

PROJECT:

Barryroe K-Well

Marine Mammal Observation Report

DATE:

October 2021

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Executive Summary

Mizen Archaeology was engaged by the Marine Institute on behalf of its client, Exola DAC, to conduct Marine Mammal Observations for a shallow geophysical survey which also included a seabed environmental baseline and habitat assessment survey at the K well location on Barryroe in the Celtic Sea. The operations comprised of side scan sonar, magnetometer, hull-mounted single beam echo sounder, and a bathymetry and sub-bottom profiler surveys. The survey area was an area 3km by 3km surrounding the Barryroe Well-K site. This required 1 sound producing operation.

A pod of 5 dolphins were sighted bow riding prior to operations beginning on 25 October, resulting in a delayed start. One incidental sighting of dolphins took place on 26 October while operations were at a stop. Geophysical survey operations were delayed 1 time over the course of the project.

Compliance with National Parks and Wildlife Service (NPWS) Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters was achieved.

1. Introduction

This report relates the results of Marine Mammal Observation (MMO) for a geophysical survey at the K well location on Barryroe in the Celtic Sea, off the coast of County. Cork, hereunder referred to as 'Barryroe Well-K'. The geophysics consisted of side scan sonar, magnetometer, hull-mounted single beam echo sounder, and a bathymetry and sub-bottom profiler surveys. The survey serves as site investigation for future seabed works at Barryroe Well-K.

1.1 Project Duration

Geophysical surveys took place from 25 to 26 October 2021. The geophysical works took place on a 24-hour basis. Two JNCC qualified MMOs remained on board the ship during the survey but as the survey was completed in a very timely manner only one MMO shift was required.

1.2 Legislation

Legislation relating to the protection of marine mammals is set out by the Minister for Arts, Heritage and the Gaeltacht as official guidelines and codes of practice under Regulation 71 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The Habitats Directive applies within Ireland's 200 nautical mile limit for the protection of species and to the Continental Shelf for habitats.

Under these regulations all marine mammal species normally occurring in Ireland must be given protection and Special Areas of Conservation (SACs) must be given proper conservation actions.

Due to potential detrimental effect on these animals from certain types of acoustic survey equipment, the National Parks and Wildlife Service (NPWS) advise *the reduction of unnecessary artificial sound signals and associated energy into the marine environment every effort should be made by marine users and operators to (a) minimise the duration and power/energy output of their sound-producing activity, and (b) seek greater technical efficiencies for the removal of unnecessary or unwanted signals/frequencies and for the benefit of the aquatic acoustic environment.*

Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (2014) published by the National Parks and Wildlife Service (NPWS) sector of Department of Arts, Heritage and the Gaeltacht outline source sound work types, risks associated with them, and proper mitigation. The Guidelines associated with activities undertaken for geophysical survey operations at Barryroe Well-K are reproduced hereunder:

4.3.4 (ii). Multibeam, single beam, side-scan sonar & sub-bottom profiler surveys

1. A qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms (Appendix 6).

2. Unless information specific to the location and/or plan/project is otherwise available to inform the mitigation process (e.g., specific sound propagation and/or attenuation data) and a distance modification has been agreed with the Regulatory Authority, acoustic surveying using the above equipment shall not commence if marine mammals are detected within a 500m radial distance of the sound source intended for use, i.e., within the Monitored Zone.

Pre-Start Monitoring

3. Sound-producing activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.

4. An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

5. In waters up to 200m deep, the MMO shall conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

6. This prescribed Pre-Start Monitoring shall subsequently be followed by a Ramp-Up Procedure which should include continued monitoring by the MMO.

Ramp-Up Procedure

7. In commencing an acoustic survey operation using the above equipment, the following Ramp-up Procedure (i.e., "soft-start") must be used, including during any testing of acoustic sources, where the output peak sound pressure level from any source exceeds 170 dB re: 1 μ Pa @1m:

(a) Where it is possible according to the operational parameters of the equipment concerned, the device's acoustic energy output shall commence from a lower energy start-up (i.e., a peak sound pressure level not exceeding 170 dB re: 1 μ Pa @1m) and thereafter be allowed to gradually build up to the necessary maximum output over a period of 20 minutes.

(b) This controlled build-up of acoustic energy output shall occur in consistent stages to provide a steady and gradual increase over the ramp-up period.

