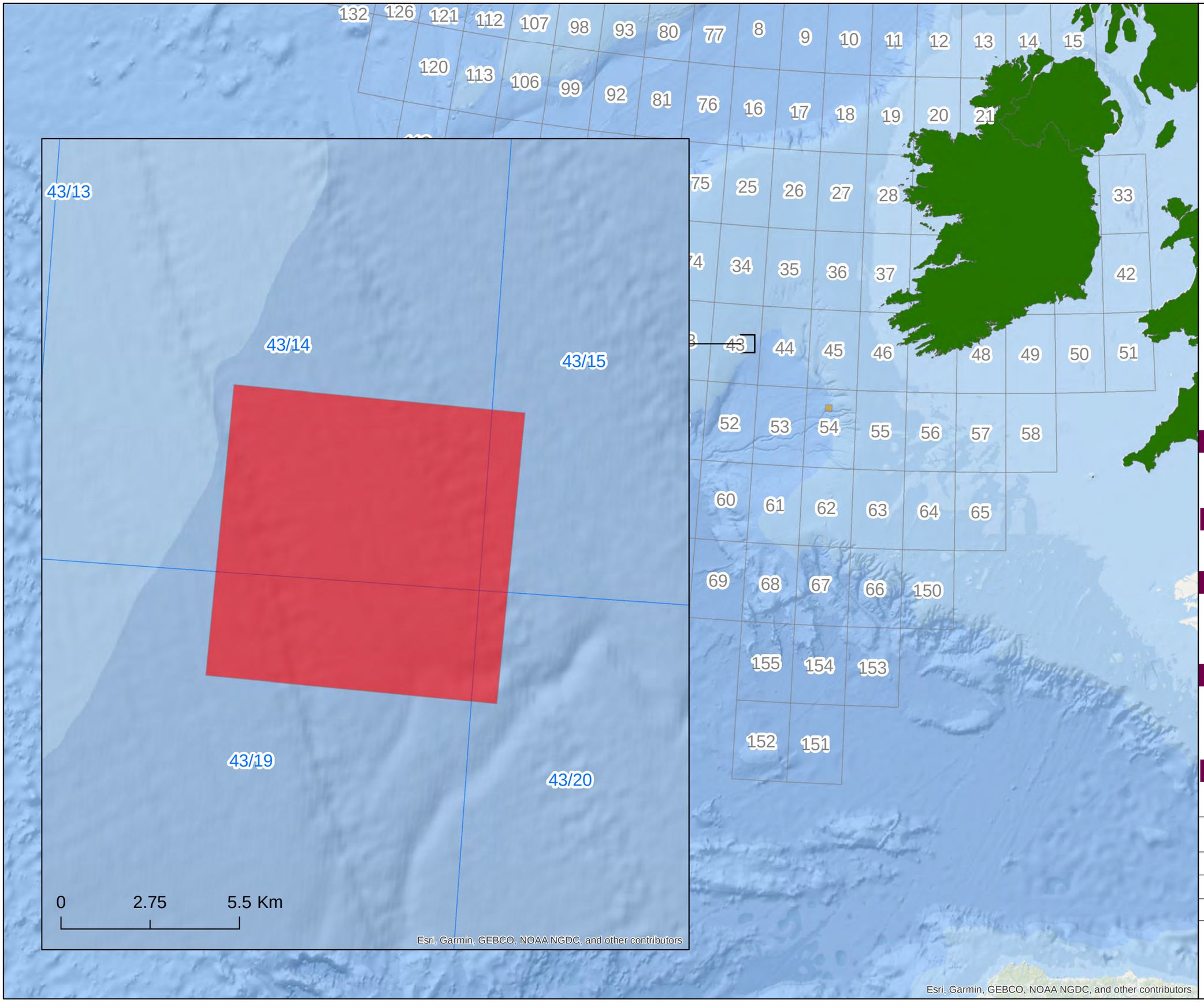
Europa Oil & Gas (Ireland West) Limited (Europa) proposes to undertake a geophysical and environmental site survey in the northwest Porcupine Basin, offshore Ireland in 2019. The name of the proposed survey is the 'Kiely East Survey' and will focus on the Kiely East prospect. **Figure 1.1** shows the greater working area (GWA) at the Kiely East prospect. The GWA is located in licensing quadrant/blocks 43/14, 43/15, 43/19 and 43/20. The survey will be conducted under Frontier Exploration Licence (FEL) 2/13 held by Europa Oil & Gas (Ireland West) Limited.

It is proposed that survey operations will be undertaken by a single survey team between June and late-November 2019. Excluding weather and technical downtime, survey operations are expected to take a total of 14 survey working days. If the survey has not commenced or concluded in 2019, operations will be undertaken sometime between early-February 2020 and late-November 2020. Final details of the timing and duration of the survey will be communicated to the Petroleum Affairs Division (PAD) of the Department of Communications Climate Action and Environment (DCCAE) in advance of operations commencing.

The aim of the survey is to:

- Accurately determine water depths and seabed/ subsurface geology at the site;
- Identify any seabed obstructions and confirm the location of any existing infrastructure (such as pipelines, wellheads);
- Assist in the identification of all geo-hazards and geological conditions that may be of significance to future drilling activities[1]. This may include shallow gas, channelling, faulting and other geological features that may be of significance;
- Provide information on the cultural potential of the survey area, including the location of any shipwrecks or other underwater cultural heritage features;
- Identify and delineate Annex I habitats (as defined in the EC Habitats Directive 92/43/EC) or other sensitive habitats and identify any areas of environmental interest;
- Establish environmental baseline to establish a benchmark for ongoing environmental monitoring as per OSPAR guidelines; and
- Acquire sediment samples for determination of physico-chemical baseline conditions.

[1] Drilling activities do not form part of this project and are therefore not assessed in this report.




## Legend

- Kiely East Survey
- Licensing grid quadrants
- Licensing grid blocks

0 125 250 Km

**Client**
Europa Oil & Gas

**Figure**
1.1

**Title**
Location of the Kiely East Survey GWA

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## 1.2 Purpose of this report

This Screening for Environmental Impact Assessment (EIA) and Environmental Risk Assessment (ERA) Report accompanies an application by Europa to the DCCAE for Approval to Conduct an Exploration Site Survey under Part 2 of the Department's Rules and Procedures Manual for Offshore Petroleum Exploration and Appraisal Operations (PAD, 2007 [Draft 2014 edition]) (herein referred to as the Rules and Procedures Manual).

Specifically, this report has been prepared to fulfil survey approval requirements as set out in the Rules and Procedures Manual by the PAD of the DCCAE and address obligations under the European Council EIA Directive 2011/92/EU of 13 December on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU of 16 April 2014 (the 2014 Directive).

This report also addresses Article 12 obligations of the European Community (EC) Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna (commonly known the Habitats Directive).

### 1.2.1 EIA Screening

The EC Directive 2011/92/EU of 13 December 2011 amended by Directive 2014/52/EU of 16 April 2014) requires that public and private projects which are likely to have significant effects on the environment are granted development consent only after an assessment of the likely significant environmental effects of those projects has been carried out by the competent authority (in this case the Minister for the DCCAE).

In Ireland, for oil and gas exploration activities, the EIA Directive is implemented through the European Union (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013, under which the Minister for the DCCAE can determine on a case by case basis if an EIA is required for any petroleum activities, including geophysical or site surveys. Under the EU (Environmental Impact Assessment) (Petroleum Exploration) Regulations 2013, the following regulations apply to Environmental Impact Statement (now called an Environmental Impact Assessment Report[2])

Regulation 3.(1) *Where the holder of a licence proposes to undertake activities under the licence, the holder shall apply to the Minister for permission to undertake the activities.*

Regulation 3.(2) *Where an application is made to the Minister under paragraph (1), and the Minister considers that the activities, the subject of the application would be likely to have significant effects on the environment by virtue, inter alia, of their nature, size and location, he or she shall require the applicant to submit an environmental impact statement in respect of the activities the subject of the application.*

This EIA Screening Report provides the relevant information to the Minister to inform their determination as to whether the purposed activity would be likely to have significant effects on the environment and whether an EIA is required. Annex IIA specifies the information which a developer must provide to the competent authority to inform the screening determination. The information to be provided includes the following:

1. A description of the project, including in particular:
    (a) the physical characteristics of the whole project and, where relevant, of demolition works;

[2]Environmental Impact Statement is now called an Environmental Impact Assessment Report under EIA Directive 2014/52/EU

(b) the location of the project, with particular regard to the environmental sensitivity of the geographical areas likely to be affected.

2. A description of the aspects of the environment likely to be significantly affected by the project.
3. A description of any likely significant effects, to the extent of the information available on such impacts, of the project on the environment resulting from:
   (a) The expected residues and emissions and the production of waste, where relevant; and
   (b) The use of natural resources, soil, land, water, and biodiversity.
4. The criteria of Annex III shall be taken into account, where relevant, when compiling the information in accordance with points 1 to 3.

This report has been prepared to provide the competent authority (in this case the Minister for the DCCAE) the information required to inform the screening determination on whether the proposed Kiely East Survey should be subject to an EIA.

### 1.2.2 Article 12 Screening Appraisal for Annex IV Species

The Directive 92/43/EC on the Conservation of Habitats, Flora and Fauna (92/43/EEC) commonly known the Habitats Directive) was adopted in 1992, came into force in 1994 and was transposed into Irish law from 1997 onwards by the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended). The main aim of the Habitats Directive is to contribute towards the conservation of biodiversity by requiring Member States to take measures to maintain or restore natural habitats listed under Annex I and species listed in the Directive.

Article 12 of the Habitats Directive requires that Member States take the requisite measures to establish a system of strict protection for Annex IV listed species in their natural range, prohibiting:

- All forms of deliberate capture or killing of individuals in the wild;
- Deliberate disturbance of these species, particularly during breeding, rearing, hibernation and/ or migration;
- Deliberate destruction or taking of eggs from the wild; and
- Deterioration of or destruction of breeding sites or resting places.

**Section 3.5** and **Section 3.6** of this report considers risk of potential impact associated with underwater noise generated by the proposed geophysical survey and positioning equipment to relevant species listed under Annex IV of the EU Habitats Directive 92/43/EEC. Species assessed include cetaceans and relevant marine reptile species. As underwater noise may indirectly impact Annex IV species through its effects on prey abundance, behaviour, and distribution; potential impacts to fish and plankton are also assessed. For the sake of completeness the assessment presented in **Section 3.5** also considers potential impact to marine mammal species listed under Annex II of the Habitats Directive for which SAC in Irish waters have been designated.

# 2 DESCRIPTION OF THE PROJECT AND THE ENVIRONMENTAL BASELINE

This section describes the characteristics and location of the proposed survey, and the physical, biological and socio-economic baseline of the surrounding environment.

## 2.1 Kiely East Survey

### 2.1.1 Survey Background

The Kiely East Survey comprises a geophysical data and environmental seabed sample acquisition programme. The aim of the proposed survey is to accurately determine water depths and seabed/ subsurface geology at the site, identify any potential seabed obstructions and confirm the location of any existing infrastructure (such as cables, pipelines, wellheads) and ship wrecks.

**Figure 1.1** shows the GWA for the proposed Kiely East Survey. The spatial extent of the GWA is 80 km$^2$. The GWA lies outside the Irish 12 nm limit and at its closest point is approximately 180 km from landfall off the west coast of County Kerry.

While the Kiely East Survey will provide information that may be of significance to future exploration and potential production activities, it is a standalone project and not part of a larger programme of development that will create a requirement or imperative for future developments to be licensed. Any future plans or projects (developments) will be subject to separate/ new authorisations. Any potential indirect, secondary or cumulative effects (including climate change effects) associated with future developments (i.e. further exploration or appraisal phase / oil or gas production), should any future developments arise, will be considered when any necessary consents for the activities involved are being sought.

### 2.1.2 Survey Rationale and Activity

#### 2.1.2.1 Site Survey

The Kiely East Survey comprise a geophysical data and environmental seabed sample acquisition programme. The aim of the proposed survey is to accurately determine water depths and seabed/ subsurface geology at the site, identify any seabed obstructions and confirm the location of any existing infrastructure (such as cables, pipelines, wellheads) and ship wrecks.

Should the application to undertake survey activities be successful it is envisaged that survey operations will be undertaken by a single survey vessel between June and late-November 2019 over a total of 14 survey working days.

Further details of the site survey operations are provided in **Section 3.4.**

### 2.1.3 Vessels and Equipment

#### 2.1.3.1 Vessels

The Kiely East Survey will be undertaken by one survey vessel. The contracted survey vessels will comply with national and international shipping guidelines, and all Health, Safety and Environment (HSE)

standards including those defined under the International Convention for the Prevention of Pollution from Ships (MARPOL). Once confirmed details of the proposed vessels (vessel name, call sign etc.) and survey equipment will be made available to the PAD DCCAE.

### 2.1.3.2 Survey Equipment

The survey will be undertaken using industry standard equipment. The specifications of the survey equipment to be used will be similar to (or the same as) those presented in **Table 2.1**.

**Table 2.2** provides a summary of the proposed geophysical and seabed sampling operations. A detailed assessment of noise emissions generated by the proposed geophysical equipment is presented in **Section 3.4**.

**Table 2.1: Equipment specifications**

| Vessel Mounted/ Towed Equipment | Model |
|---|---|
| SBES | Hull mounted Kongsberg EA400 or similar (35 kHz – 200 kHz or similar) |
| MBES | Hull-Mounted Swathe Multibeam Kongsberg EM710 or similar (70 kHz – 100 kHz or similar) |
| SSS | Towed Fish – Edgetech EM400 or similar (Dual frequency – 100 kHz/500 kHz or similar) |
| SBP | Hull-mounted pinger or chirp system – Edgetech 3300 or similar (1-16 kHz or similar) |
| SBP | 10 cu in Airgun or similar |
| USBL (topside) | Hull mounted HiPAP 502 USBL or similar |
| Magnetometer | Towed fish – Geometrics G882 caesium vapour or similar |
| **AUV Mounted Equipment** | **Model** |
| MBES | AUV mounted Simrad EM2040 or similar (300 kHz or similar) |
| SBP | AUV-Mounted Edgetech 2205 Chirp or similar (1-16 kHz or similar) |
| SSS | AUV-Mounted Tritech Seaking (Dual frequency - 200 kHz/550 kHz or similar) |
| Stills/video Camera | TBC |
| **Seabed Sampling Equipment** | **Model** |
| Core/ grab sampler | TBC |
| **Seabed Imaging Equipment** | **Model** |
| Drop-down Camera | TBC |
| **Positioning Equipment** | **Model** |
| USBL (seabed) | HiPAP 502 USBL or similar |

**Table 2.2: Summary of Operations**

| | |
|---|---|
| **Geophysical Equipment** | |
| Single-beam echosounder (SBES) and Multi-beam echosounder (MBES) | Echosounders are used to measure bathymetry and seabed topography by emitting short pulses of sound that reflect from the seabed. SBES produces a single conical beam pattern while MBES produce a narrow fan pattern. Both systems measure the time for a signal to return to the transmitter to produce high-resolution bathymetry maps of the seabed. SBES and MBES are usually used in conjunction with SSS (see below). The operating frequencies of the proposed echosounders are outlined **Table 2.1**. A detailed assessment of noise emissions generated by the proposed geophysical equipment is presented in **Section 3.4**. |
| Side Scan Sonar (SSS) | SSS provides acoustic images of the seabed and is used for the mapping of the upper layers of the seabed to determine the texture, topography and character of the seabed and sediments and detect anomalies such as boulders, outcrops, pipelines or reefs. SSS emits a narrow beam width acoustic sonar signal towards the seabed that spreads out into a narrow fan shape, or swathe. The SSS then analyses the intensity of the return (or reflectivity) from the seabed, which varies depending on the target characteristics. The operating frequencies of the proposed SSS is outlined **Table 2.1**. A detailed assessment of noise emissions generated by the proposed geophysical equipment is presented in **Section 3.4**. |
| Sub-bottom Profiler (SBP) | SBP are used for identifying and characterising layers of sediment or rock immediately below the seabed surface layers (a few tens of metres in mud, much less in sand or rock). The operating frequencies of the proposed SBP is outlined **Table 2.1**. A detailed assessment of noise emissions generated by the proposed geophysical equipment is presented in **Section 3.4**. |
| Magnetometer | Magnetometers measure ambient magnetic fields to identify magnetic anomalies on the seabed. The equipment takes passive measurements (i.e. does not actively emit a source signal) and is therefore not considered to produce a significant level of noise. |
| **Positioning Equipment** | |
| Ultra-Short baseline (USBL) | USBL is an underwater acoustic positioning system which is used with the vessel's differential Global Positioning System (dGPS) to determine the position of deployed equipment. The proposed USBL system comprises a vessel mounted transceiver and transponders attached to deployed equipment including the AUV, SSS, magnetometer and seabed samplers. The operating frequencies of the proposed USLBs are outlined **Table 2.1**. A detailed assessment of noise emissions generated by the proposed positioning equipment is presented in **Section 3.4**. |
| **Seabed Sampling** | |
| Baseline Environmental | The purpose of the environmental baseline site survey is to:<br>▪ characterise physico-chemical and biological conditions of the survey area; and<br>▪ provide a pre-drill baseline of the reference conditions against which any potential future monitoring (e.g. post drill monitoring) can be compared.<br>Sediment samples for biological, physico-chemical and geotechnical baseline investigations will be retrieved within the survey area.<br>Sediment samples will be retrieved using the following sampling equipment:<br>▪ box corer |

- grab sampler
- gravity corer

Box corer and/ or grab samples will be recovered at approximately 20 stations within the site survey area. These will be used to characterise the biological (macrofaunal) and physico-chemical baseline environment while core samples will be analysed to provide information on the geotechnical characteristics of the sediments. In all cases replicate samples will be recovered.

In addition to sampling within the site survey area, samples will be retrieved at reference stations located at least 2 km from the proposed site. Reference stations will be within the same broad habitat type to provide an undisturbed reference for potential future monitoring. The number of reference station to be sampled will depend on the number of broad habitat type sampled in the site survey area. It is anticipated that the approximately 5 reference sites will be sampled.

Macrofaunal samples will be processed and preserved on recovery ahead of onshore analysis. Sediment samples are to be prepared and stored in preparation of the following onshore lab analyses:

- particle size analysis
- total organic carbon
- total organic matter
- hydrocarbons
- metals.

Gravity cores will be acquired to ground-truth shallow soils and for basic offshore geotechnical testing (including pocket penetrometer). Cores will be recovered and cut offshore in preparation for storage and potential future geotechnical testing. Sediment description and basic geotechnical tests will be conducted offshore on the cut ends of each core section.

Seabed sediment sampling using core and grab samplers will result in disturbance to the seabed. This disturbance will be temporary and limited to the surface area (footprint) of the core and grab samplers. The footprint of the grab and corer samplers to be used will be 0.1 – 1 $m^2$, with a maximum sediment penetration depth of approx. 0.5 m. The footprint of the gravity corer is relatively small and limited to the part of the corer that will impact the seabed which is the core barrel that has a diameter of 110 mm. Sediment penetration depth of the gravity corer is approx. 2 – 4 m. Given the small footprints of the core and grab samplers and the small volumes of sediment that could be removed, and the temporary nature of sampling activities, likely significant effects can be excluded.

Prior to undertaking sediment sampling operations, the sampling stations will be visually inspected using AUV mounted cameras and/ or drop-down camera systems to ensure the areas to be sampled do not support sensitive habitats including Habitats Directive Annex I Habitats (e.g. Reef [1170] – geogenic and biogenic reef) are not impacted by the deployment of sampling equipment.

Once the vessel is on stations, the positioning of AUV and/ or drop-down camera system will be monitored from the vessel using an ultra-short baseline (USBL) system. During deployment, the AUV and/ or drop-down camera system can be re-positioned to ensure the correct position on the seabed to inspected. Sampling will not be undertaken where sensitive habitats are identified; alternative sampling stations free of sensitive habitats will be identified and sampled. Details of any previously unknown Habitats Directive Annex I Habitats will be recorded and shared with the NPWS of the Department of Culture, Heritage and the Gaeltacht (DCHG). Given the short duration and nature of visual inspections using AUV cameras and/ or drop-down camera systems, significant disturbance effect to habitats and/ or species (including those listed under Annex I, II and IV of the Habitat's Directive) can be excluded.

The effect of noise emission from USBL acoustic positioning systems is assessed in **Section 3.4**.

Europa will also ensure archaeological (e.g. ship wrecks) or cultural sites are not impacted by the deployment of sampling equipment. Using mapping of known shipwrecks and geophysical data gathered during the survey, Europa will ensure that no seabed sampling activities are undertaken in the vicinity of any features of historic or cultural importance. Sampling stations will be visually inspected using AUV cameras and/ or drop-down camera systems to ensure the areas to be sampled do not include archaeological or cultural sites. Details of any previously unknown archaeological or cultural sites will be recorded and shared with the Underwater Archaeology Unit - DCHG. Europa will appoint a suitably qualified and experienced maritime archaeologist to undertake an archaeological assessment of the proposed site based on existing published data and survey data collected as part of the Kiely East Survey.

## 2.2 Receiving Environment

This section describes the physical, biological and socio-economic (including oil and gas operations, commercial fishing, telecommunications and shipping) baseline of the receiving environment of the proposed survey. Additional detail on commercial fishing activity in the survey area is provided in the Pre-survey Fisheries Assessment Report (document reference: **MGE0719RP0015**) that accompanies this report.

### 2.2.1 Physical Environment

#### 2.2.1.1 Bathymetry, Seabed Type and Features

The water depths across the Irish shelf area are relatively shallow up to the point of the shelf break, generally ranging between 50 m and 200 m. As the continental shelf drops off into the abyssal plains, depths can increase to over 3,000 m.

Sediments in Ireland's coastal and offshore waters are influenced by hydrodynamic conditions (PAD, 2015) and range from gravels and coarse sands to soft mud and mixed sediments, and in general become finer with increasing distance from shore and increasing water depths (Rice et al, 1991; Huvenne et al, 2003). The seabed landscape in Irish Atlantic waters have been largely shaped by glacial periods, when large volumes of material were eroded from the land and deposited on the continental shelf, the shelf edge and the continental slope. Continental shelf sediments are typically sandy with patches of gravel and outcrops of rock. Fine sediments dominate in the deeper parts of the continental slope (DCENR, 2015).

Seabed carbonate mounds have been identified along the shelf edge to the north and south of the proposed survey area. The formation of carbonate mounds is generally linked to the development and growth of deep, cold-water coral species. The size and shape of mound structures vary, from simple cones to complex amalgamated ridge features covering up to 5 $km^2$ and standing up to 300 m high above the seabed (Unnithan & Shannon, 2003). Significant mound provinces (the term used to identify a cluster of mound structures) are located within located within offshore SACs. The closest offshore SAC, the Hovland Mound Province SAC, is over 62 km from the proposed survey GWA.

#### 2.2.1.2 Oceanography

The west of Ireland falls between two major gyre circulation features of the north Atlantic, the sub-polar and sub-tropical gyres, which are bounded by the region's major ocean currents (the North Atlantic Current and the Shelf Edge Current). The North Atlantic Current forms the southern boundary of the sub-polar gyre and travels eastwards from the western north Atlantic. The main branch of the North Atlantic Current then sweeps north to the west of the Rockall Bank, with a southern branch of the North Atlantic Current flowing southeast into the Bay of Biscay (PAD, 2015). The Shelf Edge Current follows the Irish Atlantic continental shelf northwards. At the edge of the continental margin is a north flowing slope current including the relatively warm and saline Shelf Edge Current, and below this, deep ocean recirculation, with Sub-Arctic Intermediate Water and Labrador Sea Water masses flowing southwards from the Arctic.

#### 2.2.1.3 Wind

The prevailing winds over the offshore waters off the south coast of Ireland are from the west and south-west (PAD, 2015). Over the open ocean, winds of greater than 8 MV (Beaufort Force 5) occur between 70 and 75 % of the time during winter months (October to March) and between 30 to 35 % of the time during summer months (April to September). Winds reach storm to hurricane strength in one third of gale conditions (PAD, 2015).

## 2.3 Biological Environment

### 2.3.1 Plankton

Plankton consists of microscopic plants (phytoplankton) and animals (zooplankton) which live freely in the water column and drift with the water currents. Plankton forms a fundamental link in the food chain. The composition of plankton communities at any time is variable and depends upon the circulation of water as well as light and nutrient availability.

#### 2.3.1.1 Phytoplankton

Phytoplankton derive energy from sunlight and are responsible for most of the primary production in the sea, thus forming the basis of the marine food web. Phytoplankton has a limited ability to move and as a result its distribution and abundance is strongly influenced by hydrographic factors such as depth, tidal mixing, temperature stratification and advection. To the west of Ireland, phytoplankton primarily comprises diatoms and dinoflagellates with some ciliates. In the area the seasonal cycle of phytoplankton growth is complex and is governed by the interaction between oceanic and continental shelf waters. Turbulence from the Irish shelf front introduces nutrients from deeper waters which causes phytoplankton growth along in a band of nutrient rich cool water along the shelf edge.

During the winter months, light availability is the primary limiting growth factor. Increasing light levels in spring leads to a rapid expansion of the planktonic population. During the summer, nutrients are depleted by phytoplankton growth and are not replenished in the photic zone as the presence of thermoclines restricts the mixing of nutrients from deeper waters. Towards the end of the summer months, phytoplankton growth diminishes as the concentrations of available nutrients decreases. In the autumn, a smaller bloom may occur as water column thermoclines are reduced due to the cooling of surface waters and increased wind induced turbulence. The reduction of thermoclines allows for increased mixing of the water column and draws nutrients from deeper waters into the photic zone (PAD, 2006).

#### 2.3.1.2 Zooplankton

Zooplankton are microscopic animals which feed on phytoplankton. The zooplankton communities in coastal water and along the shelf edge are dominated in terms of biomass and abundance by copepods, particularly the large copepod species *Calanus helgolandicus* and *Calanus finmarchicus*. Other species or groups that occur frequently or are distributed mainly in shelf waters include decapoda and echinodermata larvae (CPR Plankton Atlas, 2004). Euphausids (krill) constitute a significant presence in the zooplankton community found in surface waters, particularly in open shelf waters (PAD, 2007b). Copepods are considered to be the major trophic link between phytoplankton primary production and ichthyoplankton (fish larvae). Coastal water and the shelf edge are important spawning grounds for commercial fish species such as mackerel, hake and megrim. Any changes in zooplankton communities due to increased temperature and hydrographic changes could radically change the food environment for fish larvae in the region.

### 2.3.2 Benthos

Benthic fauna that live on or in the seabed are termed epifauna or infauna respectively. Factors which affect benthic fauna diversity include water depth, temperature, sediment type and water currents. The various components of the zoobenthos play an important role in the marine food web due to the direct and indirect dependence of demersal fishes, marine birds and marine mammals on benthic macrofauna (Boelens et al., 1999). Decomposition of organic matter, which originates from primary production in surface waters, and in coastal areas from terrestrial sources, is carried out by sediment-dwelling bacteria and benthic fauna. Benthic biota are important mediators of nutrient recycling from the sediment into the water column. The benthic fauna are important prey of higher trophic-level predators including commercially valuable demersal fish. Other species of direct commercial importance include molluscs and crustaceans.

#### 2.3.2.1 Continental Shelf

Sedimentary habitats in coastal and shelf waters vary from gravels and coarse sands to soft mud and mixed sediments. Sand and coarse sediment habitats are subject to strong wave disturbance in shallow water, or fast tidal flows where the influence of wave action is absent. Mud habitats can consist of mud or sandy mud and are typically found in sheltered areas characterised by weak current flows. Mixed sediments occur in areas that undergo alternate periods of erosion and deposition and include a mix of coarse sands, gravel, shell and fine sands and muds.

Shelf sand habitats are characterised by a diverse mix of echinoderms, bivalve molluscs, amphipod crustaceans and rich polychaete fauna. These habitats include a range of sediment types of varying diversity, with muddier sands supporting a larger biomass and more diverse macrofaunal community, while cleaner sands have relatively less diverse communities. Mud communities are typically dominated by polychaetes, with high numbers of bivalves, echinoderms and foraminifera also present. There are two broad community types identified in coastal and continental shelf sands and muddy sands; an Amphiura community and a *Chamelea gallina* community. The Amphiura community includes the brittle stars *Amphiura filiformis*, *Amphiura chiajei* and the bivalve mollusc *C. gallina*. Fine shelf mud communities are commonly characterised by bivalve species of the family Thyasiridae, brittlestars and sea urchins. Mud habitats also support a range of large burrowing megafauna including the Dublin Bay prawn *Nephrops norvegicus*. Other fauna that may be present in mud habitats include seapens, holothurians and burrowing anemones. Coarse and mixed sedimentary habitats are typically characterised by tube

dwelling species polychaetes and bivalve molluscs. DCENR (2015) also highlighted the presence of sandbanks on the continental shelf off the north-west coast of Ireland.

#### 2.3.2.2 Continental Slope

Sedimentary habitats in deeper waters (including the upper slope, bathyal and abyssal area) tend to be fine grained, depositional environments. Macrofaunal communities are dominated by deposit feeders such as holothurians, polychaetes, crustacea, bivalves, echinoderms and peanut worms (Sipuncula). In the shallower slope area, there are extensive areas of muddy habitat where the benthic communities are dominated by the burrowing activities of the prawn *Nephrops norvegicus*. This commercially important species is the target of large scale bottom trawling activity. Along the margins of the continental shelf break and slope (200 m – 750 m) the sea anemone (*Actinauge richardii*) may dominate. Other dominant species at these depths include the decapod crustaceans *Pagurus variabilis* and *Macropipus tuberculatus,* and echinoderm species including *Ophiothrix lütkeni*. Bett & Rice (1992) studied benthic macrofaunal abundances in the Porcupine Seabight and found that sipuncula (peanut worms) and echinoidea (sea urchins) were the two most abundant taxa at depths of 900 m. Community composition in the abyssal environment changes with depth as a result of food availability, as shown by Lampitt et al (1986) where crustacean biomass and abundance was seen to decrease more quickly with depth than echinoderms and other phyla. In general, crustaceans (mainly decapods) dominated at depths shallower than 1,000 m.

Reef habitats are typically subjected to strong currents and are often dominated by epifaual species including sponges, hydroids, barnacle, anemones and cup corals. Reef habitats on the continental margins range from 200 m to 2,700 m (i.e. the continental slope to lower bathyal zones). Hard substrates such as gravels and boulders, often of glacial origin, can be encountered at any depth, but are more commonly found at depths shallower than about 700 m. Certain reef forming benthic organisms are particularly important in providing suitable substrata for other animals, thereby greatly enhancing local diversity. One example is the lattice-work structure of cold water corals *Lophelia pertusa* and *Madrepora oculata,* which have the potential to modify the seafloor by constructing reef frameworks and providing habitat and shelter to other organisms. Cold-water corals tend to flourish on the upper continental slope and are often found associated with carbonate mounds. Two colonial stone coral species, *Lophelia pertusa* and *Madrepora oculata* are known to occur in Irish waters. In Irish offshore waters six SACs have been designated for Reefs [1170] which can include formations of *Lophelia pertusa* and *Madrepora oculata*.

### 2.3.3 Fish and Shellfish Species

Offshore and coastal waters around Ireland are productive and support a diverse community of fish and shellfish species (Hartley Anderson, 2005). Distribution is generally governed by the sediment type, water temperature and water depth.

Seabed sediments are varied across the proposed survey GWA and include coarse, sand and mud. Generally, coarse sediments are dominated by elasmobranchs, gurnards, cod, large whiting and a few flatfish species with populations of scallops and queen scallops may also be present in such areas. Sandy substrates support sandeels, flatfish, anglerfish, smaller gadoids, hake, plaice and dabs. Mud and clayey sediments provide habitats for burrowing crustaceans (e.g. *Nephrops norvegicus*) and some fish species including plaice and monkfish. Mixed sediment and reef habitats support crustacean species including lobster, spider crab, brown crab and velvet crab.

### 2.3.3.1 Continental Shelf

The continental shelf waters of the west of Ireland are support a diverse community of fish and shellfish. Demersal species include cod, haddock, whiting, sole, plaice, with hake, anglerfish and megrim often associated with the shelf edge. These species have a dynamic distribution that varies with feeding, nursery and spawning ground, and migratory movements. Gravelly sediments on the shelf are dominated by elasmobranchs (sharks and rays), gurnards, cod, whiting and a few flatfish species, and scallops and queen scallops are also present in these areas. Soft muddy sediments provide habitat for burrowing crustaceans, such as the commercial species Nephrops. There are higher abundances of gadoids in these areas and lower densities of plaice and dab than found in shallower sandy areas. Sandy or muddy sand sediments support communities of cod, whiting, haddock, anglerfish, hake and saithe (DCENR, 2008). Water temperature is also a significant factor in the overall distribution of fishery species in the area. For species capable of tolerating colder water temperatures (e.g. cod and herring), the southernmost extent of their habitat range is the Celtic Sea. Depending on the northward flow of warm water currents, the distribution of warmer water species (e.g. bass) varies according to the extent of the warm water currents (e.g. Eastern North Atlantic Water) (PAD, 2006).

There are 377 species of marine fish that are known to occur in Irish offshore waters. Of these, 21 are of conservation concern. **Table 2.3** lists the species conservation concern, alongside their current population trend.

**Table 2.3: Fish Species of Conservation Concern which may be present in the vicinity of the proposed Kiely East Survey (IUCN, 2016)**

| Common Name | Species Name | IUCN Status and current Population Trend |
|---|---|---|
| **Actinopterygii (ray finned fish)** | | |
| Atlantic halibut | *Hippoglossus hippoglossus* | Endangered (unknown) |
| Atlantic bluefin tuna | *Thunnus thynnus* | Endangered (decreasing) |
| European eel | *Anguilla anguilla* | Critically Endangered (decreasing) |
| Haddock | *Melanogrammus aeglefinus* | Vulnerable (unknown) |
| **Sharks** | | |
| Common thresher shark | *Alopias vulpinus* | Vulnerable (decreasing) |
| Basking shark | *Cetorhinus maximus* | Vulnerable (decreasing) |
| Tope shark | *Galeorhinus galeus* | Vulnerable (decreasing) |
| Smooth-hound shark | *Mustelus mustelus* | Vulnerable (decreasing) |
| Angular rough shark | *Oxynotus centrina* | Vulnerable (unknown) |
| Angel shark | *Squatina squatina* | Critically Endangered (decreasing) |
| Leafscale gulper shark | *Centrophorus squamosus* | Vulnerable (decreasing) |
| Porbeagle | *Lamna nasus* | Vulnerable (decreasing) |
| Smooth hammerhead | *Sphyrna zygaena* | Vulnerable (decreasing) |
| Piked dogfish | *Squalus acanthias* | Vulnerable (decreasing) |

| Common Name | Species Name | IUCN Status and current Population Trend |
|---|---|---|
| Shortfin mako | *Isurus oxyrinchus* | Vulnerable (decreasing) |
| **Skates and Rays** | | |
| Common skate | *Dipturus batis* | Critically Endangered (decreasing) |
| Sandy skate | *Leucoraja circularis* | Endangered (decreasing) |
| Undulate skate | *Raja undulata* | Endangered (decreasing) |
| White skate | *Rostroraja alba* | Endangered (decreasing) |
| Giant devil ray | *Mobula mobular* | Endangered (decreasing) |

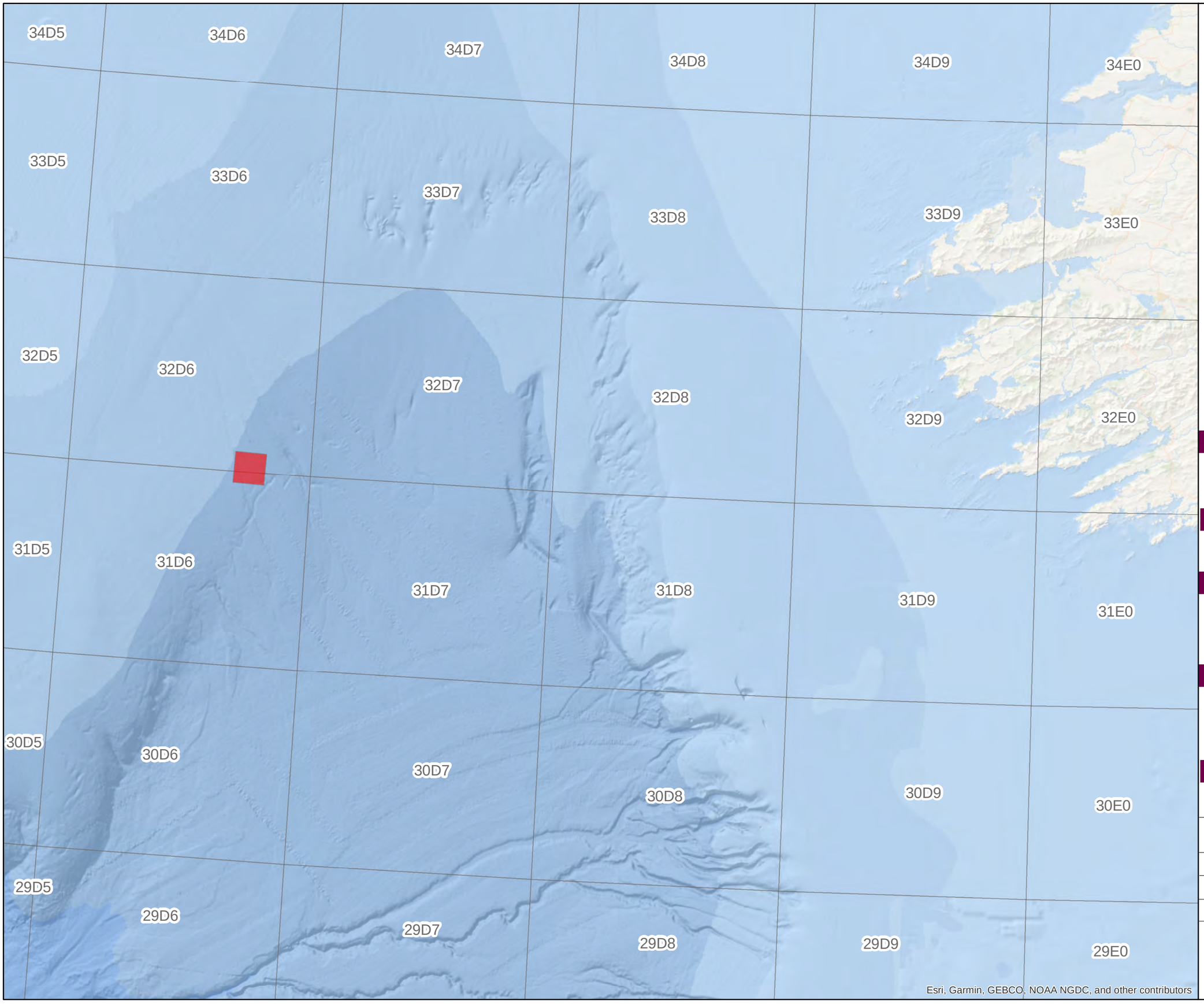
#### 2.3.3.2 Nursery and Spawning Areas

Many fish species aggregate to spawn. Whereas some species may have extensive spawning grounds that change location slightly from year to year, other species may aggregate over a more restricted spatial extent, such as specific areas on the sea floor. There are numerous modes of reproduction in fishes. Broadcast spawning, which involves shedding the eggs and sperm into the water column, is one of the more common reproductive strategies (Balon, 1984). Such species may have more extensive spawning grounds than species such as herring which deposit eggs directly on the seabed, typically preferring areas of coarse sediment.

The grounds where juvenile fish are found are termed nursery grounds. These areas may be subject to reduced rates of predation and faster growth rates than elsewhere, which may result in nursery grounds providing a greater relative contribution to adult recruitment in comparison to non-nursery ground habitats (Beck et al., 2003; Heupel et al., 2007).

The proposed survey area is located in International Council for the Exploration of the Sea (ICES) statistical rectangles 32D6 and 31D6 (see **Figure 2.1**). **Table 2.4** details the fish species which use these rectangles for spawning and nursery activities (Coull *et al*., 1998; Ellis *et al*, 2012). The proposed survey will be conducted between June and late-November 2019; there is potential that during this period the fish species using the area may be affected by survey activities.

The survey period, in part, coincides with the peak spawning and nursey period for Mackerel and Blue whiting, the peak nursey period for Anglerfish and peak spawning period for Horse Mackerel, Nephrops and Sprat. It should be noted that for most species spawning periods are not rigidly fixed and fish may spawn either earlier or later from year to year. In addition, the mapped spawning areas represent the widest known distribution of spawning activities given current knowledge and should not be seen as rigid unchanging descriptions of presence or absence (Coull *et al*., 1998).




## Legend

- Kiely East Survey
- ICES Rectangle

0 25 50 Km

**Client**
**Europa Oil & Gas**

**Figure**
**2.1**

**Title**
**Kiely East Survey relative to ICES statistical rectangles**

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**Issue Details**

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**Rev:**
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| **Drawn:** JF | **Date:** 21/05/2019 |
| **Checked:** GMcE | **Scale:** 1:1,015,850 (A3) |
| **Approved:** GMcE | **Projection:** ITM |

**NOTE:**

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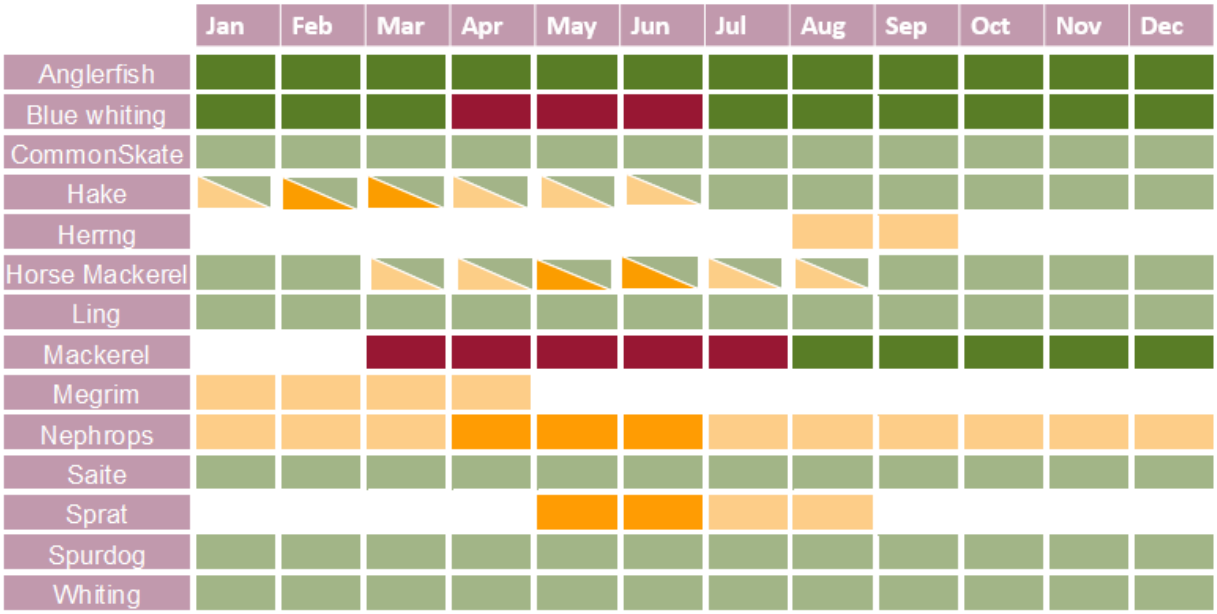
**Table 2.4: Fisheries sensitivities at Kiely East Survey GWA (Coull et al., 1998; Ellis et al., 2012; Marine Institute, 2017)**




### 2.3.3.3 Deep water species

Deep waters are waters below the continental shelf (< 200 m). Productivity at these depths is very low because of the absence of light preventing primary productivity, the lack of nutrients, and the low water temperatures. Many animals living at these depths migrate at night to the surface waters to feed.

Deep water surveys have shown that assemblages of species could be identified in relation to their depth and geographical location. **Table 2.5** lists the main deep-water fish species identified during surveys in the vicinity of the Porcupine Bank within depth range classes (DCENR, 2008).

**Table 2.5: Deep water species which may be present in the vicinity of the proposed Kiely East Survey**

| Water Depth | Species Name |
|---|---|
| 400 - 800 m | Morid cod, chimaeras, greater forkbeard, silvery pout, argentine, blue whiting, roundnose grenadier, bluemouth, blackspot grenadier, velvet belly, common Atlantic grenadier, Günther's grenadier, Kaup's arrowtooth eel, birdbeak dogfish, deep-water cardinal fish, black. |
| 800 - 1,400 m | scabbardfish, Baird's smoothhead, rockfish, shortnosed chimaeras, haddock, whiting, siki, blue ling, squalid sharks. |
| 1,400 - 2,000 m | Morid cod, roundnose grenadier, Kaup's arrowtooth eel, smooth grenadier, Baird's smoothhead, rabbitfish, large eyed-rabbitfish, spear-snouted grenadier, Portuguese |

| Water Depth | Species Name |
|---|---|
| | dogfish, Murray's longsnout grenadier, Günther's grenadier, small-mouth spiny eel, common Atlantic. |
| > 2,000 m | grenadier, slick-heads or naked-heads, orange roughy, black scabbardfish, siki, blue ling. squalid sharks. |

#### 2.3.3.4 Diadromous Species

A number of migratory species may be present in the waters offshore Ireland. Atlantic salmon (*Salmo salar*) (listed in Annex II of the Habitats Directive) is an anadromous species, spending part of their lifecycle in freshwater rivers and part in the marine environment. The migratory path for Irish salmon is northward along the west coast of Ireland, then towards Greenland and the Norwegian Sea (PAD, 2015). Trout (*Salmo trutta*) shares many of the biological features of its close relative the salmon and migrates to sea to feed. Trout are usually found in coastal waters only.

The European eel (*Anguilla anguilla*) is mostly estuarine in the early stages of its lifecycle, however mature adults migrate downstream to the sea in autumn, where they may continue on to the Sargasso Sea to mate and die.

Other migratory species, such as river lamprey (*Lampetra fluviatilis*), sea lamprey (*Petromyzon marinus*), twaite shad (*Alosa fallax*) and allis shad (*Alosa alosa*) are listed in Annex II of the Habitats Directive, limit their migratory paths to the coastal areas.

### 2.3.4 Seabirds

Seabirds are defined as those birds that spend a large part of their time on or over the sea surface. The distribution of seabirds in the offshore environment is not homogeneous, being influenced by several factors, prey availability being the most significant (PAD, 2007).

Other biological factors contributing to their distribution include the proximity of available nesting sites and social interactions. Commercial fishing can affect species distribution as many species obtain a high percentage of their food from fishing vessels, mostly at the shelf edge.

Physical factors including water depth, wind and weather, water movement, sea temperature and salinity also directly and indirectly influence seabird distribution, often through prey distribution. **Table 2.6** lists some of the main bird species that may occur offshore Ireland.

The west coast of Ireland comprises a length of exposed and inaccessible cliffs which provide ideal breeding habitat for many seabird species which feed in the offshore waters to the west of Ireland. Petrels, shearwaters, skuas, gannets, gulls and auks are the dominant seabird species in the north west of Ireland area (DCENR, 2015). The majority of these birds breed in colonies on the south-west coast of Ireland, while other overwinter in Irish waters. Other species use the area as a migratory corridor (e.g. shearwater, skua).

The offshore distribution and abundance of seabirds varies over the year, being lower during the breeding season when many species return to shore to nest. The offshore distribution outside the breeding season is mostly driven by the availability of food (DCENR, 2015). The distance birds will travel from their colonies for food varies greatly between species and this influences offshore distribution. Non-breeding birds may be found foraging further offshore than breeding birds.

Seabird abundance decreases in offshore waters following the winter period (December to February) when large numbers of seabirds start to return to their coastal colonies for the breeding season (April to June). During this breeding period, high numbers of breeding seabirds are linked to their colonies and adjacent coastal waters for feeding.

**Table 2.6: Seabirds - Continental shelf and coastal water abundance**

| |
|---|
| **PETRELS AND SHEARWATERS:** The most pelagic of all seabird species, petrels and shearwaters can cover long distances over periods of weeks and months. These bird species dominate the deepwater habitats of the continental slopes and deep basins. |
| **European storm petrel (*Hydrobates pelagicus*)**<br>The European storm petrel is a summer visitor in Ireland over shelf waters along the west coast of Ireland extending on the Porcupine Bank and southwards to the Celtic Sea area.<br>During ObSERVE surveys 608 sightings comprising a total of 843 individuals were made of unidentified petrel species. Sightings were most likely to have been of the two species of petrel breeding in Ireland, the European storm petrel (*Hydrobates pelagicus*) and Leach's storm petrel (*Oceanodroma leucorhoa*), although definitive species identification could not be made from the aircraft.<br>Sightings occurred predominantly during summer surveys in both years, throughout the majority of the survey area. Sightings were not limited to continental shelf waters, and although there were relatively more sightings in the Celtic Sea, there were numerous occurrences over deep waters of the Porcupine and Rockall Basins. |
| **Northern fulmar (*Fulmarus glacialis*)**<br>Northern fulmar is a common and widespread seabird species along British and Irish coasts, preferring offshore waters on both the shelf and continental slope.<br>During ObSERVE programme surveys northern fulmar were one of the most commonly sighted species, irrespective of season with some large flocks of over 100 birds observed in all seasonal surveys.<br>Sightings occurred throughout the survey areas, distributed over both continental shelf and deeper waters, although overall there were relatively fewer sightings over the deep waters of the Rockall Basin and the Porcupine Basin. During winter, higher densities of sightings occurred to the west and northwest of Ireland. |
| **Wilson's storm petrel (*Oceanites oceanicus*)**<br>Wilson's storm petrel is a rare visitor to the area, with all occurring between May and September during their post breeding dispersal. |
| **Leach's storm petrel (*Oceanodroma leucorhoa*)**<br>Leach's storm petrel is a migratory bird that breeds on the Stags of Broadhaven and possibly in other islands off the west of Ireland such as the Blasket Islands. The shelf break is particularly important for Leach's storm petrels during the main breeding season. In winter/early spring Leach's storm petrels virtually disappear from Irish offshore waters.<br>During ObSERVE surveys 608 sightings comprising a total of 843 individuals were made of unidentified petrel species. Sightings were most likely to have been of the two species of petrel breeding in Ireland, the European storm petrel (*Hydrobates pelagicus*) and Leach's storm petrel (*Oceanodroma leucorhoa*), although definitive species identification could not be made from the aircraft. Sightings occurred predominantly during summer surveys in both years, throughout the majority of the survey area. |

Sightings were not limited to continental shelf waters, and although there were relatively more sightings in the Celtic Sea, there were numerous occurrences over deep waters of the Porcupine and Rockall Basins.