(c) Where the acoustic output measures outlined in steps (a) and (b) are not possible according to the operational parameters of any such equipment, the device shall be switched "on" and "off" in a consistent sequential manner over a period of 20 minutes prior to commencement of the full necessary output.

8. In all cases where a Ramp-Up Procedure is employed the delay between the end of ramp-up and the necessary full output must be minimised to prevent unnecessary high-level sound introduction into the environment.

9. 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 500m radial distance of the sound source, i.e., within the Monitored Zone.

Breaks in sound output

10. If there is a break in sound output for a period greater than 30 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) must be undertaken.

11. For higher output survey operations which have the potential to produce injurious levels of underwater sound (see sections 2.4, 3.2) as informed by the associated risk assessment, there is likely to be a regulatory requirement to adopt a shorter 5-10 minute break limit after which period all Pre-Start Monitoring and a subsequent Ramp-up Procedure (where appropriate following Pre-Start Monitoring) shall recommence as for start-up.

Reporting

12. Full reporting on MMO operations and mitigation undertaken must be provided to the Regulatory Authority as outlines in Appendix 6. (NWPS 2014, 27-28).

1.3 Location

Barryroe K-Well is located in the North Celtic Sea Basin, approximately 50km from the coast of Courtmacsherry, Co Cork. The site of Well-K is located south-west to the Ballycotton Gas Fields and Kinsale Gas Fields.

The survey area was restricted to an area of 3.0km x 3.0km around the Well-K location.

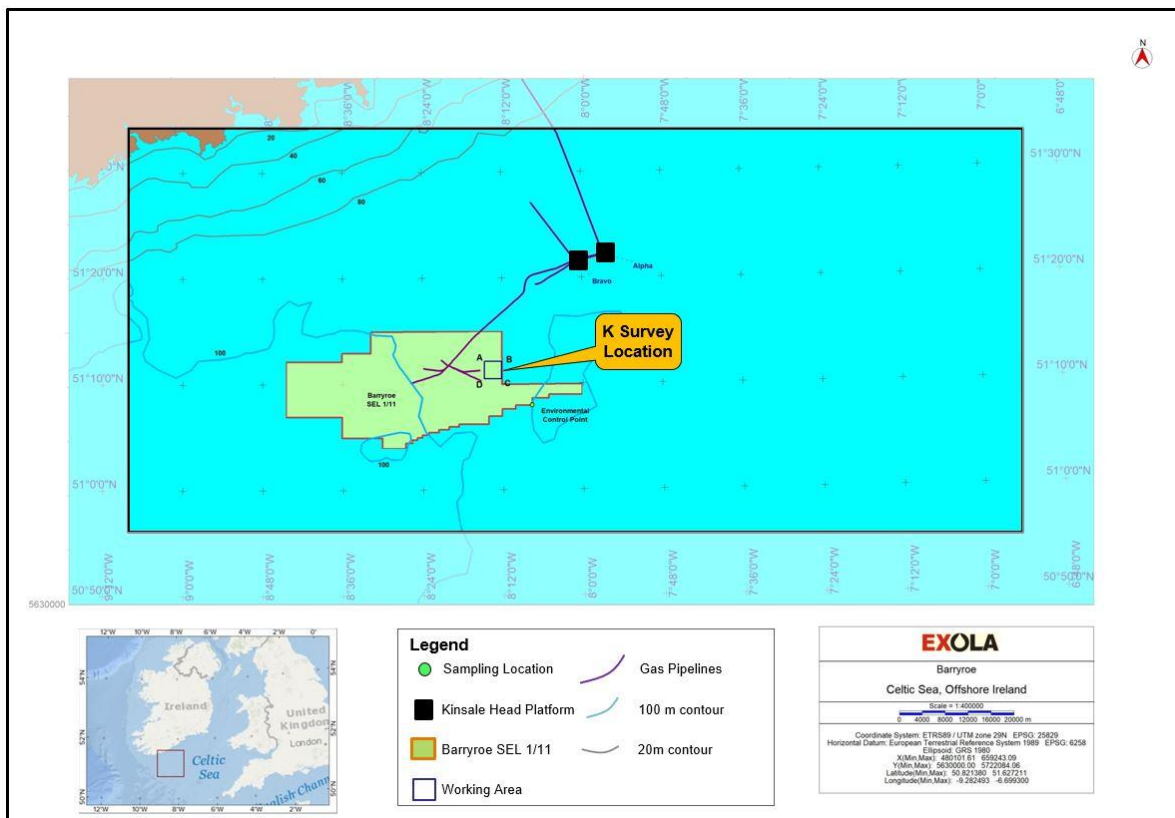


Figure 1: Location of Barryroe Well K survey area.