**Great shearwater (*Ardenna gravis*)**

Great shearwater breeds exclusively on islands in the south Atlantic reaching Ireland in July. The great shearwater is numerous and widespread over the northeast Atlantic during the summer months particularly along the shelf margin. There was a single sighting of a great shearwater (*Ardenna gravis*) during ObSERVE aerial surveys. The sighting occurred in summer 2016 and over the deep waters of the Porcupine Basin.

**Manx shearwater (*Puffinus puffinus*)**

Manx shearwater, a local breeders and passage migrant, is regularly recorded in Irish waters between March and October. Highest densities occur in the Celtic and Irish seas in summer.

As the majority of the European population spend their winters in South America records during the winter months are sporadic and mainly exist for Irish coastal areas. During ObSERVE aerial surveys Manx shearwater (*Puffinus puffinus*) were one of the more commonly sighted species. In total, 543 sightings totalling 4,091 individuals were recorded. Sightings occurred almost exclusively in summer surveys, with only nine sightings in winter. Most observations of Manx shearwater were over the continental shelf, with large numbers of sightings (and large group sizes), occurring in the Irish Sea and eastern Celtic Sea. There were also a number of records of birds occurring large distances from the coast, and over deeper waters including off the shelf edge into the Rockall basin.

**Sooty shearwater (*Ardenna griseus*)**

The sooty shearwater is a highly pelagic passage migrant that breeds on islands in the southern Pacific and Atlantic Oceans. Records are mainly confined to the eastern side of the Rockall Trough and Porcupine Bank. The species is listed as Near Threatened on the IUCN Red List.

There were six sightings of sooty shearwater during ObSERVE aerial surveys on the Porcupine Bank and west of the Porcupine Bank. Sighting comprised a total of seven individuals. All sightings occurred in the second year of surveys, with five sightings in summer and one sighting in winter.

**GANNETS:** Gannets are found only in the north Atlantic and they breed in a few, very large colonies on both mainland cliffs and remote islands off Scotland and Ireland. Gannets are partial migrants; adults usually remain in northern waters during winter while others, mainly juveniles, migrate southwards as far as western Africa.

**Northern gannet (*Morus bassanus*)**

Northern gannet has been recorded in the area throughout the year, with most sightings occurring in spring. Gannets occur in lower densities during the late summer and autumn when highest densities are recorded around their breeding colonies. The relatively high numbers of gannets recorded during the winter correspond to birds returned from their wintering grounds in Africa. The Irish offshore holds high densities of gannets. Irish waters serve as foraging areas to the large gannetries located in Little Skellig (Co Kerry), Bull Rock (Co Cork), Great Saltee Island (Co Wexford) and Irelands' Eye (Co Dublin).

During ObSERVE aerial survey a total of 1,454 sightings of 2,044 northern gannets were recorded. The species was observed throughout the survey area and in all seasons, with a clear increase in sightings in summer surveys. There were comparatively fewer sightings along the western Porcupine Bank and in the Irish Sea, with the majority of sightings occurring in over continental shelf waters, with some sightings occurring in the deeper waters of

the Porcupine Basin and Rockall Basin. Most sightings were of single individuals or small groups, however some observations of flocks of over 20 individuals were noted.

**SKUAS:** Skuas are migrant species in Irish waters. They are highly aerial and acrobatic, and are known to chase gulls, terns and other seabirds to steal their catch.

**Great skua (*Catharacta skua*)**

Great skua is the most widely recorded skua species off the west of Ireland. In contrast to other skua species; great skua are also frequently recorded during winter months, mainly over the continental shelf on the southwest coast of Ireland. Most abundant in spring and summer in the Porcupine Bank area with some records from the Celtic and Irish Seas. In winter, mainly recorded from the shelf edge west of Ireland. ObSERVE surveys reported a total of 30 sightings of 31 individuals. Sightings were evenly distributed across both summer and winter surveys, and all occurred over continental shelf waters. No great skua were sighted in Irish Sea surveys.

**Pomarine skua (*Stercorarius pomarinus*)**

Pomarine skua is a spring and autumn migrant in Irish waters, the two main migratory routes being the Irish Sea and off the west coast of Ireland. They are recorded in low numbers throughout the Irish offshore area. Most birds seem to loosely follow the shelf break on their migration route. Abundance peaks occur in May, October and November.

**Arctic skua (*Stercorarius parasiticus*)**

Arctic skuas are frequently recorded in coastal and inshore habitats during periods of migration, particularly during the post breeding season (July to September). Highest densities recorded over coastal areas of the Celtic Sea.

**Long tailed skua (*Stercorarius longicaudus*)**

The long tailed skua is the smallest and most pelagic of the skua species, which rarely approaches coastal areas during migration from the wintering grounds. Sporadic sightings have occurred over the Porcupine Basin and near the Goban Spur.

**GULLS:** Large gulls are generally sedentary and closely associated with coastal regions, occasionally dispersing offshore over the shelf and continental slope. Small gulls are far-ranging and, in many cases, spend far more of their life on the open ocean than they do near land.

**Herring gull (*Larus argentatus*)**

The most common and widespread of the three large breeding gulls in Britain and Ireland. Frequently recorded along the coast in all seasons and resident in the Celtic and Irish Sea regions of the Irish offshore area. The closest SPA designated for the species is the Beara Peninsula SPA (125 km). During ObSERVE aerial surveys herring and common gulls could not be differentiated from the aircraft and were grouped together for the purposes of analysis. In total, there were 77 sightings of 156 individuals over the four seasonal survey. Sightings were concentrated in the coastal waters of the Irish Sea in both summer and winter surveys.

**Lesser black-backed gull (*Larus fuscus*)**

This mainly coastal species migrates towards their wintering grounds in the Iberian Peninsula and north Africa but increasing numbers have been recorded overwintering in Ireland.

Present in the Celtic and Irish seas throughout the year but only recorded offshore to the west of Ireland during spring and summer.

**Great black-backed gull (*Larus marinus*)**

The largest gull species breeding in Ireland is a coastal resident only found in the north Atlantic. Great black-backed gull (Larus marinus) and lesser black-backed gulls (Larus fuscus) could not be differentiated to species during ObSERVE aerial surveys. There were 93 sightings of 230 black-backed gulls. Black-backed gull sightings were normally of single individuals, but some larger groups were observed. Sightings occurred almost exclusively over continental shelf waters and were more concentrated along transects closest to the coast. Highest number of sightings of black-backed gulls occurred in winter surveys. The density modelling showed a preference for this group to occur in coastal waters, particularly along the Irish Sea and Celtic Sea coasts.

**Black-legged kittiwake (*Rissa tridactyla*)**

A small gull species, the kittiwake is one of the most pelagic and commonly breeding seabirds in Ireland. Highest densities of kittiwakes are present during winter across the Irish Shelf Irish Shelf extending down to the southern and eastern areas of the Irish offshore.

During ObSERVE survey black-legged kittiwake was one of the more commonly sighted species in surveys, with 1,474 observations comprising a total of 2,941 individuals sighted. The distribution of sightings showed strong seasonal but very little inter-annual variability. Sightings occurred in all strata but were more common in the Irish Sea during summer surveys. There were comparatively more sightings of this gull species in winter surveys, occurring commonly throughout the survey area.

**Sabine's gull (*Xema sabini*)**

Sabine's gull is an Arctic breeder that migrates southward from Greenland to wintering areas in South Africa through the northeast Atlantic in September and October. The species is sighted in the Celtic Sea shelf area mainly during the autumn months with clear peak in September.

**TERNS:** Terns are mostly summer visitors to Ireland, breeding in coastal and inshore locations. Offshore terns are irregularly recorded from May - September at varying densities. Sightings over the shelf break and continental slope to the west of Ireland are probably non-breeders as breeding terns tend to forage inshore.

**Common tern (*Sterna hirundo*)**

The common tern is a summer visitor to Ireland that breeds in coastal and inland locations. Most birds arrive in May and highest concentrations are recorded close to their breeding areas. Offshore sightings of common Terns are limited to the shelf break during the breeding season. During ObSERVE aerial surveys Arctic tern (*Sterna paradisaea*), common tern (*Sterna hirundo*), roseate tern (*Sterna dougallii*), sandwich tern (Sterna sandvicensis) and little tern (*Sterna albifrons*) species could not be distinguished to species level and were therefore grouped into a single 'tern species' group. There were 106 observations of 168 individuals across the surveys, with a single sighting occurring in winter. The distribution of sightings was heavily skewed towards coastal waters in the Irish Sea.

**Arctic tern (*Sterna paradisaea*)**

Arctic terns travel long distances from the Arctic and European breeding grounds to their Antarctic wintering areas. Occasional Arctic tern sightings have been reported from the Celtic Sea area during the breeding season.

**AUKS:** Auks are good swimmers and divers due to their short wings, but this inhibits their capability to fly and they have one of the highest energy expenditures for flight of any vertebrate. Distribution and abundance is varied, with some species found in coastal and shelf waters while others dominate the offshore environment.

**Common guillemot (*Uria aalge*)**

Common guillemot is the largest of the four auk species breeding in Ireland. Guillemots prefer inshore waters and remain close to their colonies during breeding season, becoming more widespread during autumn and winter.

**Atlantic puffin (*Fratercula arctica*)**

The Atlantic puffin is the most pelagic of the four auk species breeding in Ireland. Listed as Vulnerable on the IUCN Red List.

### 2.3.5 Marine Mammals

The Kiely East Survey area lies within the North Atlantic Marine Ecosystem within which marine mammals are a widespread and important component. Marine mammals include cetaceans (whales and dolphins) and pinnipeds (seals). Cetaceans can be further sub-divided into two groups; odontocetes (toothed whales and dolphins) and mysticetes (baleen whales).

All cetacean species are listed in Annex IV of the Habitats Directive, and under Article 12 of the Directive are afforded strict protection, prohibiting deliberate capture, disturbance and destruction of all life stages and deterioration or destruction of breeding sites or resting places.

Two Annex IV cetacean species, Harbour porpoise (*Phocoena phocoena*) and Bottlenose dolphin (*Tusiops truncatus*), are also listed under Annex II of the Habitats Directive and have been identified as Qualify Interests of designated SACs in Irish waters.

In addition, a number of SACs have been designated in Irish coastal waters for the seal species listed under Annex II of the Habitats Directive (i.e. Harbour Seal (*Phoca vitulina*) and Grey Seal (*Halichoerus grypus*).

#### 2.3.5.1 Cetaceans

Distribution patterns of cetacean species are not uniform. The large scale and non-random distribution of marine mammals is influenced by oceanographic features (PAD, 2007). The data and information used to inform this section on marine mammals within the survey area draws predominantly from environmental reports compiled for IOSEA 1 through IOSEA 5, The data and information used to inform this section on marine mammals within the survey area draws heavily on the ObSERVE Programme (Berrow et al., 2018; Rogan et al., 2018) and the Irish Whale and Dolphin Group (IWDG) Atlas of the Distribution and Relative Abundance of Marine Mammals in Irish Offshore Waters 2005-2011 (IWDG, 2013). The ObSERVE programme, which was funded by the DCCAE and Department of Culture, Heritage and the Gaeltacht (DCHG), was undertaken between 2015 and 2018 and provides robust data on species occurrence and distribution, as well as abundance, of cetacean species along the Irish offshore continental shelf and slope waters and in the Irish Sea. The ObSERVE programme comprised a series of acoustic and aerial monitoring surveys. Acoustic and aerial surveys recorded a total of 13 species and 19 species respectively, The IWDG Atlas presents data collected during the SCOPE I and II projects, the IWDG/ Galway-Mayo Institute of Technology (GMIT) Marine Mammals and Megafauna in Irish waters project, the IWDG Ferry Surveys Programme and the IWDG casual and effort-based sightings scheme (January 2005 and January 2011).

Where relevant, the assessment of marine mammals for this report has been informed by the Joint Nature Conservation Committee Cetaceans Atlas of the North West Atlantic (Reid et al., 2003). The JNCC Atlas includes updated information from the SCANS (I and II) programmes and UK and EU surveys and data for cetaceans. This assessment is also informed by data produced as part of the Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA) study. **Table 2.7** provides summary descriptions of the distribution and occurrence of toothed whales and dolphins, baleen whales, and porpoises in Irish waters. Further information on cetacean species is included in **Appendix A**.

**Table 2.7: Cetacean species**

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| Odontocetes – Toothed whales and dolphins | Harbour porpoise *Phocoena phocoena* | II and IV | The harbour or common porpoise is the smallest (average body length of < 1.5 m) and most abundant cetacean in north-western coastal shelf waters. It is a common inshore species found across the entire Irish coast and is Ireland's only porpoise species. Abundant in the Irish Sea throughout the year and is abundant inshore along the south and southwest coasts. Breeds in Irish waters. Occurs throughout the Celtic Sea with some large aggregations noted off the south coast in the Autumn months. Some evidence for an offshore movement in spring between March and June which may be linked to calving.<br>While the species has been predominately recorded over the continental shelf and in the Irish Sea, the species was also recorded during ObSERVE programme surveys to the south west of the Erris Basin in the Rockall Basin, in south of the Slyne Basin and on the northern Porcupine Bank.<br>The Blasket Islands SAC situated at the end of the Dingle peninsula in Co. Kerry is approximately 180 km from the proposed survey area and is designated for this Annex II species. The site also has one of the Ireland's largest Grey Seal (*Halichoerus grypus*) [1364] population. |
| | Short-beaked common dolphin *Delphinus delphis* | IV | The most frequently recorded dolphin species in Irish waters. Present all year round and breeding. Within the IOSEA4 area it is most abundant off the south and southwest coasts during late summer and autumn but is found throughout the Celtic Sea and along the shelf slopes. Also present in the Irish Sea, predominantly in the summer and early autumn. An eastward movement along the south coast occurs during autumn and winter, with sightings peaking off Kerry towards late summer, between September and January off Co. Cork and November to February off Co. Waterford.<br>Short-beaked common dolphin was among one of the most common cetacean species recorded during ObSERVE aerial survey with sightings of the species being predominantly recorded to the south and west of Ireland, with no sightings recorded in the Irish Sea. |
| | Common bottlenose dolphin *Tursiops truncatus* | II and IV | The common bottle-nose dolphin is a large (1.9 - 4 m), social (often in groups of 2 - 25+ individuals) dolphin with a robust head and a distinct short beak, often white tipped on the lower jaw. Found in all Irish coastal waters and are the second most frequently recorded dolphin species in Irish waters. They occur off the entire Irish coastline, some moving around the coast, |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | | | others being semi resident. As one of Ireland most recognisable cetacean species, they are sighted in inshore habitants (particularly in the Shannon estuary) often approaching vessels and display acrobatic activity. Offshore bottle-nosed dolphins are less social toward vessels.<br>During ObSERVE programme survey the species has been recorded across Irish oceanic, neritic and coastal waters, with less sightings in the western Irish Sea. Predicted distribution for bottlenose dolphins showed the coastal waters of the south west of Ireland as an important region, along with high density areas in the north eastern part of the Porcupine Seabight and the southern part of the Celtic Sea.<br>Two SACs have been designated for the species in Irish waters; the West Connacht Coast SAC and the Lower Shannon Estuary SAC; the closest of which to the proposed survey GWA is the Lower Shannon Estuary SAC (283 km). |
| | Risso's dolphin<br>*Grampus griseus* | IV | This large robust dolphin, typically around 3.5 m, is to be found in small to medium sized groups (5-20 individuals, but often considerably higher). Recorded throughout the year in Irish waters with a wide distribution. Some seasonal movements apparent. Regularly observed inshore and in bays along the southwest and southeast coasts. Regularly occurring in the southern and central Irish Sea. Breeds in Irish waters.<br>Risso's dolphins have been recorded during offshore ObSERVE survey in all seasons in deeper waters over the continental shelf and slope. |
| | Killer whale<br>*Orcinus orca* | IV | The killer whale is the largest dolphin species, reaching up to 9.5 m in length, also being the most widespread cetacean on earth, occurring in areas from the polar ice pack, to the warm waters of the tropics. They have a very tall, triangular and erect dorsal fin, and a conical shaped black head a with signature white oval patch above and behind the eye. Observed off all Irish coasts and in the Irish Sea and predominantly to the west and south of Ireland, as well as in the Irish Atlantic margin waters between spring and Autumn. Inshore sightings tend to increase during late summer and autumn.<br>During the ObSERVE aerial surveys, three sightings of killer whale were recorded. These sightings were recorded during summer over the Erris and Donegal Basins off the northwest coast. There were insufficient sightings of to undertake predicative distribution modelling and/ or to generate abundance estimates. |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | False killer whale *Pseudorca crassidens* | IV | False killer whales are 5-6 m in length and have a slender, almost all-black torpedo shaped body with a tall, usually sickle-shaped dorsal fin slightly behind the middle of the back. The head is small and narrow, tapering to overhang the lower jaw. They are highly social, with herds as large as 600 - 800 being reported. They have a wide oceanic distribution, mainly occurring in deep tropical to warm temperate waters and usually seaward of continental shelf breaks. Most sightings in the UK and Atlantic Margins have been made between July and November.<br>A single sighting of false killer whale was reported during winter ObSERVE aerial surveys. The sighting was reported in the northern western Rockall Basin. |
| | Striped dolphin *Stenella coeruleoalba* | IV | These dolphins are sleek in appearance, with a body coloration consisting of dark grey cape extending from the beak to the dorsal fin, lighter grey flanks, leading to a pink-white underside. Sightings of striped dolphin in Ireland are very rare; two during the period of study for the Atlas. By-catch data would indicate their presence in the deep waters to the southwest of the Irish Shelf.<br>Sightings of striped dolphin were made on a few occasions during the ObSERVE Aerial project. The species is generally considered to be a more southerly distributed species, but with occasional sightings as far north as the Faroe Islands. |
| | Atlantic white-sided dolphin *Lagenorhynchus acutus* | IV | This dolphin often occurs in groups from ten's to hundreds, and can occur in groups of up to 1,000, most often offshore. Their distribution in northwest Europe is predominantly clustered in an area from west of Ireland, to the north and north-west of Britain. Smaller numbers occur around the west of Ireland. It is possible that they follow mackerel as the spawn off the south-west of Ireland's coast in February/ March. |
| | White-beaked dolphin *Lagenorhynchus albirostris* | IV | Typically in the range of 2.5 - 2.7 m, this dolphin is usually found over the continental shelf in waters of 50 – 100 m. They are usually found in groups of less than 10, but herds of up to 50 are not uncommon. They cover a large part of the European continental shelf, including an area from south to west of Ireland.<br>Atlantic white-sided dolphin was recorded a total of 8 time during ObSERVE aerial surveys with most of these occurring in deeper waters, predominantly in the summer. These sightings were widely distributed extending from the Donegal and Malin Basins and eastern Rockall Basin west of the Slyne and Erris Basins to western most edge of the central Porcupine Bank and southern Porcupine Bain. |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | | | During observe aerial surveys white-beaked dolphins were recorded on 22 occasions. Sighting occurred in both summer and winter seasons. Although sightings were predominantly in offshore waters, a number of sightings of this species were made in more coastal waters. Sightings were predominantly reported in offshore waters with a minority of sightings were made in more coastal waters. Mean group size for this species ranged from 1.5 to 8 individuals. |
| | Sperm whale *Physeter macrocephalus* | IV | Sperm whales are the largest of the toothed whales (15 - 18 m in length) and Ireland's most widely distributed and abundant deep water whale species. It has a large square head that is up to one third the size of its body and an under-slung lower jaw. They are the most social of the large whales, forming groups of adult females, calves and immature male offspring. Females remain in groups, while males leave the natal group to join other males. Groups can be well over 10 but are well spread out. Typically a group of mixed members will come together at the surface once a day. They occupy deep oceans (typically 500 - 2,000 m) and are most commonly observed either in mid-ocean or over submarine canyons at the edge of continental shelves. They are to be found beyond the north and west of Ireland.<br>Acoustic detections of sperm whales during ObSERVE programme surveys indicated that the Atlantic Margin waters off western Ireland, particularly the more northerly portions, provide important habitats for the species. During survey monitoring the species was generally detected in waters less than 300 m deep and sperm whales have rarely been reported over the continental shelf in any locations worldwide. |
| | Long-finned pilot whale *Globicephala melas* | IV | The long-finned pilot whale is one of the largest dolphins, with lengths averaging 6.7m for males and 5.7m for females, they have a square bulbous head with a lightly protruding beak. The body is dark grey to black with a grey-white anchor shaped patch on the chin. They are often seen with other cetaceans, notably bottlenose dolphins. Most often, pilot whales occur in large pods (approximately 20 individuals), and large numbers of up to 1,000 have been observed off the British Isles during April, coinciding with the start of peak conception. They mainly occur in deep waters of 200 - 3,000 m beyond the shelf where bottom relief is greatest but can also swim into coastal bays.<br>During the ObSERVE aerial surveys sightings of long-finned pilot whale were made on a total of 94 occasions. Sighting ranged from 1 to 30 individuals. This species showed an offshore distribution with most sightings occurring over the continental slope and in the deeper waters of the Rockall Trough. Predictive modelling highlights the shelf edge/slope waters to be important to |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | | | this species. Based on characteristic tonal calls the presence of long-finned pilot whales was confirmed during ObSERVE acoustics surveys. There was an increase in detection rates of long-finned pilot whales in canyons compared to slope. |
| | True's beaked whale *Mesoplodon mirus* | IV | Little is known of the True's beaked whale global distribution; they occur in the warm temperate Atlantic waters, with Ireland marking their most northerly limit. |
| | Cuvier's beaked whale *Ziphius cavirostris* | IV | Occurring globally in temperate, sub-tropical and tropical waters, these whales occur as far north as Ireland and the UK. There have only been six confirmed sightings in Irish and British waters, one of these off the south coast of Ireland, and one off the north-west coast. Stranding's have occurred on the western seaboard of Ireland and Britain.<br>During ObSERVE acoustic monitoring surveys Cuvier's beaked whale was recorded throughout the survey area in all season with the exception of the most northerly area in spring and autumn. A total of 15 sightings of Cuvier's beaked whales were recorded during the ObSERVE aerial survey. The majority of sightings were in waters deeper than 100 m. Most sightings were of single individuals, and group size ranged from 1 to 5. |
| | Northern bottlenose whale *Hyperoodon ampullatus* | IV | Northern bottlenose whale (*Hyperoodon ampullatus*) species is not common west of Ireland, although individuals have been observed during the summer months. Northern bottlenose whale are thought to migrate north in spring and south in Autumn, typically occurring in deep water.<br>During the ObSERVE surveys the presence of northern bottlenose whales was sporadic, occurring from late August to mid-September in the Porcupine Shelf region. It was proposed that that northern bottlenose whales occur predominantly further west in deeper water. Visual surveys have reported northern bottlenose whales in deep waters of the Rockall Trough and along the eastern edge of the Rockall Bank. As part of the ObSERVE aerial survey northern bottlenose whales were confirmed in deeper waters along the shelf edge and canyons during winter months. |
| Mysticetes – Baleen whales | Fin Whale *Balaenoptera physalus* | IV | The second largest of the baleen whales, the fin whale is Ireland's most common large baleen whale, reaching a length of between 17.5 and 20.5 m. They are classed as being an endangered species. They have a grey body colour, and the Balaenopterid characteristic of a V-shaped head with a single central ridge, and a dorsal fin situated two-thirds along the back. Most often they occur alone or in pairs, but also form larger pods of 3-20. They prefer deep waters, 400 - 2,000 |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | | | m beyond continental shelf's and high areas with variations in bathymetry. Fin whale numbers are lowest in Ireland during winter and spring. Abundance and distribution increased in Irish shelf waters and Rockall Trough during summer; peak relative abundances recorded off the south coast and northwest shelf slopes in late summer and autumn. They inhabit the waters of the Rockall Trough year round, with numbers peaking here from August to March. The sightings and records along the slopes of the Rockall are thought to be primarily migrating individuals.<br>During ObSERVE acoustic monitoring fin whale detections occurred along the shelf edge in all seasons, with highest detection reported at the northernmost extent of the Irish shelf. During aerial surveys fin whales were seen in both summer and winter. Most sightings were of single individuals and were predominantly in waters along the edge of the continental shelf, with just one sighting in coastal waters in winter. |
| | Minke whale<br>*Balaenoptera acutorostrata* | IV | The minke whale grows to a length of 7 - 8.5 m and has diagonal white bands on the upper parts of pectoral fins, and a slender, pointed triangular head. They are most often sighted alone or in pairs, but also occur in pods of 10 - 15. They will commonly approach vessels and bow/ stern ride boats. They are the most commonly sighted whales in inshore Irish waters, being seen off all coasts, primarily in shallow waters (<200 m). They are present mainly from April to November and occur along all Irish coasts, most commonly off the south and southwest of Ireland.<br>During ObSERVE aerial survey minke whale was the most frequently observed and most abundant of the mysticete species identified. The ObSERVE programme also reported that minke whale appear to undergo seasonal movements with predicted distribution in summer showing a wide spatial distribution, including coastal and continental habitat use, whereas the winter distribution was predicted to occur south and west of Ireland, with very little of the coastal area predicted to be of high use, including the Irish Sea. |
| | Humpback whale<br>*Megaptera novaengliae* | IV | A large baleen whale of 11m-16m in length, the Humpback whale has many distinguishable features from the rest of the Balaenopteridae such as a slender flattened head covered with fleshy tubercles, and distinctly notched and irregular edged tail flue. Humpback whale occurs in Irish waters mainly over the period January - July, predominantly off the south and southeast coasts. It has also been recorded in St. George's Channel and the Irish Sea.<br>During ObSERVE acoustic surveys humpback whales were rarely detected, with most detection from the western and south-western zones in April and May Humpback whales were infrequently seen during the ObSERVE aerial survey, with sightings occurring in winter only. Humpback |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | | | whales are a migratory species believed to range widely throughout the North Atlantic from their winter breeding grounds in the West Indies to feeding areas throughout middle-high latitudes. |
| | Blue whale *Balaenoptera musculus* | IV | Blue whales are the largest of all cetaceans, and the largest known mammal. An adult will typically range from 20 - 28 m in length but can reach up to 33m. They have a distinctive dorsal fin of triangular shape, located three quarters down along the back, and a broad flattened, u-shaped rostrum, from which a single ridge runs to a prominent splash guard around the blowhole. All sightings were recorded on the slopes of the Irish Shelf and Porcupine Bank and occurred during the month of September. Additional data indicates that blue whales migrate southward to the west of the Irish Shelf from July to March, peaking during autumn.<br>A number of large whales were sighed during the ObSERVE aerial surveys however there was no confirmed sighting of blue whale. ObSERVE acoustic monitoring did however record 880 acoustic detection of blue whale during the study. |

### 2.3.5.2 Pinnipeds

Harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) are common in Irish waters, although they are concentrated in coastal and nearshore waters. Both species have established terrestrial haul-out sites along all coastlines of Ireland, which they leave when foraging and to which they return to rest during the moulting and breeding season. Harbour seal and the grey seal are both listed under Annex II of the EC Habitats and Species Directive as species whose conservation requires the designation of SACs. In addition, harbour and grey seals are protected under the Conservation of Seals Act, 1970. **Table 2.8** provides summary descriptions of the distribution and occurrence of harbour and grey seal. Further information on pinniped species is included in **Appendix A**.

**Table 2.8: Pinniped species**

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| Pinnipeds – Seals | Harbour seal (*Phoca vitulina*) | II | The harbour seal is the smaller of the two species of pinniped that breed in Ireland and is an important predator in the north-east Atlantic and Celtic Seas.<br>During the pupping (June) and moulting seasons (late July/ August) they spend more time ashore than at other times of the year.<br>The greatest numbers of harbour seals are found along the western seaboard in predominantly sheltered areas such as inshore bays and islands, coves and estuaries.<br>Given the widespread distribution of the species, harbour seal may be in the survey area during proposed survey activity. The Kenmare River SAC located approximately 202 km from the proposed survey area is designated for the species. |
| | Grey seal (*Halichoerus grypus*) | II | Grey Seal have a temperate to sub-Arctic distribution in North Atlantic waters over the continental shelf (Thompson and Härkönen, 2008).<br>In Ireland the greatest concentrations are found on exposed south-western, western, and northern coasts.<br>Grey seals spend most of the year at sea hunting for prey, only returning to shore during moulting and breeding season. Breeding season generally occurs between September and December, with seals preferring remote and generally undisturbed areas.<br>Grey seals have a moulting season during the spring months, during which time they spend the majority of time ashore. Given the species widespread distribution and foraging behaviour, grey seal may occur within the survey area during proposed survey activity.<br>The closest onshore/ coastal SAC to the proposed survey GWA where grey seal is designated is the Blasket Islands SAC (180 km). |

### 2.3.6 Marine Reptiles

Five species of marine turtle have been recorded in varying abundances in UK and Irish waters (Brongersma, 1972; Penhallurick, 1990; Langton et al., 1996; Gaywood, 1997; Pierpoint and Penrose, 1999) (see **Table 2.9**). Most of the information on the distribution of marine turtles in Irish and UK waters has been gained from strandings data, providing little indication of their distribution at sea.

Satellite telemetry studies have provided information (albeit limited) describing the extent of their range within the north Atlantic and their general movements outside the nesting period (Hays et al., 2004), but offer no indication of their small-scale movements around Ireland and the UK. An extensive review of marine turtles in Irish waters was carried out by King and Berrow (2009). They suggest that turtle sightings offshore, especially along the continental shelf edge and slope waters are considerably under-reported.

The turtle species listed in **Table 2.9** are protected under Annex IV of the European Union's Habitats Directive (Council Directive 92/43/EEC). Of the species listed in **Table 2.9**, one is listed, *Caretta caretta*, in Annex II of the Habitats Directive. Conservation of marine turtles is further addressed under the Bern Convention on the Conservation of European Wildlife and Habitats 1979 (Appendix II), and the Bonn Convention on the Conservation of Migratory Species of Wild Animal 1980 (Appendix I and II).

**Table 2.9: Marine Reptile Species**

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| Marine Reptiles – Turtles | Leatherback turtle (*Dermochelys coriacea*) | IV | Only one species, the leatherback turtle (*Dermochelys coriacea*), is reported annually and is considered a regular member of Irish marine fauna (Godley et al., 1998). Leatherback turtles are highly migratory and found in all the world's oceans, although the Atlantic is its last stronghold. It is the largest species of turtle and typically grows to over 2 m in length and averages 360 kg in weight. The leatherback turtle is by far the most numerous turtle in Irish waters, accounting for at least 80 to 83 per cent of records. The breeding sites of leatherback turtle frequenting Irish waters are unknown, but a satellite telemetry study two adult turtles were tracked south from south-west Ireland to West Africa and then across the Atlantic (see www.turtle.ie) (King and Berrow, 2009). Satellite tagging undertaken by the Coastal and Marine Resources Centre (CMRC) at University College Cork has recorded the movements of two leatherback turtles off the south-west coast of Ireland (Doyle et al., 2008). In general, sightings suggest that leatherback turtles move into Irish waters from the south and west before moving northward around the west coast of Ireland or through the Irish Sea (Pierpoint, 2000). During the ObSERVE programme surveys only there were only two confirmed sightings of leatherback turtle; both sightings were in summer on the continental shelf approximately 200 km east of the Goban Spur. |
| | Loggerhead turtle (*Caretta caretta*) | II and IV | Loggerhead turtles (*Caretta caretta*) have been recorded less frequently than leatherback turtle, with most individuals thought to have been carried north from their usual habitats by currents |

| Group | Common Name (Scientific Name) | Habitats Directive Annex(es) | Species Description |
|---|---|---|---|
| | | | (Penhallurick, 1990; Mallinson, 1991). Loggerhead turtles occur throughout the tropics, subtropics and warm temperate waters. Most records of loggerhead turtles in Irish waters come from strandings (King and Berrow, 2009), which could reflect the relative ease in identification of stranded animals more than the frequency of stranding events in Ireland. |
| | Kemp's Ridley turtle (*Lepidochelys kempii*) | IV | Kemp's Ridley (*Lepidochelys kempii*) turtle is the smallest and most endangered of the world's sea turtles (listed as critically endangered by IUCN). As with loggerhead turtles, most records in Ireland are from stranding events, most of which were located on the coastline between Cork and Donegal (King and Berrow, 2009). |
| | Hawksbill turtle (*Eretmochelys imbricate*) | IV | Two vagrant species recorded in Irish waters; sightings/ strandings are rare (Brongersma, 1972; O'Riordan et al., 1984; Branson, 1997). |
| | Green turtle (*Chelonia mydas*) | IV | |

## 2.3.7 Protected Sites

### 2.3.7.1 SACs – Offshore

In Irish offshore waters a total of six SACs have been designated (NPWS, 2014 a-f). Irish offshore SACs are designated for the protection of the Habitats Directive Annex I habitat of Reef [1170]. Reef [1170] habitat can include geogenic and/ or biogenic reef (EC, 2013).

Biogenic reefs are formed by the accumulations of dead or living hard-bodied animals, including cold-water coral reef species which can accumulate over millions of years to form carbonate mound structures that measure up to 5 km across and rise up to 350 m above the seafloor (NPWS, 2014 a-f). Geogenic reef includes exposed rocky substrate including boulder and cobble fields that can provide substrate for colonisation by fauna including coral species (Guinan and Leahy, 2009). Offshore biogenic and geogenic reef habitats support diverse communities comprising anemones, sponges, crustaceans and fishes.

Potential likely significant effects of the proposed Kiely East Survey to reef habitats and associated species comprising offshore SACs can be discounted as, based on distance from the proposed survey, no potential pathway for interaction exists between the Qualifying Interests and survey activities (i.e. no connectivity exists) (the closest offshore SAC is 62 km from the proposed survey).

### 2.3.7.2 SACs – Onshore/ Coastal

An extensive network of onshore/ coastal SAC sites are located along Ireland's coast. Qualifying Interests of these SAC sites include a range of terrestrial, coastal, and marine Annex I habitats and Annex II species, including fish and marine mammals. Designated Annex I habitats include reefs, cliffs, caves, offshore islands, sand dunes, salt marsh, intertidal bays, sandflats, beaches and rivers.

Potential effect of the proposed Kiely East Survey to coastal, terrestrial and marine Annex I habitats and non-mobile Annex II species can be discounted as, based on distance from the proposed survey, no

potential pathway for interaction exists between the Qualifying Interests and survey activities (i.e. no connectivity exists). With regard Annex II mobile species of onshore/ coastal SACs, potential likely significant effects to freshwater fish species can be discounted as these species are highly unlikely to be present in significant numbers in the vicinity of the proposed survey.

Five Annex II aquatic mammal species and and four Annex II diadromous fish species have been designated for SACs in Ireland;

- *Lutra lutra* (Otter) (Species code: 1355);
- *Phocoena phocoena* (Harbour porpoise) (Species code: 1351);
- *Halichoerus grypus* (Grey seal) (Species code: 1364);
- *Phoca vitulina* (Harbour seal) (Species code: 1365); and
- *Tursiops truncatus* (Common Bottlenose Dolphin) (Species code: 1349).
- *Salmo salar* (Atlantic salmon) (Species code: 1106);
- *Lampetra fluviatilis* (River lamprey) (Species code: 1099);
- *Petromyzon marinus* (Sea lamprey) (Species code: 1095); and
- *Alosa fallax* (Twaite shad) (Species code: 1103).

Otter [1355] is a predominantly freshwater aquatic mammal with coastal territories within 3 to 4 km of the coastline (PAD, 2015a). Given that the proposed survey area is approximately 202 km from the nearest onshore/ coastal Natura 2000 Site (Kenmare River SAC [Site code: 002158] [NPWS, 2014g]) for which otter is a designated Qualifying Interest, likely significant effects to the species can be ruled out (i.e. no connectivity exists). As a result Otter [1355] is excluded from further consideration.

In contrast, potential likely significant effects to Annex II marine mammal species *Phocoena phocoena* (Harbour porpoise), *Halichoerus grypus* (Grey seal), *Phoca vitulina* (Harbour seal) and *Tursiops truncatus* (Common Bottlenose Dolphin) cannot be readily discounted as the foraging behaviour of these wide ranging and migratory species may result in them being in the vicinity of the Kiely East Survey during operations.

Similarly, potential effects to the following diadromous fish species cannot be readily discounted; Twaite shad (*Alosa fallax*), River lamprey (*Lampetra fluviatilis*), Sea lamprey (*Petromyzon marinus*) and Atlantic salmon (*Salmo salar*).

The closest onshore/ coastal SACs to the proposed survey where the above marine mammals and diadromous fish species are designated as Qualifying Interests include:

- Kenmare River SAC (Site code 002158);
- Lower River Shannon SAC (Site code: 002165);
- Blasket Islands SAC (Site code: 002172); and
- Blackwater River (Cork/Waterford) SAC (Site code: 0032170).

**Table 2.10** lists the marine mammal and diadromous fish Qualifying Features for which the above sites are designated and outlines the distances of the site from the proposed survey. The location of these sites relative to the proposed survey area is shown in **Figure 2.2**.

**Table 2.10: Marine Mammal Qualifying Interests of Onshore/ Coastal SACs located closest to the proposed Kiely East Survey GWA**

| SAC Site Name (Site Code) | Marine Mammal Qualifying Species | Distance to proposed survey GWA |
|---|---|---|
| Kenmare River SAC (Site code 002158) (NPWS, 2014g). | *Phoca vitulina* (Harbour Seal) [1365] | 202 km |
| Lower River Shannon SAC (Site code: 002165) (NPWS, 2013d). | *Tursiops truncatus* (Common Bottlenose Dolphin) [1349] | 283 km |
| Blasket Islands SAC (Site code 002172) (NPWS, 2013e). | *Phocoena phocoena* (Harbour Porpoise) [1351]<br>*Halichoerus grypus* (Grey Seal) [1364] | 180 km |
| Blackwater River (Cork/Waterford) SAC (Site code: 0032170) | *Salmo salar* (Atlantic salmon) [1106]<br>*Lampetra fluviatilis* (River lamprey) [1099]<br>*Petromyzon marinus* (Sea lamprey) [1095]<br>*Allosa fallax* (Twait shad) [1103] | 210 km |

### 2.3.7.3 Onshore / Coastal SPAs

The waters around the Irish coast support a diverse range of seabird species. Of these some are present throughout the year while others are only present during the winter season, breeding season or during migration. Ireland's coast supports breeding, nesting and resting habitats for many seabird species, while coastal and offshore waters provide rich feeding grounds for breeding and nonbreeding seabirds as well as pelagic and species migrating through the area.

Around the Irish coast an extensive network of onshore/ coastal SPAs have been designated under the Birds Directive for the protection of populations and habitats of bird species. The nearest onshore/ coastal SPAs to the proposed survey area include:

- Blasket Islands SPA (Site code: 004008);
- Skelligs SPA (Site code: 004007);
- Puffin Island SPA (Site code: 004003); and
- Inveragh Peninsula SPA (Site code: 004154).

The Qualifying Features of these SPA sites are presented in **Table 2.11**. The location of these sites relative to the proposed survey area is shown in **Figure 2.3**.

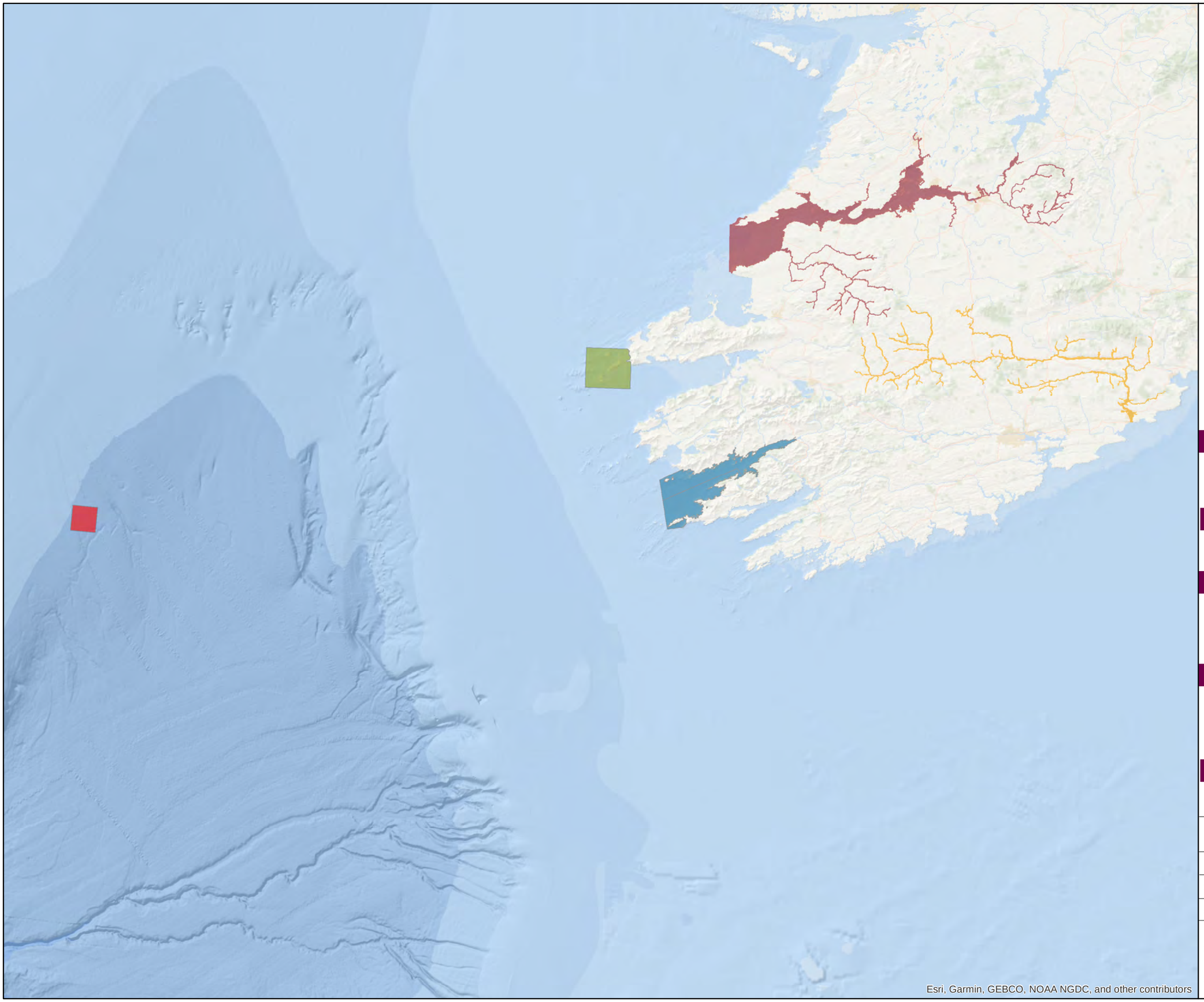
**Table 2.11: Onshore/ Coastal SPAs located closest to the proposed Kiely East GWA**

| SPA Site Name (Site Code) | Qualifying Interests | Distance to proposed survey GWA |
|---|---|---|
| The Blasket Islands SPA (Site code: 004008) | Fulmar (*Fulmarus glacialis*) [A009], Manx Shearwater (*Puffinus puffinus*) [A013], Storm Petrel (*Hydrobates pelagicus*) [A014], Shag (*Phalacrocorax aristotelis*) [A018], Lesser Black- | 180 km |

| SPA Site Name (Site Code) | Qualifying Interests | Distance to proposed survey GWA |
|---|---|---|
| | backed Gull (*Larus fuscus*) [A183], Herring Gull (*Larus argentatus*) [A184] Kittiwake (*Rissa tridactyla*) [A188], Arctic Tern (*Sterna paradisaea*) [A194], Razorbill (*Alca torda*) [A200], Puffin (*Fratercula arctica*) [A204], Chough (*Pyrrhocorax pyrrhocorax*) [A346]. | |
| Skelligs SPA (Site code: 004007) | European storm petrel *Hydrobates pelagicus* [A014], northern Gannet (*Morus bassanus*) [A016], Fulmar (*Fulmarus glacialis*) [A009], Manx Shearwater (*Puffinus puffinus*) [A013], Kittiwake (*Rissa tridactyla*) [A188], Guillemot (*Uria aalge*) [A199] and Puffin (*Fratercula arctica*) [A204]. | 183 km |
| Puffin Island SPA (Site code: 004003) | Fulmar (*Fulmarus glacialis*) [A009], Manx Shearwater (*Puffinus puffinus*) [A013], Storm Petrel (*Hydrobates pelagicus*) [A014], Lesser Black-backed Gull (*Larus fuscus*) [A183], Razorbill (*Alca torda*) [A200] and Puffin (*Fratercula arctica*) [A204]. | 194 km |
| Inveragh Peninsula SPA (Site code: 004154) | Fulmar (*Fulmarus glacialis*) [A009], Peregrine (*Falco peregrinus*) [A103], Kittiwake (*Rissa tridactyla*) [A188], Guillemot (*Uria aalge*) [A199], Chough (*Pyrrhocorax pyrrhocorax*) [A346] | 194 km |

### 2.3.7.4 OSPAR Marine Protected Areas

Under the OSPAR Convention, Ireland is committed to establish marine protected areas to protect biodiversity. This includes the development of an ecologically coherent network of Marine Protected Areas (MPAs). No legislation is currently used in Ireland to legally underpin protected areas established to fulfil commitments under international conventions. Therefore, since the creation of MPAs would not afford any legal protection to the relevant areas on their own, Ireland has established a number of its SACs as OSPAR MPAs for marine habitats, including four of its six offshore SACs as OSPAR MPAs for marine habitats. These MPAs are named the Belgica Mound Province MPA (O-IE-0002987), the Hovland Mound Province MPA (O-IE-0002988), the North West Porcupine Bank MPA (O-IE-0002990) and the South West Porcupine Bank MPA (O-IE-0002989).




## Legend

- Kiely East Survey
- Blackwater River (Cork/Waterford) SAC
- Blasket Islands SAC
- Kenmare River SAC
- Lower River Shannon SAC

0 30 60 Km

**Client**
**Europa Oil & Gas**

**Figure**
**2.2**

**Title**
# Closest SACs designated for marine mammals and diadromous fish

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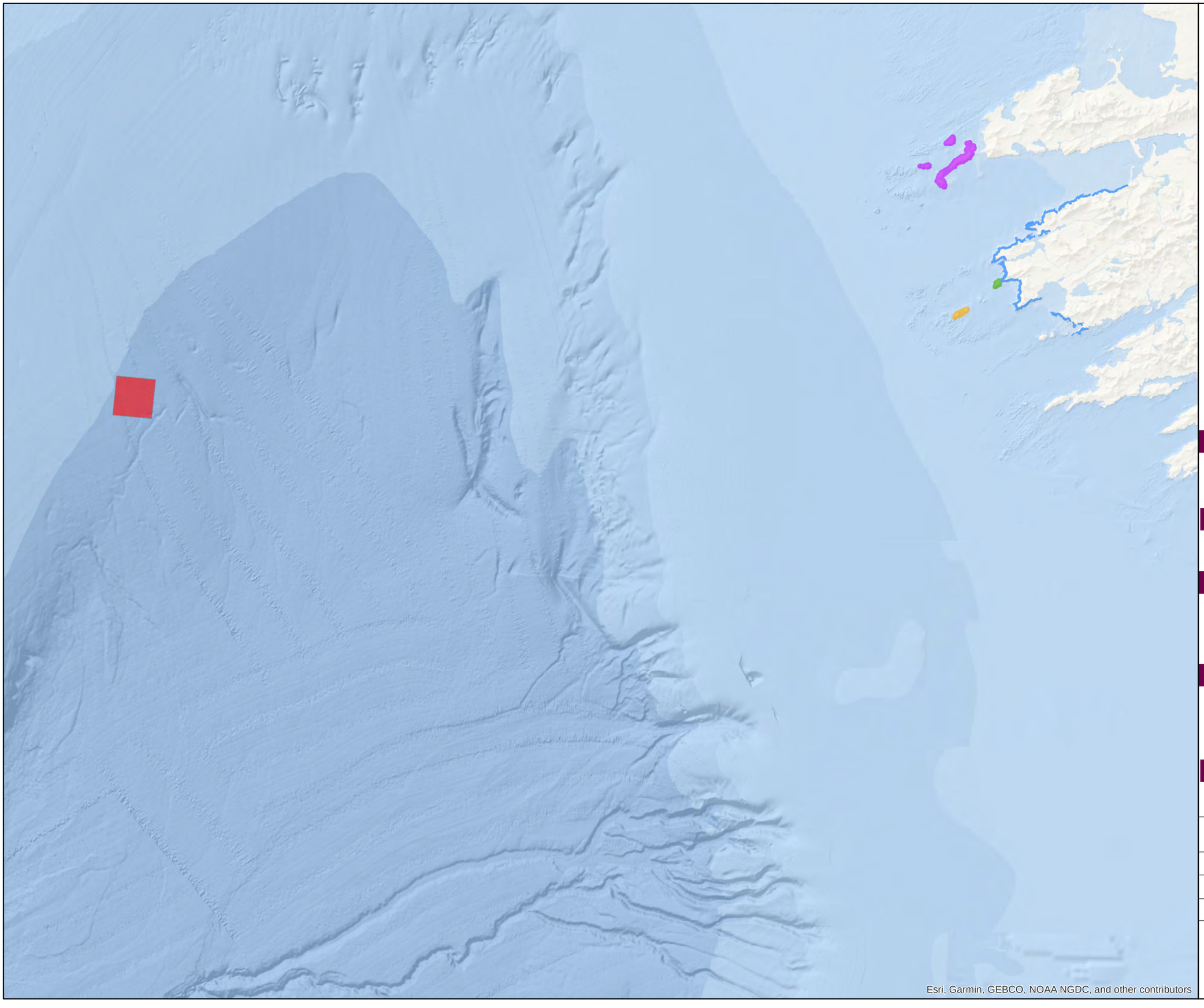


## Legend

- Kiely East Survey
- Blasket Islands SPA
- Iveragh Peninsula SPA
- Puffin Island SPA
- Skelligs SPA

0 20 40 Km

**Client**

**Europa Oil & Gas**

**Figure**

**2.3**

**Title**

**Survey area relative to the closest SPAs**

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## 2.4 Socio-economic Setting

Ireland's ocean resource consists of approximately 900,000 km$^2$ of seabed and 1,448 km of coastline. In 2016, Ireland's ocean economy had a turnover of €5.7 billion.