2. Marine Mammal Observation of Barryroe K-well

2.1 Assessment of risk for marine mammals at Barryroe K-well

An Appropriate Assessment Screening and Natura Impact Statement (NIS) was compiled prior to geophysical works at the Barryroe K-well. Section 5.2 deals with the *Impacts to Marine Mammals from Underwater Noise* (Exola DAC, 2019).

Harbour porpoise, bottlenose dolphins and grey seals are highlighted as the species most likely to be impacted due to the frequent sightings of these species in the general area of Barryroe K-well.

The mitigation proposed by the NIS to minimize and/or eliminate the likely effects of anthropogenic sound on marine mammal species are reproduced hereunder:

- *Marine Mammal Observers (MMOs) to monitor marine mammals and log all data according to the standardised forms provided in the DAHG Guidance and provide an MMO report to the Regulatory Authorities;*
- *Acoustic surveying will not commence if marine mammals are detected within a 500m radius around the acoustic sources (referred to as the Monitored Zone);*
- *Sound-producing survey activities will only be commenced in daylight hours where effective visual monitoring, as determined by the MMO, can be achieved;*
- *For sound-producing survey activities, as water depths across the proposed survey area are less than 200m, pre-start-up monitoring will be conducted by the MMO at least 39 minutes before any activity using the acoustic sources is due to commence. Sound-producing survey activity using the acoustic sound sources will not commence until at least 30 minutes have elapsed with no marine mammal detected within the Monitored Zone by the MMO. This pre-start monitoring will be followed by the soft-start procedure;*
- *Commencement of sound-producing survey activated 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 1uPa at 1 metre. The build-up of acoustic energy will occur in consistent stages to provide a steady and gradual increase in power (over a period of 20 minutes). 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 a period of 20 minutes prior to commencement of the full necessary output;*

- Where a soft-start procedure is employed, the delay between the end of the soft0start and the start of the survey will be minimised to prevent unnecessary high-level sound introduction;
- Where there is a break in sound output (e.g. in the event of equipment failure, shut-down, etc.) from the acoustic sources for more than 30 minutes, all soft-start procedures must be undertaken before activity can recommence;
- Full reporting on MMO operations and mitigation measures undertaken must be provided to the relevant Regulatory Authorities in accordance with the DAHG Guidance (2019, 41-42).

2.1.1 Cetaceans

There are 24 known cetacean species which frequent Irish waters. Ten are considered year-round residents, while six are considered seasonal, and six others are considered vagrant or rare (NWPS, 2020). Harbour porpoise and bottlenose dolphins are listed on the EU Habitats Directive Annex II, while all other cetaceans are listed on the EU Habitats Directive Annex IV (EC.europa.eu. 2020).

Year-round	Seasonal	Vagrant
Harbour porpoise	Blue whale	Northern right whale
Atlantic white-sided dolphin	Minke whale	Beluga
White-beaked dolphin	Fin whale	False killer whale
Bottlenose dolphin	Sei whale	Gervais' beaked whale
Commo dolphin	Humpback whale	True's beaked whale
Risso's dolphin	Stripped dolphin	Pygmy sperm whale
Killer whale		
Northern bottlenose whale		
Long-finned pilot whale		
Sperm whale		
Cuvier's beaked whale		
Sowerby's beaked whale		

Table 1: Cetacean species in Irish waters, (Cetaceans / National Parks & Wildlife Service, 2020a).

There have been 540 sightings of cetaceans off the coast of Co Cork under the period of 20 October 2020 to 20 October 2021. Of these, 248 were sighted off the coast between Glandore and Cork Harbour, Co Cork.