The direct economic value was worth €1.8 billion or approximately 0.9% of GDP. Ireland's ocean economy provided employment for 30,176 full time equivalents (FTEs) (HOOW, 2017).

### 2.4.1 Shipping and Commercial Fishing

The Irish Atlantic Seaboard supports important shipping ports at Galway, Cork, and along the Shannon Estuary. Additionally, major trade routes between Europe, America, and Asia cross the vicinity of Ireland's west coast. Most of the shipping routes off the west and southwest coast of Ireland are transatlantic between North and South America, and northern European ports based in Ireland, UK, and mainland Europe. Shipping corridors are located in the north and south of the Porcupine Basin.

The waters around Ireland contain some of the most productive fishing grounds in the EU. These waters include a large area of shallow continental shelf (< 200 m), two important off-shore banks (Porcupine and Rockall) and a large area of continental slope.

Over time, fisheries have developed and expanded from coastal waters, throughout the shelf, to the deep sea and oceanic waters. Fisheries offshore, across the continental shelf and in coastal waters are important both nationally and internationally, with a wide range of fish and shellfish species targeted by demersal and pelagic fishing fleets.

The Irish fishing fleet consists of approximately 2,000 vessels, pelagic and demersal, of which approximately 500 are 10 m in length or greater. Based on figures reported by the SFPA, in 2016 there were 21,818 landings of fish and shellfish to Irish ports from nine countries, with a combined weight of 276,233 tonnes, and valued at just less than €372 million. Although the number of landings and the weight landed in 2016 decreased by 1.5% and weight 7.3% respectively when compared to 2015, the overall value of landing in 2016 was 4% higher than 2015.

The average value per tonne in 2016 was €1,347 compared to €1,196 in 2015. Irish vessels accounted for 85% of the landings, 75% of the tonnage landed and 69% of the value. Further information regarding commercial fisheries can be found in the **Pre-survey Fisheries Assessment Report** (document reference: **MGE0719RP0015**) prepared for the proposed survey. The report is included as part of the application to the PAD for approval to undertake survey activities.

EMODnet vessel density mapping[3] indicates that fishing and shipping activity in the areas immediately adjacent to the Kiely East GWA is low. Considerable fishing activity occurs on the edge of the Porcupine Basin and on the Porcupine Basin during the months January to September. Given the short duration of the proposed survey (14 days) the survey will only marginally increase the level of overall vessel activity in the area.

[3] EMODnet vessel density mapping http://www.emodnet-humanactivities.eu/view-data.php

## 2.4.2 Other Socio-Economic Receptors

### 2.4.2.1 Oil and Gas

Current and planned offshore oil and gas activity is outlined in **Table 2.12**.

**Table 2.12: Oil and Gas Activity**

| Operator | Activity | Description |
|---|---|---|
| Vermillion | Gas Production | The proposed survey GWA lies over 340 km south of the Corrib gas pipeline. |
| | Pipeline Inspection Survey | Vermillion intend to undertake pipeline inspection survey at the Corrib Gas Field pipeline and infrastructure in 2019. The proposed survey programme involves a geophysical and visual survey of the subsea infrastructure between the Corrib Field and the landfall. |
| Europa Oil & Gas | Site Surveys | Europa Oil & Gas also plan to undertake site survey operations at the Inishkea prospect located in the Slyne Basin and at the Edgeworth prospect along the eastern flanks of the Porcupine Basin. The same survey vessel and geophysical equipment will be used for site surveys at Inishkea, Kiely East and Edgeworth. |
| CNOOC | Site Survey | Geophysical site survey in the Slyne/ Erris Basin to the north of the proposed Kiely East Survey. The CNOOC survey will involve that use of noise generating geophysical equipment including airguns, SBES, MBES and SBP. |
| NEXEN/ CNOOC | Exploration Drilling | NEXEN/ CNOOC plans to drill a single exploration well in the Iolar prospect in the Porcupine Basin approximately 230 km west of the Irish coastline. Drilling operation are planned for Q2/ Q3 2019. |
| ENI BV Ireland | Debris Clearance, Environmental Baseline and Habitat Assessment. | ENI BV Ireland plan to undertake a debris clearance, environmental baseline and habitat assessment site survey prior to deepwater drilling operations which will target the Dunquin South formation. The proposed ENI BV Ireland survey is approximately 70 km south east of the Kiely East Survey. The ENI BV Ireland site survey is currently scheduled to take place from mid-June 2019. |
| Exola/ Providence | Site Survey | Exola plan to undertake a site survey at Barryroe, North Celtic Sea of the south west coast of Ireland. Operations are proposed planned to be undertaken in Q2/ Q3/ Q4 2019 |
| PSE Kinsale Energy/ PSE Seven Heads Limited | Gas Production | Ongoing gas production and storage at the Kinsale Area gas fields. |
| | Decommissioning | Planned decommissioning of certain facilities of the Kinsale Area gas fields. |

### 2.4.2.2 Existing Pipeline and Submarine Cables Oil and Gas

A number of submarine telecommunication cables traverse Irish waters across the Atlantic towards the US. The International Cable Protection Committee (ICPC) helps protect submarine cables against interactions and impacts from offshore activities (including oil and gas exploration) through the publication of notifications and charting outlining the location of submarine cables. Using ICPC notifications and

charts Europa will ensure that seabed sampling activities are not undertaken in the vicinity of any submarine cables. In addition, to using ICPC mapping, geophysical data collected during the survey will be used to confirm seabed obstructions and existing infrastructure (such as cables, pipelines and wellheads etc.) (see **Section 2.1** for further details) thereby effectively removing the potential for interaction.

Europa are aware that TE SubCom are planning the construction of the HAVFRUE telecommunications cable system off the Mayo coast with cable laying scheduled for July.

DeepSea Fibre Networks Ltd. is planning to construct a new sub-sea telecoms cable system linking Galway, on the west coast of Ireland, to Bilbao, on the north coast of Spain.

#### 2.4.2.3 Military Activity

There are no military practice and exercise areas within or close to the proposed survey operational area (PAD, 2011). Therefore, military activities have not been considered further in this assessment.

#### 2.4.2.4 Renewable Energy Activities

Current offshore renewable energy development in Irish waters is limited to a wind farm located in the Irish Sea (PAD, 2015). Therefore, offshore wind farms have not been considered further in this assessment.

#### 2.4.2.5 Recreation and Tourism

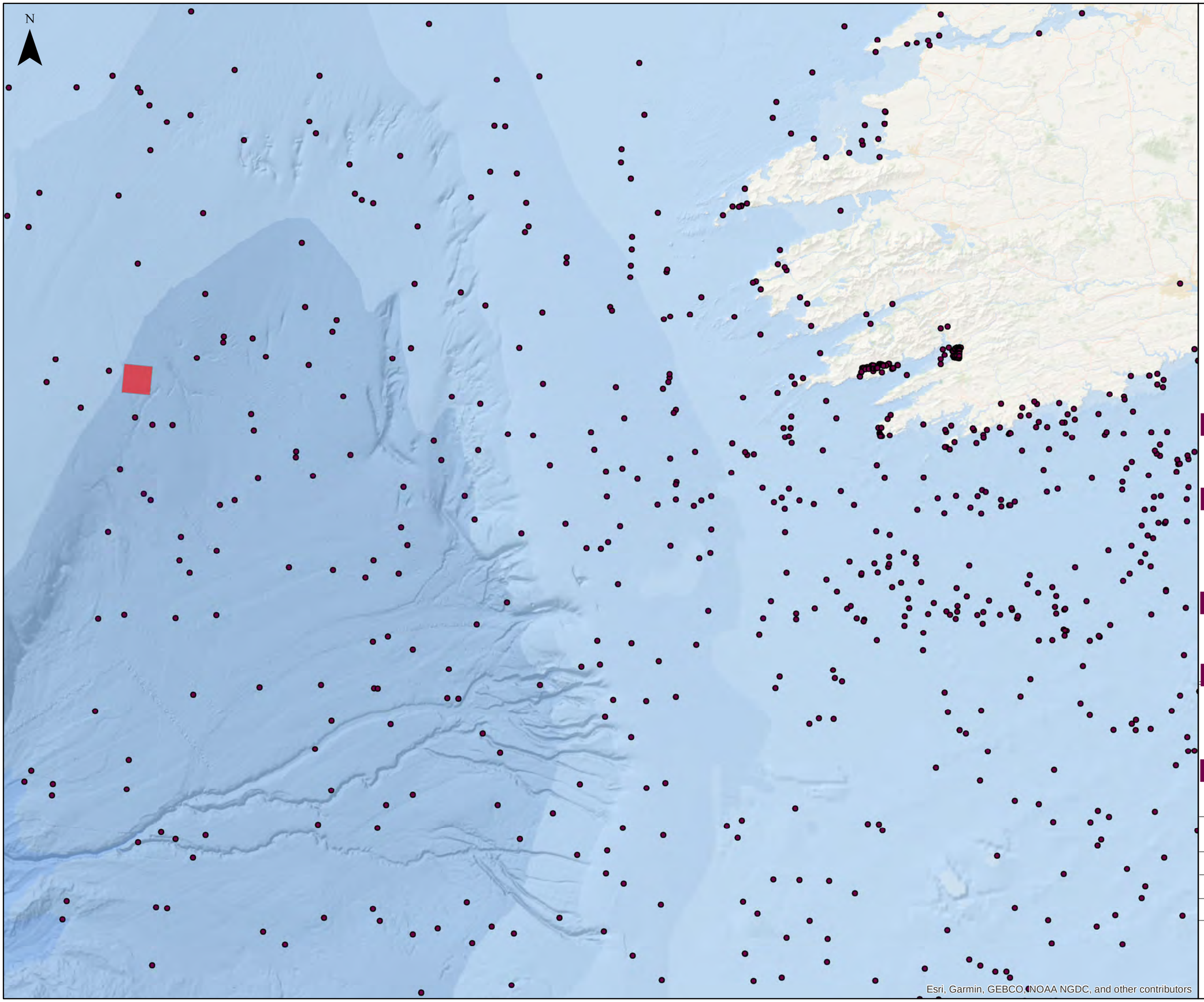
Marine-based tourism is largely limited to coastal waters, with no tourism present within the proposed survey area which is located approximately 180 km offshore. Therefore, recreation and tourism have not been considered further in this assessment

#### 2.4.2.6 Underwater Archaeology

Wrecks over 100 years old and archaeological objects found underwater are protected under the National Monuments (Amendment) Acts 1987 to 2004. Significant wrecks less than 100 years old are designated by Underwater Heritage Order (UHO) on account of their historical, archaeological or artistic importance.

As there are no identified underwater archaeological wrecks[4] within the survey operational area or the survey greater working area the potential for interaction is low (**Figure 2.4**). Prior to undertaking sediment sampling operations, the sampling stations will visually be inspected using ROV/ AUV and/ or drop down camera system to ensure cultural heritage features are not impacted by the deployment of sampling equipment. Geophysical data collected during the proposed survey will be used to inform an underwater archaeology assessment of the area and identify any cultural heritage features (e.g. ship wrecks). The underwater archaeology assessment wee be undertaken by a qualified and suitably experience archaeologist. The report and any pertinent data will be provided to the Underwater Archaeology Unit at the Department of Culture, Heritage and the Gaeltacht (DCHG).

[4] http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=89e50518e5f4437abfa6284ff39fd640




## Legend

- Kiely East Survey
- Wrecks

0 25 50 Km

**Client**

**Europa Oil & Gas**

**Title**

**Survey GWA relative to identified wrecks**

**Figure**

**2.4**

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# 3 DESCRIPTION OF INTERACTIONS AND LIKELY SIGNIFICANT EFFECTS

This section provides a description of potential interactions occurring between survey aspects (impact mechanisms) and the environment (receptors).

## 3.1 Survey Aspect Identification

**Table 3.1** and **Table 3.2** respectively outline aspects of the Kiely East Survey (impact mechanisms) and physical, biological and socio-economic environmental receptors considered in the assessment.

**Table 3.1: Potential survey aspects associated with proposed activities and unplanned events**

| Planned Activities |
|---|
| Physical Presence of Vessel and Equipment<br>Obstruction to other sea users by vessel<br>Disturbance to fauna |
| Physical Changes<br>Physical disturbance to the seabed |
| Underwater Acoustic Emissions<br>Acoustic emissions from geophysical equipment |
| Atmospheric Emissions<br>Caused by power generation on the survey vessel |
| Marine Discharges<br>Food waste and grey-, black-, bilge- and ballast-water |
| Waste Solids<br>Solid waste or liquid that cannot be discharged at sea |
| **Unplanned Events** |
| Accidental Hydrocarbon Spill |

**Table 3.2: Physical and biological and socio-economic receptors**

| Physical Receptors |
|---|
| Water quality, Air quality |
| **Biological Receptors** |
| Plankton, Benthic Habitats, Fish, Seabirds, Marine Mammals, Marine Reptiles, Protected Sites |
| **Socio-economic Receptors** |
| Shipping Industry, Fishing Industry, Oil and Gas Industry |

## 3.2 Potential Interactions between Survey Aspects and Environmental Receptors

### 3.2.1 Physical Presence of Vessel and Equipment

#### 3.2.1.1 Obstruction to other sea users by vessel

The survey vessel and survey equipment may present a temporary obstacle to other sea users involved in the following industries: shipping, oil and gas, commercial fishing.

During geophysical data acquisition operations the vessel will be towing a range of geophysical equipment. While towing the geophysical equipment the vessel will be following rectilinear routes in order to maintain the spatial integrity and arrangement of the equipment.

During ROV/ AUV operations and during environmental seabed sampling activity the vessel will be required to maintain position at specific locations within the survey operation area. As a consequence, the survey vessel will be limited in its ability to manoeuvre out of the way of approaching vessels and other sea users may need to accommodate the survey vessel by deviating from their planned route.

In addition, the presence of the survey vessel may result in a temporary restriction of access to fishing grounds for national and international commercial fishing fleets and therefore potential delays to fishing activities. Fishers may be displaced to an area within a couple of kilometres of their usual fishing grounds or will be unable to fish for a period while the vessel is undertaking survey operations.

Significant disruption impacts to other users can be avoided by introducing standard management practices. Specific measures that will be implemented for the survey to reduce risk of interference where possible include:

- Notification of the proposed survey to other sea users in the region ahead of the survey taking place (24 hours before commencement of survey).
- Implementation of a safety zone around the survey vessel during operations.
- The survey will meet national and international regulations for vessel navigation and the regulations defined by the IMO and Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) for avoiding collisions at sea.
- Communication and positioning equipment will be present on-board the survey vessel to maintain communication with other sea users and provide accurate information on the position of the survey vessel, towed equipment and ROV/AUV.
- Approaching vessels will be contacted by VHF radio to warn them of the presence of the survey and to provide relevant instructions to approaching vessels such as changes of course.
- The survey vessel will have early warning radar (radar system used primarily for the long-range detection of its targets) and communication systems on board to identify and communicate, as early as possible, with other vessels that may be approaching the survey vessel.
- A FLO has been appointed and has undertaken fisheries consultations and completed a Pre-survey Fisheries Assessment Report (document reference: **MGE0719RP0015**). Fishery organisations and fishery protection agencies have been consulted and made aware of the

proposed survey. Fishery organisations consulted include the Killybegs Fishermen's Organisation, the Irish South & West Fish Producers Organisation, the Irish South & East Fish Producers Organisation, the Irish Fish Producers Organisation and the Anglo North Irish Fish Producers Organisation while relevant fishery protection agencies consulted included the Sea Fisheries Protection Agency and the Naval Service. The FLO, who will be shore-based, will be available to communicate detail of the survey vessel to fishers and other users in the area throughout the duration of the survey.

- Details of the survey programme will be communicated to the fishing and shipping industry through issue of a Notice to Mariners and Radio Navigational Warnings.

**Conclusion: No likely significant effects to environmental receptors**

#### 3.2.1.2 Disturbance to fauna

There is potential that the physical presence of the survey ship and equipment may result in disturbance impacts to a range of marine fauna (including birds, mammals and reptiles). The susceptibility of marine fauna to disturbance will vary according to species behaviour including foraging and/ or surfacing habits, the function of habitat in the survey area (e.g. breeding, feeding) and aspects of the proposed survey activity (including vessel speed) and the temporal duration and spatial extent of the survey.

Given the nature of the proposed survey vessel activities, and the relatively short duration (approximately 14 days) and small spatial scale of the survey, it is concluded that if realised disturbance impacts to marine fauna from the presence of the survey vessel and equipment will be short-term and not significant.

Potential environmental effects associated with physical presence of vessel and equipment can be discounted and are not considered further in this assessment.

**Conclusion: No likely significant effects to environmental receptors**

### 3.2.2 Physical Changes

#### 3.2.2.1 Physical disturbance to the seabed

Seabed sampling will result in localised physical disturbance to the seabed. Physical disturbance to the seabed will be highly localised (limited to the footprint of the samplers) and temporary in nature; as a result, no significant environmental effects are anticipated.

Potential environmental effects associated with physical presence of vessel and equipment can be discounted and are not considered further in this assessment.

**Conclusion: No likely significant effects to environmental receptors**

### 3.2.3 Underwater Acoustic Emissions

Sources of underwater acoustic emissions generated during the survey include SBES, MBES, SSS, SBP and USBL. In terms of underwater acoustic emissions, interactions with the following receptors are possible: fish, seabirds, marine mammals, marine reptiles and the commercial fishing industry; as a result this survey aspect/ environmental receptor combinations are brought forward in the assessment to determine the significance of potential effects (see **Section 3.4**).

### 3.2.4 Atmospheric Emissions

The main source of atmospheric emissions during the survey will result from engine exhaust gases from the survey vessel. The principal atmospheric emissions from these sources will include carbon dioxide, methane, nitrogen oxides, sulphur oxides, carbon monoxide and volatile organic carbons. Given the offshore location of the survey, emissions are anticipated to disperse rapidly under typical prevailing conditions to levels approaching background within a few tens of metres of their source.

Potential environmental effects associated with atmospheric emissions can be discounted and are not considered further in this assessment.

**Conclusion: No likely significant effects to environmental receptors**

### 3.2.5 Marine Discharges

The potential discharges into the marine environment from the survey are wastewater (grey water [waste water from sinks, showers, and baths] and black water [sewage]), food waste, bilge water and ballast water. Treated grey and black water will be discharged in line with MARPOL 73/78 Annex IV but will likely contain solids, detergents, pathogens and chlorine. Food waste will be macerated in line with MARPOL 73/78 requirements, and no discharges will be made within 12 nm of the coastline. Discharge of bilge water from the survey vessel will comply with standards set out in the 1973/78 MARPOL Convention with no discharge occurring within the 12 nm limit. Ballast water discharges may be required during operations and will be managed through a Ballast Management Plan. Given the short duration of the survey, discharges are likely to be small in volume and will rapidly disperse in the marine environment.

Potential environmental effects associated with discharges can be discounted and are not considered further in this assessment.

**Conclusion: No likely significant effects to environmental receptors**

### 3.2.6 Solid Wastes and Waste Management

The following waste streams are expected to be generated by the proposed survey:

- General refuse (wastes such as packaging etc.).
- Medical waste.
- Potentially hazardous wastes such as thinners, paints and lubricants.

A Waste Management Plan (WMP) will be implemented and will describe all operational procedures related to the treatment, disposal and management of generated wastes. Careful consideration will be given to minimising the total amount of waste generated and controlling its eventual disposal. Responsible waste management may be accomplished through hierarchical application of the practices of source reduction, reuse, recycling, recovery, treatment and responsible disposal.

All wastes will be brought back to shore for disposal in accordance with local legislation and guidelines at a licensed facility. Consequently, significant environmental effects associated with survey wastes can be discounted and are not considered further in this assessment.

**Conclusion: No likely significant effects to environmental receptors**

### 3.2.7 Unplanned Events

Although unlikely, hydrocarbon spills (diesel fuel, hydraulic oil and lubricants) of varying sizes and types may result from accidental events during operations, including releases of hydrocarbons during the storage and handling of oil drums, mechanical failure (such as a fault in the oil/ water separator) and the deck drainage system. A less likely scenario is a larger scale spill, due to an unplanned event such as collision with the survey vessel, which could result in significant environmental damage and associated social and economic impacts. Proximity to shore is a large factor in the resulting level of ecological and social impact.

Given the low probability for unplanned events/ spills and the offshore location of the survey it is concluded that significant environmental effects associated with hydrocarbon spills can be discounted and are not considered further in this assessment.

**Conclusion: No likely significant effects to environmental receptors**

## 3.3 Summary of Potential Interactions between Survey Aspects and Environmental Receptors

**Table 3.3** summarises the assessment of potential interactions between survey aspects and environmental receptors. **Table 3.3** also indicates where potential significant interactions are assessed.

**Table 3.3: Summary of the assessment of potential interactions between planned survey activities and unplanned events with environmental receptors**

| Survey Aspect | Environmental Receptor | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Physical | | Biological | | | | | | | Socio-Economic | | |
| | Water quality | Air quality | Plankton | Fish | Seabirds | Article 12 Annex IV Marine Mammals | Marine Reptiles | Benthic Habitats | Protected Sites | Shipping Industry | Fishing Industry | Oil and Gas Industry |
| **Physical Presence of Vessels/ Equipment** | | | | | | | | | | | | |
| Obstruction to other sea users | | | | | | | | | | | | |
| Disturbance to fauna | | | | | | | | | | | | |
| **Physical Changes** | | | | | | | | | | | | |
| Physical disturbance to the seabed | | | | | | | | | | | | |
| **Underwater Acoustic Emissions** | | | | | | | | | | | | |
| Geophysical equipment | | | Assessed in Section 3.8 | Assessed in Section 3.9 | Assessed in Section 3.7 | Assessed in Section 3.5 | Assessed in Section 3.6 | | | | Assessed in Section 3.9 | |
| **Atmospheric Emissions** | | | | | | | | | | | | |
| Caused by power generation on the survey vessel | | | | | | | | | | | | |

| Survey Aspect | Environmental Receptor | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Physical | | Biological | | | | | | | Socio-Economic | | |
| | Water quality | Air quality | Plankton | Fish | Seabirds | Article 12 Annex IV Marine Mammals | Marine Reptiles | Benthic Habitats | Protected Sites | Shipping Industry | Fishing Industry | Oil and Gas Industry |
| **Marine Discharges** | | | | | | | | | | | | |
| Food waste and grey-, black-, bilge- and ballast-water | | | | | | | | | | | | |
| **Waste Solids** | | | | | | | | | | | | |
| Solid waste or liquid that cannot be discharged at sea | | | | | | | | | | | | |
| **Accidental Hydrocarbon Spill** | | | | | | | | | | | | |

**Key:**

| |
|---|
| Significant potential interaction discounted |
| Potential significant interaction |
| No interaction |

# 3.4 Potential Impacts Associated with Underwater Noise

## 3.4.1 Introduction

During the proposed survey noise will be generated by the equipment listed in **Table 3.4**.

Noise emissions can result in environmental effects including:

- Physical damage to animals close to the sources.
- Disruption of behavioural patterns (e.g. migration, breathing, nursing, breeding, feeding etc.).

At long ranges, noise emissions could potentially disturb fauna and cause short-term behavioural changes by effecting, for example, the ability of animals to communicate and determine the presence of predators, food, underwater features and obstructions while at close ranges, high energy noise sources may result in physical injury including permanent or temporary auditory damage.

Biological and socio-economic receptors which may interact with underwater acoustic emissions from the proposed survey include are indicated in **Table 3.3**; these include

- Seabirds (potential effects assessed in **Section 3.7**);
- Plankton (potential effects assessed in **Section 3.8**);
- Fish (including commercial fisheries) (potential effects assessed in **Section 3.9**);
- Marine mammals and, marine reptiles (Article 12 assessment presented in **Section 3.5** and **Section 3.6**).

To assess expected underwater noise levels from the proposed Kiely East Survey and determine whether likely significant effects are possible, an underwater noise modelling exercise was undertaken to predict the likely spatial area (or zone) around the noise source within which noise emissions exceed thresholds of potential injury and behavioural effects.

## 3.4.2 Underwater Noise

There are several methods available for modelling the propagation of sound between a source and receiver ranging from very simple models which simply assume spreading according such as 10 log r or 20 log r relationship to full acoustic models (e.g. ray tracing, normal mode, parabolic equation, wavenumber integration and energy flux models). Semi-empirical models are available which lie somewhere in between and provide a balance for environmental impact assessment.

For impulsive sound, such as that produced by survey equipment sources, the sound propagation is more complex than can be modelled using a simple N log r relationship. The Root Mean Square (RMS) sound pressure level of an impulsive sound wave will depend upon the time window used. Another important factor affecting the received sound pressure level from noise is the source directivity. Sound sources are designed so that the majority of acoustic energy is directed downwards towards the ocean bottom. Therefore, the amount of energy emitted horizontally is significantly less than directed downwards. This is a frequency dependent effect and is more pronounced at higher frequencies than at lower frequencies.

Sound propagation modelling for this assessment was therefore based on an established, peer reviewed, range dependent sound propagation model which utilises the model developed by Rogers (1981)[5]. The model provides a robust balance between complexity and technical rigour over a wide range of frequencies, has been validated by numerous field studies and has been benchmarked against a range of other models. The following inputs are required for the model:

- Time series source sound level data;
- range (distance from source to receiver);
- water column depth (input as bathymetry data grid);
- sediment type;
- sediment and water sound speed profiles and densities;
- sediment attenuation coefficient; and
- source directivity characteristics.

The absorption coefficient of sea water is calculated based on Ainslie and McColm[6]. Bathymetry, salinity and temperature profile data were taken from Marine Institute data. The propagation model also takes into account the depth dependent cut-off frequency for propagation of sound (i.e. the frequency below which sound does not propagate). It should be noted that the effect of directivity has a strong bearing on the calculated zones for injury and disturbance because a marine mammal could be directly underneath an array for greater distances in deep water.

Noise levels (and associated range of effects) will vary depending on actual conditions at the time (day-to-day and season-to-season) and that the model predicts a typical worst-case scenario. Injury and disturbance ranges should be viewed as indicative and probabilistic ranges due to animal behaviour and possible habituation.

The RPS model is specifically designed to calculate uniform, directional and impulsive sources. Directionality is considered using a range of azimuth and dip angle source profiles. Each profile is entered as a time series input to incorporate impulsive characteristics if present. The time series propagation is calculated in the frequency domain using the Rodgers model. Calculations are carried out for peak-peak, 0-peak, SEL, $SEL_{cum}$ and RMS received levels. The propagation is corrected for species sensitivity as appropriate and the results are interpolated into a 3D array for visualisation.

### 3.4.3 Noise Source Level

Noise source level data has been provided by the client. Sources such as ship-board compressors, magnetometers and receiver arrays are not significant noise sources and have not been included in the model.

[5] Rogers, P. H., (1981) Onboard Prediction of Propagation Loss in Shallow Water, Naval Research Laboratory Report 8500.

[6] M.A. Ainslie & J.G. McColm, "A simplified model for viscous and chemical absorption in sea water", J. Acoust. Soc. Am., 103(3), pp. 1671-1672, March 1998.

**Table 3.4** outlines the maximum operating frequencies and energy range of the proposed noise generating geophysical equipment included in the model[7].

The most significant surface source is the SBP airgun source as this is a low frequency sound which is not absorbed easily as is the case with higher frequencies. The source data for the source was only available for the azimuth 0 degrees Dip 0 degrees direction, which is the worst case. This data was used with the other source level data to calculate a potential PTS zone and a disturbance zone for each species.

The seabed AUV and USBL transponder have been calculated separately due to their location. No overlap exists between the PTS zones.

**Table 3.4: Underwater Noise Sources Modelled**

| Equipment | Description | Frequency (kiloHertz) | Source Level (SPL) (dB re 1µPas@ 1m) | Source Level (Peak) (dB re 1µPa@ 1m) |
|---|---|---|---|---|
| MBES | Kongsberg EA400 | 70/100 | | 211 |
| SBES | Kongsberg EM710 | 35/200 | | 210 |
| USBL (topside) | Kongsberg HiPAP 502 | 21/31 | | 207 |
| SSS | Edgetech EM400 | 35/200 | | 211 |
| SBP | Edgetech 3300 | 2-15 | 190 | 200 |
| SBP | 10 cu in Airgun | 0-10 | 202 | 196 |
| AUV MBES | Simrad EM2040 | 300 | | 218 |
| AUV SBP | Edgetech 2205 | 1-16 | 181 | 195 |
| AUV SSS | Tritech Seaking | 220 | | 210 |
| USBL (seabed) | Kongsberg HiPAP 502 | 21/31 | | 190 |

### 3.4.4 Noise Thresholds

The zone of injury is defined here as the distance over which noise levels exceed the Permanent Threshold Shift (PTS) of marine mammal leading to non-reversible auditory injury. The PTS thresholds used here are the thresholds defined in NOAA (2018)[8] Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing. These thresholds are more recent than the thresholds

[7] Vessel engines/ compressors, magnetometers and receiver arrays are not significant noise sources and have not been included in the model. Sound velocity profiler is an extremely low power acoustic device operating at 2,500 kHz which is well above the hearing frequency of any species of concern and therefore not a risk; sound velocity profiler as not been included in the model.

[8] NOAA 2018. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0)

defined in the DAHG (2014)[9] Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters which are based on threshold defined in Southall et al (2007)[10].

A summary and a comparison of the thresholds is presented in **Table 3.5.** Injury thresholds are based on two noise parameters namely; linear (i.e. un-weighted) peak Sound Pressure Level (SPL) and marine mammal hearing-weighted Sound Exposure Level (SEL). The hearing weighting function is designed to represent the bandwidth for each group within which acoustic exposures can have auditory effects. The DAHG[11] (2014) categories include:

- low-frequency cetaceans (i.e. marine mammal species such as baleen whales with an estimated functional hearing range between 7 Hz and 35 kHz);
- mid-frequency cetaceans (i.e. marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales with an estimated functional hearing range between 150 Hz and 160 kHz);
- high-frequency cetaceans (i.e. marine mammal species such as true porpoises, with an estimated functional hearing range between 275 Hz and 160 kHz); and
- phocid pinnipeds (in water) (i.e. true seals with an estimated functional hearing range between 50 Hz and 86 kHz).

The noise threshold for disturbance in marine mammals is taken from NOAA (2016)[12] Fisheries Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing.

The PTS criteria used for fish and sea turtles are taken from Popper et al. (2014)[13] (see **Table 3.6**). In the case of fish, thresholds established for fish with swim bladders was used.

[9] DAHG 2014. Guidance to Manage the Risk to Marine Mammals from Man Made Sound Sources in Irish Waters, Department of Arts, Heritage and the Gaeltacht, January 2014.

[10] Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene., C. R. Jr., Kastak, D., Ketten, D. R., Miller, J. H., Nachtigall, P. E., Richardson, W. J., Thomas, J. A., and Tyack, P. L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4): 411-521.

[11] Now the Department of Culture, Heritage and the Gaeltacht

[12] NOAA 2016. Fisheries Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing, July 2016

[13] Popper et al. (2014), Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI,

**Table 3.5: Comparison of NOAA and NPWS Marine Mammal Criteria (Impulsive Sources)**

| Receptor | NOAA Criteria* | | NPWS Criteria | |
|---|---|---|---|---|
| | dB re 1 µPa(peak)(flat) | $SEL_{cum}$ dB re 1 $\mu Pa^2$-s | dB re 1 µPa(peak)(flat) | SEL dB re 1 $\mu Pa^2$-s |
| Low Frequency Cetaceans | 219 | 183 | 230 | 198 |
| Mid Frequency Cetaceans | 230 | 185 | 230 | 198 |
| High Frequency Cetaceans | 202 | 155 | 230 | 198 |
| Phocid Pinnipeds | 218 | 185 | 218 | 186 |
| Otariid Pinnipeds | 232 | 203 | - | - |
| Disturbance (all marine mammals) | 160 dB re 1 µPa RMS | | | |

*As noted above the NOAA criteria are used in this assessment

**Table 3.6: Noise Threshold – Fish and Sea Turtles**

| Receptor | Popper et al. Criteria | |
|---|---|---|
| | dB re 1 µPa(peak)(flat) | $SEL_{cum}$ dB re 1 $\mu Pa^2$-s |
| Fish Eggs and Larvae | 207 | 210 |
| Mortality PTS in adult Fish* | 207 | 207 |
| Sea Turtles | 207 | 210 |

*Impact is dependent upon physiology; the lowest injury threshold is for fish where swim bladders are essential to hearing; this threshold has been used for determining impact distance.

### 3.4.5 Zone of Impacts

The PTS exclusion zones for high frequency cetaceans are 44 metres from the surface sources, 16 metres from the AUV and 3 metres from the seabed USBL. High frequency cetaceans are the most sensitive species in each case because of the number of high frequency sources deployed on the survey.

The PTS impact radius for low frequency cetaceans, fish and turtles is effectively zero when their hearing sensitivity is taken into account (i.e. noise impact thresholds for mid-frequency cetaceans, fish eggs and larvae (plankton) and sea turtles will not be exceeded).

The impact radius for disturbance is 111 metres at the surface, 6 metres from the AUV and is effectively zero from the USBL at the seabed because the 160 dB RMS threshold is not a cumulative metric whereas 155 dB $SEL_{cum}$ is a cumulative criterion impacting high frequency cetaceans. The PTS impact radius for phocid pinnipeds is 2 m from the source. In all cases the maximum radius of impact is in close proximity to the survey vessel.

**Table 3.7: Zone of potential impact**

| Species | Criteria | | PTS Impact Zone Surface | PTS Impact Zone AUV | PTS Impact Zone Seabed |
|---|---|---|---|---|---|
| | dB re 1 µPa(peak)(flat) | $SEL_{cum}$ dB re 1 $\mu Pa^2$-s | m | m | m |
| Low Frequency Cetaceans[1] | - | - | - | - | - |
| Mid Frequency Cetaceans[1] | - | - | - | - | - |
| High Frequency Cetaceans[1] | - | 155 | 44 | 16 | 3 |
| Phocid Pinnipeds[1] | - | - | 2 | - | - |
| Otariid Pinnipeds[1] | - | - | - | - | - |
| Marine Mammal Disturbance[1] | 160 dB RMS re 1 µPa | - | 111 | 6 | - |
| Fish Eggs and Larvae[2] | - | - | - | - | - |
| Mortality PTS in adult Fish[2] | - | - | - | - | - |
| Sea Turtles[2] | - | - | - | - | - |
| | - | indicates the threshold for the species was not exceeded | | | |
| | 1 | NOAA 2018 thresholds | | | |
| | 2 | Popper et al. (2014) thresholds | | | |

# 3.5 Article 12 Assessment – Annex IV Marine Mammals

## 3.5.1 Physical and Behavioural Effects

The likely zone of impact of acoustic emissions for marine mammals indicates that received noise levels will be below the injury/ PTS criteria for high frequency cetaceans and phocid pinniped within 44 m and 2 m of the sound sources respectively.

Behavioural reactions to acoustic exposure are generally variable, context-dependent, and less predictable than the effects of noise exposure on hearing or physiology. This is because behavioural responses to anthropogenic sound are dependent upon operational and environmental variables, and on the physiological, sensory, and psychological characteristics of exposed animals. It is important to note that the animal variables may differ (greatly in some cases) among individuals, of a species and even within individuals depending on various factors (e.g. sex, age, previous history of exposure, season, and animal activity). NOAA (2018) provides behavioural threshold (potential to cause disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering) for cetaceans. Disruptions to cetacean behaviour will occur within 111 m of the sound source.

Given the above, underwater noise has the potential to result in likely significant effects to Article 12 Annex IV marine mammal species. Given the potential for effects mitigation measures (detailed in **Section 3.11**) have been identified to manage the risk of impacts.

Given strict adherence to the mitigation outlined in **Section 3.11** it is unlikely that any marine mammal will be subject to sound pressure levels exceeding the injury threshold of marine mammals. Therefore, significant effect to marnine mammals can be excluded.

## 3.6 Article 12 Assessment – Annex IV Marine Reptiles

The two main potential impacts that operations can have on marine reptiles (turtles) are physical effects from the acoustic signals and behavioural disruption. It has been proposed that turtles use acoustic cues in perception of their local and distant environment on their long (sometimes 1,000s of km) migrations between nesting and foraging sites (Swan et al., 1994; Godley et al., 2003). Sound emitted during survey operations could interfere with turtle reception of environmental cues such as sound generated by distinctive patterns of surf, which has an acoustic sound frequency in the range of highest sensitivity of turtle hearing. However, effects on turtles in this way are purely speculative, as no evidence of turtles using sound to navigate has been confirmed.

Few data exist on the effects of geophysical survey activity on turtles. It is possible that acoustic emissions would mortally injure turtles that are very close to the source, although preliminary data suggests that sea turtles are highly resistant to high intensity explosives (Ketten et al., 2005, as cited in Popper et al., 2014), making it likely that they would be resistant to damage. Mortality/ potential mortal injury for marine reptiles is estimated by Popper et al. (2014) to occur at received sound levels exceeding SEL 210 re 1µPa$^2$s. Modelling shows that this noise impact threshold will not be exceeded.

**Conclusion: No likely significant effects**

## 3.7 Seabirds – Potential Impacts

An assessment of likely significant effects of noise emissions to seabird species is presented in the Screening for AA and NIS (document reference: **MGE0719RP0014**). In summary, the assessment focused on Qualifying Features of onshore/ coastal SPA sites located closest to the proposed survey operational area, and considered the likelihood of interaction with survey noise based on species distribution and typical feeding and diving behaviour. The assessment concluded that significant effect to seabird Qualifying Features could be excluded.

In addition, it should be noted that the IOSEA 5 assessment (PAD, 2015a, b) considered the potential for acoustic emissions to affect seabirds. The assessment outlined that while some birds (such as auks, the family to which puffin belongs) spend extended periods of time underwater, acoustic emissions have not been known to cause any fatalities or result in variation in the abundance of birds seen at nesting sites (PAD, 2015a).

As such, the IOSEA 5 assesses impact on seabirds as ‘Neutral’. In addition, the impact of seismic surveys on all Irish SPAs was screened out for IOSEA 5 (PAD, 2015b). As the noise emissions anticipated from the proposed survey are significantly less than that produced by large scale seismic surveys it can be concluded that acoustic emissions arising from the proposed survey will have no likely significant effect on the Conservation Objectives of any onshore/ coastal SPA sites.

Given these assessments, it is concluded that underwater noise will not result in likely significant effects to seabirds.

**Conclusion: No likely significant effects**

## 3.8 Plankton – Potential Impacts

Fish eggs and invertebrate larvae are considered part of the plankton (meroplankton) as they are relatively immobile, and their movements depend on transport by prevailing currents and tidal water mass movement. Invertebrate plankton species that have a gas filled flotation aid (such as cephalopods) are more likely to respond to underwater noise.

Studies, including those of Kostyuchenko (1971) have shown that a 1.4 x 104 kiloPascals (142.7 kg/cm$^2$) noise level discharged by an energy source caused damage to fish eggs within a range of 5 m, while Popper et al., (2014) cites studies which show that zooplankton and icthyoplankton can be killed within a distance of less than 2 m and sub lethal injuries expected within 5 m.

Mortality of fish eggs and larvae is estimated by Hasting (2010) to occur at received sound levels exceeding SEL 210 dB re 1µPa$^2$s. For the Kiely East Survey, modelling shows that this threshold will not be exceeded.

Studies on the effects of noise on larval fish and invertebrate populations indicate that any effect is very small when compared to total population sizes, mortality rates or events such as storms, cyclones or natural shifts in oceanographic patterns (Swan et al., 1994). Any removal of plankton from an area due to noise disturbance (a maximum of 5 - 10 m from source) will be short term with any organisms removed quickly replaced due to their often rapid generational turnover times.

Given these assessments, it is concluded that underwater noise will not result in likely significant effects to plankton.

**Conclusion: No likely significant effects**

## 3.9 Fish – Potential Impacts

The hearing system of most fishes is sensitive to sound pressures between 50 Hz and 500 Hz (Ladich and Fay, 2012). Sound is perceived by fish through the ears and the lateral line (the acoustico-lateralis system) which is sensitive to vibration. Some species of teleost or bony fish have a structure linking the gas filled swim bladder to the ear. The swim bladder is sensitive to the pressure component of a sound wave, which it resonates as a signal that stimulates the ears (Hawkins, 1993). These species, therefore, usually have increased hearing sensitivity over the same range, and sensitivity to sound at higher frequencies extending above 3,000 Hz. Such species are considered to be more sensitive to anthropogenic underwater noise than species, such as cod, (Gadhus spp.) that do not possess a structure linking the swim bladder and inner ear. Fish species that either do not possess a swim bladder (e.g. elasmobranchs and scombrid fish (mackerel and tunas)) or have a much reduced swim bladder (e.g. flatfish) tend to have relatively low auditory sensitivity.

### 3.9.1 Physical Effects

Fish are generally more sensitive to low frequency sounds that are difficult to reproduce in a laboratory therefore there is limited data on the impact of noise on fish (Hawkins, 2011). Despite the increasing interest of scientists, regulators and environmental groups in anthropogenic sounds, there are very little

experimental data that directly addresses how these sources affect fish in their natural habitat (Popper et al., 2005).

Data for fish show that exposure to moderately loud noises can result in temporary threshold shift (TTS) (i.e. temporary hearing loss) in a few species that have been studied including goldfish (*Carassius auratus*) and other species (Popper and Clarke, 1976; Scholik and Yan, 2001; 2002; Amoser and Ladich, 2003; Amoser et al., 2004; Smith et al., 2004a; 2004b).

Popper and Hastings (2009) found that exposure of fish to high noise levels could cause possible rupture of blood vessels leading to superficial or internal bleeding. Seismic surveys have also been reported to cause some damage to the sensory hair cells of the ear of the pink snapper, however it was not identified if this resulted in hearing loss and no mortality was seen as a result (McCauley et al., 2003).

Direct injuries occur when the fish, at whatever life stage, comes within a few metres of a sound source where SPLs are most extreme (Swan et al., 1994; Turnpenny and Nedwell, 1994). However, where injury effects have been demonstrated, these have been under experimental conditions which are either unrepresentative of normal operations or which would arise only in special circumstances (e.g. McCauley et al., 2003). There is no recorded evidence that energy sources have killed fish or caused injuries during seismic survey operations (Turnpenny and Nedwell, 1994).

Popper et al. (2014) suggest that mortality of fish eggs and larvae can occur at SEL 210 dB re 1µPa$^2$s. Similarly, mortality/ PTS in adult fish can occur at SEL 207 dB re 1µPa (dependent upon physiology). For the Kiely East Survey, modelling shows that this threshold will not be exceeded; significant impacts to fish will not occur.

Given these assessments, it is concluded that underwater noise will not result in significant effects in fish.

**Conclusion: No likely significant effects**

### 3.9.2 Behavioural Effects

There is conflicting evidence on the behavioural effects of geophysical surveys on fish. Numerous studies have reported no significant effect on the behaviour of various fish species, even in very close proximity (1.5 m) to the seismic source (Pickett et al., 1994; Wardle et al., 1998). Wardle et al. (2001) used a video system to examine the behaviours of fish and invertebrates on a coral reef in response to emissions from seismic acoustic sources that were carefully calibrated and measured to have a peak SPL of 210 dB re 1 µPa at 16 m from the source and 195 dB re 1 µPa at 109 m from the source. They found no permanent changes in the behaviour of the fish or invertebrates on the reef throughout the course of the study, and no animals appeared to leave the reef. There was no indication of any observed damage to the animals (Wardle et al., 2001).

In contrast, a number of studies have concluded that fish leave the immediate area around the survey vessel for the period when the acoustic source is active (Lokkeborg and Soldal 1993). Turnpenny and Nedwell (1994) have concluded that during seismic survey operations, fish tend to avoid the area out from between 200 and 2,000 m of the source. Behavioural effects might impair reproductive effort of schooling species which form dense breeding aggregations (e.g. herrings and sardines) if the survey was conducted over an entire spawning period across such an area (Swan et al., 1994). However, the spatial extent of the survey is approximately 80 km$^2$ and will be conducted over a realtively short period of time (approximately 14 days); therefore unlikely to result in significant disruption.

Given these assessments, it is concluded that underwater noise will not result in significant behavioural effects in fish.

**Conclusion: No likely significant effects**

### 3.9.3 Indirect Impacts on Commercial Fisheries

There is a concern that physical effect and behavioural changes (as described above) might alter the volume of catches of commercially exploited fish species (Brand and Wilson, 1996). A series of studies have been undertaken to determine the effects of seismic survey operations on fish catches and distribution, primarily in the United States and Europe (e.g. California: Greene, 1985; Pearsons et al., 1992, Norway: Dalen and Knutsen, 1987; Lokkeborg and Soldal, 1993; UK: Chapman and Hawkins, 1969; Pickett et al., 1994). The conclusions of these studies are however ambiguous. It has been noted that pelagic species appear to disperse to a greater extent, resulting in a decrease in reported catches from the area (Dalen and Knutsen, 1987).

Skalski et al. (1992) showed a 52 percent decrease in rock-fish (Sebastes sp.) catch when the area of catch was exposed to a single acoustic source emission resulting in a received level of sound at 186–191 dB re 1 µPa (mean peak level). These investigators also found that fishes would show a startle response to received sounds as low as 160 dB re 1 µPa, but this level of sound did not appear to elicit a decline in catch. The basis for the decrease in catch is not clear, and it should be noted that, for the most part, there was no actual visual observation of the behaviour of the fish during acoustic source exposure.

Evidence of the impact of seismic surveys on fish catch rates is inconclusive. There is some evidence of fish catches declining following a seismic survey however given the short duration (14 days) and limited spatial extent of the survey, any significant impact is unlikely. Catches will most probably return to normal after the survey is complete, resulting in minor consequences to local fishing activities (Engås et al., 1996; Engås and Løkkeborg, 2002; Popper et al., 2009).

Given the above, it is concluded that underwater noise will not result in significant effects to commercial fisheries.

**Conclusion: No likely significant effects**

## 3.10 In-combination Effects

The only source of impact from the proposed Kiely East Survey that has the potential to result in significant effects is underwater noise generated by the proposed geophysical survey and positioning equipment. The assessment of in-combination effects considers activities proposed by other planned operations that may act in-combination with underwater noise generated by the Kiely East Survey to result in likely significant effects. The receptors of concern are marine mammal species listed under Annex IV and Annex II of the habitats Directive.

Europa undertook consultations with other oil and gas operators with operations planned offshore Ireland in 2019. Summaries of these planned operations are included in **Table 3.8** below. In several cases there is potential that these planned operations may act in-combination with the Kiely East Survey. To inform the assessment of in-combination effects, Europa consulted information included by the operators in

current applications[14] made to the DCCAE for approval to undertake planned operations. In addition to oil and gas operations other offshore activities proposed for 2019 include the construction of telecommunication infrastructure and marine research (see **Table 3.8** for details).

In summary, there is potential in-combination effects to marine mammals from the following operations:

- Vermillion – Corrib Gasfield pipeline inspection survey;
- CNOOC – site survey at Slyne/ Erris Basin and surrounding continental shelf
- Europa Oil & Gas – site surveys in the Inishkea and Edgeworth prospects;
- NEXEN/ CNOOC – drilling operations at Iolar prospect;
- ENI Ireland BV – site surveys in the Porcupine Basin;
- Exola/ Providence – site survey operations at Barryroe licence area in the North Celtic Sea Basin;
- Kinsale Energy and PSE Seven Heads Limited – decommissioning gasfield infrastructure; and
- Marine Institute – acoustic fisheries survey.

The potential in-combination effects associated with the above operations are the same as those potential effects described above for the Kiely East Survey. Mitigation measures to minimise and/ or eliminate likely significant effect of the Kiely East Survey on marine mammal Qualifying Features are proposed in **Section 3.11.1** below while mitigation to manage potential effects from concurrent survey operations operating within 100 km of each other is outlined in **Section 3.11.2**).

**Table 3.8: Other offshore activities and potential for in-combination effect with the proposed Kiely East Survey**

| Operator | Location | Activity Description | Potential In-combination effects? |
|---|---|---|---|
| **Vermillion** | Corrib Gasfield Slyne Basin | Vermillion intend to undertake pipeline inspection survey at the Corrib Gasfield and pipeline in 2019. The proposed survey programme involves a geophysical and visual survey of the subsea infrastructure between the Corrib Field and the landfall. | **Yes** Noise generated by geophysical equipment proposed for the Vermillion survey may act in-combination with the Kiely East Survey to result in likely significant effect to marine mammal Qualifying Features. Geophysical equipment proposed include MBES, SBP, SSS, sound velocity probes. Europa are in communication with Vermillion to ensure operations are coordinated. |

[14] Current application to the DCCAE for statutory consents: https://www.dccae.gov.ie/en-ie/natural-resources/topics/Oil-Gas-Exploration-Production/environment/statutory-consents/current-applications-for-statutory-consents/Pages/Current-Applications-for-Statutory-Consents.aspx

| Operator | Location | Activity Description | Potential In-combination effects? |
|---|---|---|---|
| **CNOOC** | Slyne/ Erris Basin and surrounding continental shelf | CNOOC plan to conduct a site survey in 2019 to the north of the proposed Kiely East Survey GWA in the Slyne/ Erris Basin area. | **Yes** The CNOOC site survey involves that use of noise generating equipment including seismic airguns, MBES, SBP, SSS; this equipment has potential to result in-combination effects to marine mammal species. Europa are in communication with CNOOC to ensure operations are coordinated. |
| **TE SubCom** | Slyne Basin and surrounding continental shelf | Construction of the HAVFRUE telecommunications cable system off the Mayo coast to the north of the proposed Kiely East Survey GWA. During mid– to late–July 2019 TE SubCom plan to undertake cable laying operations. | **No** As there are no geophysical operations proposed, no likely significant effect to Natura 2000 sites arising from in combination effects are predicted. While no in-combination effects are anticipated, Europa are in regular communication with TE SubCom to ensure operations are coordinated. |
| **Europa** | Slyne Basin and Porcupine Basin | Site survey operations at the Inishkea prospect located in the Slyne Basin and at the Edgeworth prospect along the eastern flanks of the Porcupine Basin. | **Yes** The same survey vessel and geophysical equipment will be used for site surveys at Inishkea, Kiely East and Edgeworth. While Europa will not be undertaking concurrent survey operations at Inishkea, Kiely East and Edgeworth, and despite the considerable distance between the survey areas, there is potential for in-combination effects to marine mammal species. |
| **NEXEN/ CNOOC** | Porcupine Basin | NEXEN/ CNOOC plans to drill a single exploration well in the Iolar prospect in the Porcupine Basin over 230 km west of the Irish coastline. | **Yes** For the proposed drilling operation NEXEN/ CNOOC may be required to undertaken geophysical vertical seismic profiling (VSP). There is potential that VSP activation may act in-combination with the Kiely East Survey to result in likely significant effect to marine mammal Qualifying Features. |
| **ENI Ireland BV** | Porcupine Basin | ENI Ireland BV plan to undertake a debris clearance, environmental baseline and habitat assessment in the Porcupine Basin. | **Yes** Geophysical equipment proposed for the survey include SSS, MBES and SBP. Noise generated by this equipment may act in-combination with the Kiely East Survey to result in likely significant effect to marine mammals. |
| **Exola/ Providence** | North Celtic Sea | Exola/ Providence plan to conduct a site survey within the Barryroe licence area in the North Celtic Sea Basin. | **Yes** The site survey will comprise a seabed and shallow geophysical survey and an environmental baseline and habitat assessment survey. There is potential that noise generated by geophysical equipment may this equipment may act in-combination with the Kiely East Survey to result in likely significant effect to marine mammals. |
| **Kinsale Energy and PSE Seven Heads Limited** | North Celtic Sea | Decommissioning of gasfield facilities located off the south coast of Ireland. | **Yes** The decommissioning will result in the generation of noise that may act in-combination with the Kiely East Survey to result in likely significant effect to marine mammals. |

| Operator | Location | Activity Description | Potential In-combination effects? |
|---|---|---|---|
| **Marine Institute** | West and southwest coasts | The Marine Institute will carry out the Western European Shelf Pelagic Acoustic (WEPAS) survey targeting herring (*Clupea harengus*) and boarfish (*Capros aper*) over a six week period beginning June 2019. | The survey will be used to determine the distribution and abundance of target species to the north, west and south of Ireland and will take place onboard the RV Celtic Explorer. The Marine Institute has indicated that they envisage the WEPAS will be operating over continental shelf and eastern flank areas of the Rockall Trough. There is potential that acoustic survey equipment used by the WEPAS and Kiely East Survey may result in result in-combination effects. Europa are in communication with the Marine Institute to ensure operations are coordinated. |
| **DeepSea Fibre Networks Ltd.** | Galway Bay, Porcupine Sea Bight, Porcupine Abyssal Plain and Bay of Biscay | DeepSea Fibre Networks Ltd. is planning to construct a new sub-sea telecoms cable system linking Galway, on the west coast of Ireland, to Bilbao, on the north coast of Spain. | **No**<br>The proposed route corridor comprises a 500m corridor and is 1,774km overall from Ballyloughane Strand to the coastline of Spain. The planned route extends south west from Galway Bay before dropping into the deep water of the Porcupine Sea Bight and then turning south on to the Porcupine Abyssal Plain before turning south east to the Bay of Biscay and landfall at Bilbao. No in-combination effects are anticipated. |

As outlined above there is potential that activities proposed oil and gas operators and research activities may act in-combination with the Kiely East Survey to result in likely significant effects. However, strict adherence to the mitigation measures detailed in **Section 3.11**, which includes NPWS Guidance (NPWS, 2014) and PAD/ NPWS recommendations, the risk to marine mammal species will managed. Given the above, it is concluded underwater noise will not result in likely significant effects in Article 12 Annex IV marine mammal species.

## 3.11 Mitigation

Under Section 2.1 of the Rules and Procedures (PAD, 2007a [draft updated 2014]) applicants are required to submit an Application for Approval to PAD to conduct any Geophysical or other Exploration Survey, Site Survey or Route Survey prior to the planned commencement of the survey. This should include information on the specific impact mitigation and monitoring practices that will be applied during the survey in relation to marine mammals. Specifically, operators are required to ensure that current best industry practices are applied with regard to impact mitigation and monitoring measures in relation to marine mammals. In line with this requirement, the proposed survey will adhere to DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014)[15] and recommendations from PAD and NPWS in relation to the separation distance between the concurrent acoustic surveys.

[15] DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014) https://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf

### 3.11.1 DAHG 2014 Guidance

As geophysical equipment proposed for the Kiely East Survey include 10 cu in. seismic airguns (see **Table 2.1**), DAHG (2014) protective measures will be implemented during the Kiely East Survey. DAHG (2014) measures include the use of marine mammal observers (MMOs) and operational protocols; these measures are summarised below. Sound-producing survey activity shall not commence until all protective measures (including monitoring measures and ramp-up procedures) outlined in DAHG (2014) have been successfully completed.

MMO Requirements:

- Qualified MMOs to be appointed to monitor marine mammals and operator's implementation of the DAHG guidance.
- Seismic surveying shall not commence if marine mammals are detected within a 1,000 m radial distance of the sound source.

Pre-Start Monitoring:

- Pre-start monitoring will only be undertaken when visual conditions are conducive to effective monitoring and outside of the hours of darkness. Sound producing activity will only commence where the required pre-start monitoring periods have elapsed with no marine mammals detected within the monitored zones by the MMO.
- Sound-producing survey activities will only be commenced in daylight hours where effective visual monitoring, as determined by the MMO, can be achieved.
- Operations in waters < 200 m and > 200 m, the MMO will conduct pre-start-up constant effort monitoring for 30 and 60 minutes respectively before the sound-producing activity is due to commence. Sound-producing activity will not commence until monitoring period have elapsed with no marine mammals detected within the monitored zones by the MMO.
- In the case of site survey operations in < 200 m survey operations the MMO will conduct pre-start-up constant effort monitoring for 30 minutes before the sound-producing activity is due to commence.
- Pre-Start Monitoring shall subsequently be followed by a Ramp-Up Procedure.

Ramp-up Procedure:

- Commencement of sound-producing survey activities will be undertaken using a 'soft-start' (ramp-up and gradual increase in energy/noise source) procedure for any equipment where the output peak SPL. exceeds 170 dB re 1µPa @ 1 m. The build-up of acoustic energy output will occur in consistent stages to provide a steady and gradual increase in power over a period of 40 minutes in the case of 10 cu in. seismic airgun operation and 20 mins in the case of site survey activity. Where the power of acoustic noise sources cannot be increased gradually, due to operational parameters of the device, the device will be switched "on and 'off" in a consistent sequential manner for the duration of the defined ramp-up period prior to commencement of the full necessary output.
- Where a soft-start procedure is employed, the delay between the end of the soft-start and the start of the survey will be minimised to prevent unnecessary high-level sound introduction.
- In all cases the delay between the end of ramp-up (i.e., the necessary full seismic output) and the start of a survey line or station will be minimised to prevent unnecessary high-level sound introduction into the environment.

- Once the Ramp-Up Procedure commences, there is no requirement to halt or discontinue the procedure at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 1,000 m radial distance of the sound source.

Line changes:

- Where the duration of a survey line or station change will be greater than 40 minutes the activity shall, on completion of the line/station being surveyed, either

  (a) shut down and undertake full Pre-Start Monitoring, followed by a Ramp-Up Procedure for recommencement, or

  (b) undergo a major reduction in seismic energy output to a lower energy state where the output peak sound pressure level from any operating source is 165 - 170 dB re: 1µPa @1m, and then undertake a full Ramp-Up Procedure for recommencement.

- Where the duration of a survey line or station change will be less than 40 minutes the activity may continue as normal (i.e. under full seismic output).

Breaks in Sound:

- If there is a break in sound output for a period of 5-10 minutes (e.g., due to equipment failure, shut-down, survey line or station change), MMO monitoring will be undertaken to check that no marine mammals are observed within the Monitored Zone (i.e. within the 1,000 m radius) prior to recommencement of the sound source at full power.
- Where a marine mammal is observed within the Monitored Zone during such a break of 5-10 minutes, then all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) shall recommence as in a normal start-up operation.
- In any case, if there is a break in sound output for a period greater than 10 minutes (e.g., due to equipment failure, shut-down, survey line or station change) then all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) will be undertaken.

Reporting:

- Full reporting on MMO operations and mitigation undertaken will be provided to the Regulatory Authority.

Passive acoustic monitoring

- In addition to the above measures, MMOs will use of passive acoustic monitoring (PAM) to optimise marine mammal detection around the survey.

### 3.11.2 PAD/ NPWS Guidance

In line with current recommendations from PAD and NPWS, Europa will maintain a 100 km separation distance between the concurrent acoustic surveys that may be operating. Implementing a 100 km separation zone between concurrent acoustic survey operations will ensure in-combination effects from noise generating equipment are avoided. Europa are in regular communication with operators proposing

to undertake operations offshore Ireland in 2019. Survey operations will be coordinated to ensure a 100 km separation is maintained between surveys during concurrent geophysical operations.

# 4 EIA SCREENING ASSESSMENT

Annex III of the 2014 Directive outlines criteria for determining whether a development would or would not be likely to have significant effects on the environment. **Table 4.1** evaluates the Characteristics of the Proposed Project; **Table 4.2** assesses the criteria relating to the Location of Proposed Project and the Types and Characteristics of Potential Impacts are assessed in **Table 4.3.**

The structure of the assessment is also informed by the European Commission EIA Screening Guidance (2017)[16] and the DCCAE EIA Guidance Screening Table[17].

[16] Environmental Impact Assessment of Projects Guidance on Screening (Directive 2011/92/EU as amended by 2014/52/EU) http://ec.europa.eu/environment/eia/pdf/EIA_guidance_Screening_final.pdf

[17] https://www.dccae.gov.ie/documents/CopyofEIAScreeningTableSeismic.pdf

**Table 4.1: Characteristics of the Proposed Development**

| The characteristics of projects must be considered, with particular regard to: | | |
|---|---|---|
| **(a) The size and design of the whole project?** | Europa Oil & Gas (Ireland West) Limited (Europa) propose to undertake geophysical and environmental site survey activities in the northwest Porcupine Basin, offshore Ireland in 2019. The name of the proposed survey is the 'Kiely East Survey' and will focus on the Kiely East prospect. The GWA is located licensing quadrant/blocks 43/14, 43/15, 43/19 and 43/20 and will be conducted under (FEL) 2/13 held by Europa Oil & Gas (Ireland West) Limited. .<br>The greater working area (GWA) for the proposed Kiely East Survey is shown in **Figure 1.1**. The Kiely East prospect survey GWA is located over 180 km from landfall at the Blasket Islands off the west coast of County Kerry. The proposed survey working area at the Kiely East prospect is approximately 80km$^2$.<br>The Kiely East Survey comprises a geophysical data and environmental seabed sample acquisition programme. The aim of the proposed survey is to accurately determine water depths and seabed/ subsurface geology at the site, identify any seabed obstructions and confirm the location of any existing infrastructure (such as cables, pipelines, wellheads) and ship wrecks.<br>Should the application to undertake survey activities be successful it is envisaged that survey operations will be undertaken by a single survey vessel between June and late-November 2019 over a total of 14 survey working days. | |
| **Screening Question** | **Briefly Describe** | **Is this likely to result in a significant impact? (Yes / No – Why?)** |
| **(b) cumulation of impacts with other existing and/or approved projects** | The project may interact in a cumulative manner with other planned activities (oil and gas exploration and research) planned with an overlapping duration to the proposed survey. | **No significant impacts**<br>Europa are aware of other activities oil and gas exploration and research activities planned offshore Ireland in 2019. Details of these activities are outlined in **Section 3.10**. In summary, there is potential in-combination effects of noise emissions to marine mammals from the following operations:<br>• Vermillion – Corrib Gasfield pipeline inspection survey;<br>• CNOOC – Site survey at Slyne/ Erris Basin and surrounding continental shelf |

- Europa Oil & Gas – site surveys in the Slyne Basin;
- NEXEN/ CNOOC – drilling operation at Iolar prospect;
- ENI Ireland BV – site surveys in the Porcupine Basin;
- Exola/ Providence – site survey operations at Barryroe licence area in the North Celtic Sea Basin;
- Kinsale Energy and PSE Seven Heads Limited – decommissioning gasfield infrastructure; and
- Marine Institute – acoustic fisheries survey.

The potential in-combination effects associated with the above operations are the same as those potential effects described for the Kiely East Survey in **Section 3.4** above. Mitigation measures to minimise and/ or eliminate likely significant effect of the Kiely East Survey on marine mammal Qualifying Features are proposed in **Section 3.11.1**. The above listed exploration activities will also be subject to implementing these mitigation measures.

In the case of concurrent survey using acoustic equipment a 100 km separation zone between active surveys will be maintained (see **Section 3.11.2**).

| | | |
|---|---|---|
| **(c) the use of natural resources, in particular land, soil, water and biodiversity** | The use of natural resources will be required to undertake the survey, specifically use of fuel and other products/ materials required to operate the survey vessel. Fuel and potable water resources are non-renewable. | **No significant impacts**<br>Resource usage will be limited by the short duration of the project and will be comparable to any other shipping/ fishing operations of similar duration. |
| | The waters within which the proposed survey activities are proposed contain important commercial fishing resources. | **No significant impacts**<br>The main survey aspect that may give rise to potential impacts to fish and shellfish is underwater noise. However, based on the assessments presented in **Section 3.9.3** above it was determined the survey is not likely to have significant impacts upon commercial species. |
| **(d) production of waste?** | Solid waste will be generated in the form of general refuse, scrap metal and packaging. These will be typical of any routine shipping or survey operation. | **No significant impacts**<br>Food waste disposable at sea will be macerated prior to discharge, following the procedures defined in the MARPOL convention.<br>All remaining waste will be transported back to shore for appropriate disposal. |
| **e) pollution and nuisances** | Planned discharges to the marine environment (grey water, black water, ballast water and bilge water) will occur during operations. All discharges will be treated prior to release into the marine environment, however grey water and sewage discharges could potentially contain solids, detergents, pathogens and chlorine, and bilge water discharges could potentially include traces of oil. | **No significant impacts**<br>Planned discharges to the marine environment will be controlled through the integrated management system, and adherence to appropriate legislation (such as 1973/78 MARPOL convention), to ensure that any discharges of pollutants are non-significant. Given the short duration of the survey, discharges are likely to be small in volume and will rapidly disperse in the marine environment. As a result, potential significant impacts associated with discharges can be discounted. |

| | |
|---|---|
| Accidental discharge of fuel could occur in the event of vessel collision or equipment malfunction. This could result in direct, indirect and secondary impacts, depending on the size and type of spill. | **No significant impacts**<br>Given the low probability for unplanned events/ spills and the offshore location of the survey it is concluded that significant environmental effects associated with hydrocarbon spills can be discounted. |
| Emissions to air will occur as a result of power generation for the operation of the vessel and the use of ancillary equipment. It should be noted, however, that the survey will be operating in the open sea environment and any emissions from the survey are not likely to affect human communities onshore and no discernible effect on the local ambient air quality is anticipated. | **No significant impacts**<br>Atmospheric emissions associated with power generation will be no different to routine shipping, fishing and survey operations.<br>All equipment to be used on-board the survey vessels will be certified and properly maintained to ensure that the release of substances to air will be kept to a minimum. |
| The survey equipment will generate noise, which will be released directly into the marine environment. The receptors of greatest concern are Article 12 Annex IV marine mammals and marine reptile species. | **No significant impacts**<br>Following implementation of mitigation measures prescribed by DAHG (2014) and PAD (2007 [draft updated 2014]) potential impacts are considered to be non-significant. |
| The vessels will be lit at night, resulting in localised light release. Interactions with seabirds is possible, however impacts will be no different to typical shipping/ fishing operations. No releases of heat energy or electromagnetic radiation are expected. | **No significant impacts**<br>Light associated with vessels will be comparable to other shipping/ fishing activities in the area and is a safety requirement. Potential impacts are considered to be non-significant. |

| | | |
|---|---|---|
| **e) the risk of major accidents and/or disasters which are relevant to the project concerned, including those caused by climate change, in accordance with scientific knowledge?** | The probability of a hydrocarbon spill, occurring as a result of collision, equipment malfunction or incident while re-fuelling at sea (if undertaken), is remote.<br>All offshore operations entail risks for those working on the operations.<br>No primary risks to wider human health are considered likely.<br>The waters within which the survey is located can be subject to severe winds, fogs, wave heights etc. Such conditions are expected within the Atlantic waters and do not present environmental problems for the survey. | **No significant impacts**<br>Operational risks (i.e. those with the potential to affect offshore personnel) will be managed through the Health Safety and Environment procedures and international procedures, to mitigate risks as far as reasonably practical. Major accident or injuries are not likely.<br>Unplanned events could result in discharges of hydrocarbons to the marine environment. The likelihood and consequence of such events are limited through the implementation of suitable measures – international best practice and survey vessel specific procedures. The survey vessel SOPEP and any bridging documents will provide procedures for emergency response. The risk is rated as low, and not considered to be significant. |
| **(f) Are there risks to human health (for example due to water contamination or air pollution)?** | The operation of vessels will require the usage of fuel and other on-board chemicals at sea. | **No significant impacts**<br>There will be no planned discharge of harmful substances. A Waste Management Plan (WMP) will be developed to provide procedures for appropriate disposal.<br>Europa and the vessel operator will maintain high environmental standards. A Shipboard Oil Pollution Emergency Plan (SOPEP) will be in place for the survey vessel to describe the response arrangements for an accidental release of hydrocarbons. This will limit the potential consequences associated with an unplanned (accidental) event. |

**Table 4.2: Location of the Proposed Project**

| Screening Question | Briefly Describe | Is this likely to result in a significant impact? (Yes / No – Why?) |
|---|---|---|
| **The environmental sensitivity of geographical areas likely to be affected by projects must be considered, with particular regard to:** | | |
| **(a) the existing and approved land use** | The site constitutes a previously undeveloped but licensed marine space. The survey is proposed to last approximately 14 survey working days depending on weather. While survey activities are underway fishing vessels may be excluded from a limited area surrounding the survey vessel. | **No significant impacts**<br>Mitigation measures such as Marine Notice (to mariners), and consultation with the fisheries industry, will ensure that impacts associated with exclusion from fishing grounds are not significant. |
| **(b) the relative abundance, availability, quality and regenerative capacity of natural resources (including soil, land, water and biodiversity) in the area and its underground** | Protected marine mammals (e.g. Habitats Directive Annex II and IV species) have a known distribution within the proposed survey area. Marine mammals may be affected by noise disturbance resulting from the use of the acoustic source. Potential interaction of Annex II and IV marine mammal species and Annex IV reptile species with the proposed survey are discussed above in **Section 3.5** and **Section 3.6** above and within the AA Screening report (document reference: **MGE0719RP0014**) that accompanies this report. | **No significant impacts**<br>When encountering high levels of noise disturbance, potential impacts to fauna can range from injury/ death to changes in species behaviour. Given the relatively small zones of impact (described in **Section 3.4.5**), the implementation for mitigation measures (detailed in **Section 3.11**), the short duration of the proposed survey (14 days), it is unlikely that species will be present in significant numbers in the vicinity of the proposed survey.<br>Furthermore fauna would generally be expected to avoid and move away from loud noise sources in order to avoid injury it can be concluded that the proposed survey will not result in significant impact to fauna. |

| | | |
|---|---|---|
| **(c) the absorption capacity of the natural environment, paying particular attention to the following areas:** | | |
| **(i) wetlands, riparian areas, river mouths;** | **N/A** | **N/A** |
| **(ii) coastal zones and the marine environment;** | The proposed survey overlaps Ireland's western continental shelf. Potential impacts of the survey are discussed in detail in **Section 3** above and within the AA Screening report (document reference: **MGE0719RP0014**) that accompanies this report. | **No significant impacts**<br>Adherence to international and industry best practice and project specific commitments will ensure that the proposed survey does not result in significant long-lasting impacts to the environment. In the unlikely event of an unplanned incident, impacts will be limited through the use of mitigation measures. |
| **(iii) mountain and forest areas;** | **N/A** | **N/A** |
| **(iv) nature reserves and parks;** | **N/A** | **N/A** |
| **(v) areas classified or protected under national legislation; Natura 2000 areas designated by Member States pursuant to Directive 92/43/EEC and Directive 2009/147/EC;** | Potential effect of the proposed survey to coastal, terrestrial and marine Annex I habitats and non-mobile Annex II species can be discounted as, based on distance from the proposed survey, no potential pathway for interaction exists between the Qualifying Interests and survey activities (i.e. no connectivity exists).<br>With regard Annex II mobile species of onshore/ coastal SACs; Following implementation of protective measures prescribed by NPWS (2014) and PAD (2007a [draft updated 2014]) potential | **No significant impacts**<br>Given the distance of the proposed survey from Natura 2000 Sites and OSPAR MPAs (see **Section 2.3.7**) and the nature of the survey activities proposed and the implementation of protective measures, it can be concluded that there will be no direct, indirect or cumulative likely significant effects to the Conservation Objectives of Natura 2000 Sites. For further information see AA Screening report (document reference: **MGE0719RP0014**). |

| | | |
|---|---|---|
| | impacts to Annex II mobile species are considered to be non-significant.<br>In Irish offshore waters a total of six SACs have been designated (NPWS, 2014 a-f). Ireland has established four of its six offshore SACs as OSPAR. Potential likely significant effects of the proposed Kiely East Survey to offshore protected sites can be discounted as, based on distance from the proposed survey, no potential pathway for interaction exists between the sites and survey activities (i.e. no connectivity exists) (the closest offshore site is over 50 km from the proposed survey). | |
| **(vi) areas in which there has already been a failure to meet the environmental quality standards, laid down in Union legislation and relevant to the project, or in which it is considered that there is such a failure;** | Existing environmental pollution/damage in the area is low. The main users of the sea are transient, with no stationary activities being undertaken in the area.<br>There are no existing environmental standards, specific to the area or relevant in a broader context (national/ international), which will be exceeded by the proposed survey. | **No significant impacts** |
| **(vii) densely populated areas;** | The project is located approximately 180 km from the nearest landfall. | **No significant impacts** |
| **(viii) landscapes and sites of historical, cultural or archaeological significance.** | | |
| **Landscape** | The proposed Kiely East Survey is located approximately 180 km from landfall, therefore no landscape and scenic impacts are expected. | **No significant impacts** |

| | | |
|---|---|---|
| **Sites of historical, cultural or archaeological significance** | The proposed survey will not interact with shipwrecks or cultural sites. Using mapping of known shipwrecks and geophysical data gathered during the survey, Europa will ensure that no seabed sampling activities are undertaken in the vicinity of any features of historic or cultural importance. See **Section 2.4.2.6** for further details. | **No significant impacts** |

**Table 4.3: Types and Characteristics of Potential Impacts**

| Screening Question | Discussion |
|---|---|
| **(a) the magnitude and spatial extent of the impact (for example geographical area and size of the population likely to be affected);** | Geophysical data will be acquired using standard equipment. Site survey data will be acquired over approximately 80 $km^2$ in at Kiely East prospect. |
| **(b) the nature of the impact;** | The EIA Screening process has identified that the only source of impact that has the potential to significantly impact the marine environment is underwater noise generated by the proposed geophysical survey and positioning equipment.<br>Noise generated from this equipment will generate noise, which will be released directly into the marine environment which may impact sensitive receptors such as the Article 12 Annex IV and Annex II species. To assess expected underwater noise levels from the proposed Kiely East Survey and determine whether likely significant effects are possible, an underwater noise modelling exercise was undertaken to predict the likely spatial area (or zone) around the noise source within which noise emissions exceed thresholds of potential injury and behavioural effects in species of concern. |
| **(c) the transboundary nature of the impact;** | No |
| **(d) the intensity and complexity of the impact;** | The receptors of greatest concern are Annex IV and Annex II species. However, the intensity and complexity of impacts are expected to be low. Following the implementation for mitigation measures (detailed in **Section 3.11**) likely significant impact will not occur |
| **e) the probability of the impact;** | Based on the probability of interaction between receptors and survey aspects, impacts upon receptors are outlined in **Section 3.3**. The probability impacts arising from noise emissions to Annex II and Article 12 Annex IV marine species is considered low. |

| Screening Question | Discussion |
|---|---|
| **(f) the expected onset, duration, frequency and reversibility of the impact;** | The short duration of the proposed survey and the fact that marine species would generally be expected to avoid and move away from loud noise sources in order to avoid injury it can be concluded that the proposed survey will not result in significant impact to marine fauna. |
| **(g) the cumulation of the impact with the impact of other existing and/or approved projects;** | Europa are aware of other activities oil and gas exploration and research activities planned offshore Ireland in 2019. These activities are summarised in **Table 4.1** above and detailed in **Section 3.10**. The potential in-combination effects associated with the above operations are the same as those potential effects described for the Kiely East Survey in **Section 3.4** above. Mitigation measures to minimise and/ or eliminate likely significant effect of the Kiely East Survey on marine mammal Qualifying Features are proposed in **Section 3.11.1**. The above listed exploration activities will also be subject to implementing these mitigation measures.<br>In the case of concurrent survey using acoustic equipment a 100 km separation zone between active surveys will be maintained. Impacts resulting from concurrent survey operations (oil and gas operations, and research) will be managed through clear communication between operators. |
| **(h) the possibility of effectively reducing the impact.** | Following implementation of mitigation measures prescribed by DAHG (2014) and PAD (2007 [draft updated 2014]) potential impacts from noise on sensitive receptors are considered to be non-significant. |

# 5 EIA SCREENING SUMMARY

This EIA Screening report has been prepared to provide the competent authority, the Minister for the DCCAE, the information required to inform the screening determination on whether the proposed Kiely East Survey should be subject to an EIA in accordance with Annex IIA of the EIA Directive.

This assessment has identified that the only source of impact to receptors is the underwater noise generated by survey equipment. The environmental receptors of concern include Annex IV and Annex II marine mammal species. Based on the nature and duration of the proposed site survey operations, and strict adherence to DAHG Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014) and recommendations from PAD and NPWS, in relation to the separation distance between the concurrent acoustic surveys, no significant effects will occur.

In summary, this EIA Screening Report has concluded that there will be no significant effects on the environment from the proposed Kiely East Survey and it is therefore considered that an EIA is not required.

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# Appendix B

## Cetacean and Pinniped Species

# Cetaceans - Odontocetes (Toothed Whales and Dolphins)

## Harbour porpoise

Harbour porpoises are the most frequently sighted cetacean species in Irish coastal waters (Berrow et al. 2010) but are thought to predominantly occur in coastal waters and in depths of less than 300 m (Reid et al. 2003). SCANS-II (2008) was a dedicated harbour porpoise survey over continental shelf waters, where 705 harbour porpoise detections were recorded throughout the entire survey area, including Irish waters. However, during offshore surveys over deep water, harbour porpoise detections were scarce. During 55 days and 533 hours of towed acoustic effort, O'Brien et al. (2013) recorded two harbour porpoise detections, both in inshore waters off the northwest coast.

The species is also recorded in offshore areas of the Irish shelf in spring with sightings occurring in shallower water of offshore banks such as the Porcupine and Rockall Bank. Their relative abundance within the Irish Sea shows little seasonal variation. Monitoring has indicated an offshore movement from near coastal waters in early summer, most likely linked to calving (Reid et al. 2003).

During ObSERVE acoustic monitoring surveys harbour porpoise were recorded in spring to the south west of the Erris Basin in the Rockall Basin and in summer and autumn to the south of the Slyne Basin and on the northern Porcupine Bank. ObSERVE aerial monitoring reported the species predominately over the continental shelf and in the Irish Sea. Predicted distribution modelling based on aerial monitoring results highlighted the importance of the Irish Sea, an area in the middle of the continental shelf over the North Porcupine Basin and the south west part of the Celtic Sea (over the North Celtic Sea Basin).

## Short-beaked common dolphin

The short-beaked common dolphin is Ireland's most abundant dolphin, occurring throughout all Irish waters to varying densities. Highest relative abundances have been recorded off Irelands south and southwest coasts, with lower densities recorded along the shelf slopes and deeper waters of the Rockall Trough and Porcupine Abyssal Plain. It is estimated from the SCANS II and CODA survey data correlated within the Atlas that there is a total population of 40,000 individuals in Irish waters. Recorded all year round, the highest densities were recorded off the south and south-west coasts in the summer and autumn. Extremely large pods (100 - 1000's) can occur in the southern approaches of the Irish sea in spring and summer.

Short-beaked common dolphin was among one of the most common cetacean species recorded during ObSERVE aerial survey with sightings of the species being predominantly recorded to the south and west of Ireland, with no sightings recorded in the Irish Sea.

## Common bottlenose dolphin

The common bottle-nosed dolphin is a large (1.9 - 4 m), social (often in groups of 2 - 25+ individuals) dolphin with a robust head and a distinct short beak, often white tipped on the lower jaw. As one of Ireland most recognisable cetacean species, they are sighted in inshore habitants (particularly in the Shannon estuary) often approaching vessels and display acrobatic activity. Offshore bottle-nosed dolphins are less social toward vessels. They are offered protection in the Lower Shannon Estuary SAC and the west Connacht Coast SAC. They occur off the entire Irish coastline, some moving around the coast, others being semi resident.

According to data correlated in the Atlas, distribution of this dolphin is continuous from inshore to offshore areas, with some indications of a preference for the slopes of the Irish Shelf and offshore banks. They have also been cited in abyssal waters. Higher abundances are in the offshore waters to the west of Ireland. No specific seasonality traits have been deciphered for the bottle-nose dolphin; it has been recorded year round.

The CODA survey estimated an abundance of 19,019 bottlenose dolphins within European Atlantic Waters beyond the continental shelf. It is estimated that populations of approximately 8,500 may occur in waters over shelf slopes and deeper waters around the Rockall Trough and Porcupine Abyssal Plain.

During ObSERVE aerial surveys bottlenose dolphin was the most frequently sighted cetacean species. The species was more frequently seen in winter months than in the summer months. The species was recorded across the entire survey area, in oceanic, neritic and coastal waters, with few sightings in the western Irish Sea. Predicted distribution for bottlenose dolphins showed the coastal waters of the south west of Ireland as an important region, along with high density areas in the north eastern part of the Porcupine Seabight and the southern part of the Celtic Sea.

## Risso's dolphin

This large robust dolphin, typically around 3.5 m, is to be found in small to medium sized groups (5-20 individuals, but often considerably higher). They are a comparatively uncommon species.

Risso's dolphins have been recorded on a regular but infrequent basis around the entire Irish coast. While they are most often sighted at depths of greater than 200m in areas over continental shelf slopes or the slopes of oceanic islands elikely signifcant effectwhere in the world, the dolphin seems to display a preference for inshore shelf waters in Ireland. Relative abundances off the north and northwest coasts are low. They have been recorded in Irish waters from April to November, peaking in the summer months and largely absent from Irish waters from December to March. Repeated sightings of some of these animals in near-shore coastal waters of Ireland may suggest some site fidelity by some individuals or groups.

During the ObSERVE aerial survey Risso's dolphins were seen in all seasons in a variety of habitats, with some sightings close inshore, but most in deeper waters over the continental shelf and slope.

## Killer whale

The killer whale is the largest dolphin species, reaching up to 9.5 m in length, also being the most widespread cetacean on earth, occurring in areas from the polar ice pack, to the warm waters of the tropics. They have a very tall, triangular and erect dorsal fin, and a conical shaped black head a with signature white oval patch above and behind the eye.

This whale is widely distributed in the deep North Atlantic waters and in coastal European waters. Within the UK and Ireland, they are most commonly sighted off northern and western Scotland, also occurring west and south of Ireland. Data correlated for presentation in the Atlas indicate sighting predominantly in inshore waters of the northeast, north, west and south coasts. Smaller numbers of sightings have occurred in offshore waters over the Irish Shelf. Seven killer whales photo identified in Irish waters are all bar one part of the 'West Coast Community' killer whale group (10 in total) first recognised off the West Scottish waters. Reports of large assemblages up to 100 are reported by the Irish Naval Service off the northwest coast in proximity to the mackerel fishing fleet; these assemblages are thought to be from Norwegian or Shetland populations. Killer whales were recorded in Irish waters during all months but January, with the most sightings during summer and close to shore around bays and islands.

During the ObSERVE aerial surveys, three sightings of killer whale were recorded. These sightings were recorded during summer over the Erris and Donegal Basins off the northwest coast. There were insufficient sightings of to undertake predicative distribution modelling and/ or to generate abundance estimates.

## False killer whale

False killer whales are 5-6 m in length and have a slender, almost all-black torpedo shaped body with a tall, usually sickle-shaped dorsal fin slightly behind the middle of the back. The head is small and narrow, tapering to overhang the lower jaw. They are highly social, with herds as large as 600 - 800 being reported. They have a wide oceanic distribution, mainly occurring in deep tropical to warm temperate waters and usually seaward of continental shelf breaks. Most sightings in the UK and Atlantic Margins have been made between July and November.

A single sighting of false killer whale was reported during winter ObSERVE aerial surveys. The sighting was reported in the northern western Rockall Basin. There were insufficient sightings of either species to generate abundance estimate. There were insufficient sightings of to undertake predicative distribution modelling and/ or to generate abundance estimates.

## Striped dolphin

These dolphins are sleek in appearance, with a body coloration consisting of dark grey cape extending from the beak to the dorsal fin, lighter grey flanks, leading to a pink-white underside.

Sightings of striped dolphin in Ireland are very rare; two during the period of study for the Atlas. By-catch data would indicate their presence in the deep waters to the southwest of the Irish Shelf. This data is insufficient to infer seasonal or temporal trends.

Sightings of striped dolphin were made on a few occasions during the ObSERVE Aerial project. The species is generally considered to be a more southerly distributed species, but with occasional sightings as far north as the Faroe islands.

## Atlantic white-sided dolphin

This dolphin often occurs in groups from ten’s to hundreds, and can occur in groups of up to 1,000, most often offshore. Their distribution in northwest Europe is predominantly clustered in an area from west of Ireland, to the north and north-west of Britain. Smaller numbers occur around the west of Ireland. It is possible that they follow mackerel as the spawn off the south-west of Ireland’s coast in February/ March. It is possible that white sided dolphins range much further into the open Atlantic than previously thought.

Sightings documented in the Atlas were mainly in deep waters (> 200 m) on or close to the slopes of the continental shelf with further sightings in the deep waters of the central Rockall Trough. Only a small number of sightings are in shallow waters, confirming their preference for deeper waters.

Highest abundances were in the Rockall Trough to the north-west of the coast, where group sizes up to 250 were observed. It has been estimated that approximately 5,500 white sided dolphins were found in the Rockall Trough and Porcupine Bank in August 2000. Data would suggest that the dolphins are present in Irish water from December to June; peak sightings occurred in summer and reduced sightings in autumn.

Atlantic white-sided dolphins was recorded a total of 8 times during ObSERVE aerial surveys with most of these occurring in deeper waters, predominantly in the summer. These sightings were widely distributed

extending from the Donegal and Malin Basins and eastern Rockall Basin west of the Slyne and Erris Basins to western most edge of the central Porcupine Bank and southern Porcupine Bain.

## White-beaked dolphin

Typically in the range of 2.5 - 2.7 m, this dolphin is usually found over the continental shelf in waters of 50 – 100 m. They are usually found in groups of less than 10, but herds of up to 50 are not uncommon.

They cover a large part of the European continental shelf, including an area from south to west of Ireland. Data from UK and Irish waters indicate a decline in their abundance in Irish waters with rising sea temperatures seen as the cause.

Present on the continental shelf year round in near shore UK waters, they have also been sighted year round in Irish waters, but these sighting in Ireland have been scarce, preventing an acceptable judgement on temporal changes in distribution and abundance. In the UK, however, they are observed most frequently between June and October.

During observe aerial surveys white-beaked dolphins were recorded on 22 occasions. Sighting occurred in both summer and winter seasons. Although sightings were predominantly in offshore waters, a number of sightings of this species were made in more coastal waters. Sightings were predominantly reported in offshore waters with a minority of sightings were made in more coastal waters. Mean group size for this species ranged from 1.5 to 8 individuals.

## Sperm whale

Sperm whales are the largest of the toothed whales (15 - 18 m in length) and Ireland's most widely distributed and abundant deep water whale species. It has a large square head that is up to one third the size of its body and an under-slung lower jaw. They are the most social of the large whales, forming groups of adult females, calves and immature male offspring. Females remain in groups, while males leave the natal group to join other males. Groups can be well over 10 but are well spread out. Typically a group of mixed members will come together at the surface once a day.

Sperm whales spend over 80% of their time underwater and are difficult to monitor visually; therefore, acoustic monitoring is a valuable tool for the detection of this species. They occupy deep oceans (typically 500 - 2,000 m) and are most commonly observed either in mid-ocean or over submarine canyons at the edge of continental shelves. They are to be found beyond the north and west of Ireland. Sightings recorded in the IWDG Atlas were all in water greater than 500m and most often beyond 1,000 m, occurring predominantly within the Rockall Trough. Sightings are clustered in areas adjacent to the slopes of Rockall Trough and above underwater seamounts and other such features. It is estimated that approximately 1,100 individuals inhabit the waters to the west of Ireland and Scotland.

Highest relative abundances were recorded in the winter months in the Rockall Trough, also occurring here, in a more northerly area, during summer. However as this whale spends the predominant proportion of their lives in deep waters, they are most often undetectable by the visual survey methods used for the presented data.

Using detections of the unique click characteristics of sperm whales captured by passive acoustic monitoring the ObSERVE programme undertook the first density and abundance estimates for sperm whales in Irish waters. Results indicated that the Atlantic Margin waters off western Ireland, particularly the more northerly portions, provide important habitats for sperm whales. During PAM monitoring, no sperm whales were detected in waters less than 300 m deep and sperm whales have been rarely been reported over the continental shelf in any locations worldwide.

## Long-finned pilot whale

The long-finned pilot whale is one of the largest dolphins, with lengths averaging 6.7m for males and 5.7m for females, they have a square bulbous head with a lightly protruding beak. The body is dark grey to black with a grey-white anchor shaped patch on the chin. They are often seen with other cetaceans, notably bottlenose dolphins. Most often, pilot whales occur in large pods (approximately 20 individuals), and large numbers of up to 1,000 have been observed off the British Isles during April, coinciding with the start of peak conception.

A survey of deepwater habitats in Northwest Europe in 2007 estimated approximately 20,000 individuals in the deep waters to the west of Ireland and Scotland, whereas in the 1980s the estimated population was approximately 780,000 in the Northeast Atlantic.

They mainly occur in deep waters of 200 - 3,000 m beyond the Irish shelf edge where bottom relief is greatest, but can also swim into coastal bays and fjords. They occur along the shelf edge out the south coast, with highest relative abundances recorded in the Rockall Trough, most specifically along the lower continental shelf slopes and the lower slopes of the Porcupine Bank. High abundances also occurred at deep water bathymetric features such as sea mounts. They were also recorded in the Porcupine Seabight (in lower densities) and in the areas of deeper water slopes south of the Goban Spur. Occasional sightings have been recorded in waters over the Irish shelf.

Long finned pilot whales appear to display little seasonality, being recorded throughout the year in Irish waters. They do however display temporal changes with highest relative abundances along the slopes of the Rockall Trough and Irish Shelf during spring and early summer and a reduction in abundance in autumn and winter. Long-finned pilot whales have been reported along the shelf edge, with greater abundance over the Erris Basin compared to the southwest and the Porcupine Seabight.

During the ObSERVE aerial surveys sightings of long-finned pilot whale were made on a total of 94 occasions. Sighting ranged from 1 to 30 individuals. This species showed an offshore distribution with most sightings occurring over the continental slope and in the deeper waters of the Rockall Trough. Predictive modelling highlights the shelf edge/slope waters to be important to this species. Based on characteristic tonal calls the presence of long-finned pilot whales was confirmed during ObSERVE acoustics surveys. There was an increase in detection rates of long-finned pilot whales in canyons compared to slope.

## True’s beaked whale

Little is known of the True’s beaked whale global distribution; they occur in the warm temperate Atlantic waters, with Ireland marking their most northerly limit. The Sowerby’s beaked whale occurs in the temperate and col-temperate cold waters of the North Atlantic as far north as the Labrador and Norwegian Sea Atlantic. The Gervais’ beaked whale only occasionally occurs in cooler temperate seas, with Ireland marking their northern limit of distribution.

It was noted in Berrow et al. (2018) that True’s beaked whale which is a deep-diving species may have been detected infrequently during ObSERVE acoustic surveys. Jessop et al. (2018) noted recent research on the diet of True’s beaked whale suggests that mesopelagic fish are an important component of the diet of True’s beaked whale.

## Cuvier’s beaked whale

Occurring globally in temperate, sub-tropical and tropical waters, these whales occur as far north as Ireland and the UK. There have only been six confirmed sightings in Irish and British waters, one of these

off the south coast of Ireland, and one off the north-west coast. Strandings have occurred on the western seaboard of Ireland and Britain.

During the ObSERVE acoustic monitoring surveys Cuvier's beaked whale was recorded throughout the survey area in all season with the exception of the most northerly area in spring and autumn. A total of 15 sightings of Cuvier's beaked whales were recorded during the ObSERVE aerial survey. The majority of sightings were located in waters deeper than 100 m. Most sightings were of single individuals, and group size ranged from 1 to 5.

## Northern bottlenose whale

The northern bottlenose Whale is one of five beaked whales in Irish waters. They only occur in temperate subpolar and polar seas in the North Atlantic, but they are more numerous at higher latitudes in colder waters between 0 and 2.5 degrees. Social organisation of the beaked whale is poorly known but composition appears to vary. They are deep divers (up to 1,450 m), with dives lasting up to 70 minutes, surfacing for up to 10 minutes after such prolonged dives.

40,000 of these whales were estimated in the eastern North Atlantic from data collected during surveys in 1987 and 1989. In northwest Europe they are most often observed in deep waters. The species appears to move toward northwest European shelf waters during the summer. The majority of sightings reported in the 2003 JNCC Atlas have been made north and west of Scotland along the continental shelf edge over the 1000 m bathymetry lines. The northern bottlenose whale is less common west of Ireland.

During the ObSERVE surveys the presence of northern bottlenose whales was sporadic, occurring from late August to mid-September in the Porcupine Shelf region. It was proposed that that northern bottlenose whales occur predominantly further west in deeper water. Visual surveys have reported northern bottlenose whales in deep waters of the Rockall Trough and along the eastern edge of the Rockall Bank. As part of the ObSERVE aerial survey northern bottlenose whales were confirmed in deeper waters along the shelf edge and canyons during winter months.

## Gervais's beaked whale

Gervais beaked whale are only known from stranding records in Irish waters.

## Beluga whale

Beluga whale are considered vagrants and occur very infrequently. During ObSERVE aerial survey Beluga was recorded on one occasion, with a sighting of a group of three whales in the winter 2015-16. These individuals were sighted in deep water southwest of the Porcupine Basin near the Canice Basin. This was the third recorded sighting of beluga in Irish waters.

## Pygmy sperm whale

Records of pygmy sperm whales are limited to stranding records and their providence is unknown.

# Cetaceans - Mysticetes (Baleen Whales)

## Fin whale

The second largest of the baleen whales, the fin whale is Ireland's most common large baleen whale, reaching a length of between 17.5 and 20.5 m. They are classed as being an endangered species. They have a grey body colour, and the Balaenopterid characteristic of a V-shaped head with a single central ridge, and a dorsal fin situated two-thirds along the back. Most often they occur alone or in pairs, but also form larger pods of 3-20. They prefer deep waters, 400 - 2,000 m beyond continental shelf's and high areas with variations in bathymetry.

They are primarily distributed along or beyond the 500 m depth contour, in areas like Rockall Trough and Porcupine Bight. They are commonly sighted off the Irish coast, with the highest relative abundance being off the south coast, inshore to the deeper waters of Labadie Bank in the south and Celtic Deep in the east. Many fin whales in these southern coastal waters have been recorded over many years, highlighting a trait of site fidelity. The CODA survey estimated an abundance of 9,019 (cv = 0.21) fin whales within the geographical area it covered. Greatest recorded abundances were off the north-west coast of Spain/Portugal.

Fin whales numbers are lowest in Ireland during winter and spring. Abundance and distribution increased in Irish shelf waters and Rockall Trough during summer; peak relative abundances recorded off the south coast and northwest shelf slopes in late summer and autumn. They inhabit the waters of the Rockall Trough year round, with numbers peaking here from August to March. The sightings and records along the slopes of the Rockall are thought to be primarily migrating individuals.

During ObSERVE acoustic monitoring fin whale detections occurred along the shelf edge in all seasons, with highest detection reported at the northernmost extent of the Irish shelf. During aerial surveys fin whales were seen in both summer and winter. Most sightings were of single individuals and were predominantly in waters along the edge of the continental shelf, with just one sighting in coastal waters in winter.

## Common minke whale

The minke whale is the smallest of the rorquals (the Balaenopterid family consisting of the blue, fin, sei and humpback whales), growing to a length of 7 - 8.5 m. It differs to the rest of the balaenopterid family with diagonal white bands on the upper parts of pectoral fins, and a slender, pointed triangular head. They are most often sighted alone or in pairs, but also occur in pods of 10 - 15. They will commonly approach vessels and bow/ stern ride boats.

They are the most commonly sighted whales in inshore Irish waters, being seen off all coasts, primarily in shallow waters (<200 m). Total summer populations of approximately 30,000-40,000 were estimated by the Atlas for northwest European waters. The CODA survey estimated an abundance of 6,765 (cv = 0.11) minke whales within the geographical area it covered.

Minke whales occur in greatest relative abundance off the south and southwest coasts in autumn and in the western Irish Sea in spring. These abundances are thought to be linked to the foraging on assemblages of pelagic schooling fish. They are also present at low relative abundances across the Irish shelf from spring to late autumn, but largely absent in all areas during winter.

During ObSERVE aerial survey minke whale was the most frequently observed and most abundant of the mysticete species identified. The ObSERVE programme also reported that minke whale appear to undergo seasonal movements with predicted distribution in summer showing a wide spatial distribution,

including coastal and continental habitat use, whereas the winter distribution was predicted to occur south and west of Ireland, with very little of the coastal area predicted to be of high use, including the Irish Sea.

## Humpback whale

A large baleen whale of 11m-16m in length, the Humpback whale has many distinguishable features from the rest of the Balaenopteridae such as a slender flattened head covered with fleshy tubercles, and distinctly notched and irregular edged tail flues. They are most often seen alone or in pairs. In breeding grounds, groups of several animals can form with male escort accompanying mother-calf pairs. While humpback populations have been severely depleted, signs of recovery are noted in the northwest Atlantic, where photo identification studies indicates numbers approximately 10,600. Sightings in Irish waters are limited to seasonal foraging grounds off the south and south west coast, with two sightings made to the west of the Irish shelf, where the animals may have been using the western shelf edge as a migratory corridor.

Present in Irish waters from June to February, with little sightings from March to May when they are assumed to have migrated to tropical breeding grounds. Foraging animals were most frequent off the south coast from late July to February. These whales show a high-level of site fidelity off the south coast. They also peak in abundance in the western Irish Sea in early spring and summer. US Navy SOSSUS hydrophone array data indicate a southward migration of the Humpback Whale west of the Irish shelf from mid-October to late March.

During ObSERVE acoustic surveys humpback whales were rarely detected, with most detection from the western and south-western zones in April and May Humpback whales were infrequently seen during the ObSERVE aerial survey, with sightings occurring in winter only. Humpback whales are a migratory species believed to range widely throughout the North Atlantic from their winter breeding grounds in the West Indies to feeding areas throughout middle-high latitudes.

## Blue whale

Blue whales are the largest of all cetaceans, and the largest known mammal. An adult will typically range from 20 - 28 m in length, but can reach up to 33m. Calves are born up to 7m in length. They have a distinctive dorsal fin of triangular shape, located three quarters down along the back, and a broad flattened, u-shaped rostrum, from which a single ridge runs to a prominent splash guard around the blowhole. Blue whales raise their flukes before a long dive. Surfacing patterns will typically involve a vertical slender blow which can reach a height of 9m, followed by a long shallow roll, exposing a long muscular back, with the small dorsal fin being exposed just before the dive. Blue whales are believed to have the capacity to dive up to 500m, but rarely exceed 200m.

Blue whales have a global distribution. North Atlantic population of Blue whales has been severely reduced, and the species is classified as being endangered. Population estimates for the region indicating up to 2,500 whales in the central North Atlantic; for example a maximum of 442 individuals has been estimated for the waters around Iceland alone. Small numbers regularly pass west of Britain and Ireland, and it is believed that the species occurs in small numbers within the deep waters of the Rockall Trough.

Only two sightings were recorded during the survey period for the Atlas, with some further sightings in late summer 2012. All sightings were recorded on the slopes of the Irish Shelf and Porcupine Bank and occurred during the month of September. Additional data indicates that blue whales migrate southward to the west of the Irish Shelf from July to March, peaking during the autumn months.

A number of large whales were sighed during the ObSERVE aerial surveys however there was no confirmed sighting of blue whale. ObSERVE acoustic monitoring did however record 880 acoustic detection of blue whale during the study.

### Bowhead whale

Bowhead whale are considered vagrants and occur very infrequently while other species. Bowhead whale have been recently sighted in inshore waters and are not expected to occur offshore.

### Sei whale

During the ObSERVE surveys there were only two confirmed winter sightings of sei whale, while there were four additional sightings of either fin or sei whales. Sei whales and fin whales are difficult to differentiate at sea but, in general, sei whales are not frequently sighted at these latitudes.

# Pinnipeds - Seals

## Harbour (or common) Seal

The harbour seal is the smaller of the two species of pinniped that breed in Ireland and is also an important predator in this area of the North Atlantic. Common seals are generalist feeders that take a wide variety of fish, cephalopods, and crustaceans obtained from surface, mid-water, and benthic habitats. During the pupping (June) and moulting seasons (late July/August) they spend more time ashore than at other times of the year. The greatest numbers of harbour seals are found along the western seaboard in predominantly sheltered areas.

## Grey Seal

Grey seals have a cold temperate to sub-arctic distribution in North Atlantic waters over the continental shelf. In Ireland the greatest concentrations are found along the western seaboard, although they also occur along the southern and south-eastern coast. The grey seal generally breeds between September and December, and prefers remote and generally undisturbed areas. Grey seals have a moulting season during the spring months, during which time they spend the majority of their time ashore.