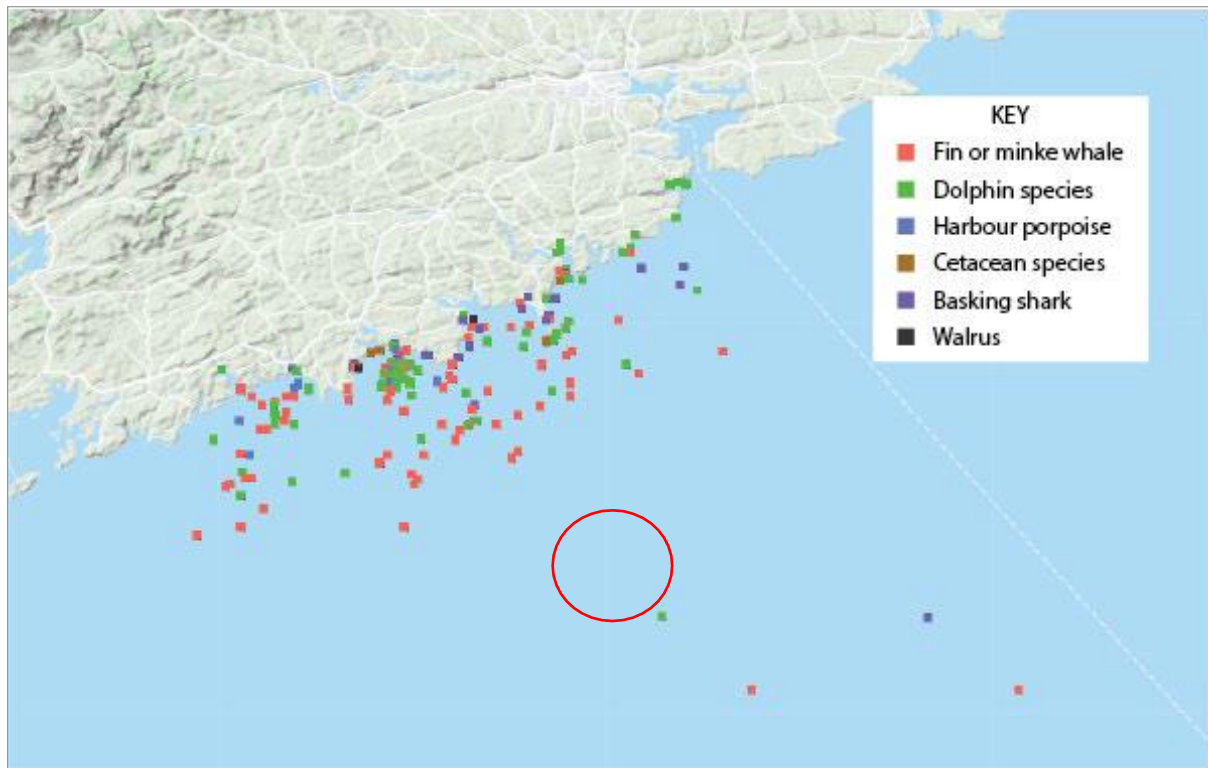


Figure 2: Cetacean sightings off the coast of Co Cork between Glandore and Cork Harbour, Co Cork under the period 20 October 2020 to 20 October 2021. Barryroe Well-K location highlighted. Data from IWDG Sightings Database.

There were 7 sightings observed at the Kinsale Gas Fields in the 12 months prior to the geophysical survey works, all of which occurred during the spring and summer months.

Species	Date	Number of animals	Record ID
Fin whale	26/07/2021	4	38793
Basking shark	14/07/2021	5	38115
Fin Whale	02/07/2021	3	37951
Whale species	12/06/2021	3	37770
Common dolphin	12/06/2021	100	37769
Basking shark	12/06/2021	5	37768
Bottlenose dolphin	15/04/2021	1	37217

Table 2: Sightings at the Kinsale Gas Field under the period 20 October 2020 to 20 October 2021.

2.1.2 Pinnipeds

The main two types of seals found in Ireland are the Grey seal (*Halichoerus grypus*) and the Harbour/Common Seal (*Phoca vitulina*). These two types make up a majority of findings all along the Irish coast. These mammals are listed as E.U. Directive Annex II species and are protected in all EU waters (EC.europa.eu. 2020).

Grey seals prefer remote haul-out sites including rocky coasts, beaches, uninhabited islands and seacaves. Grey seal haul-outs can be found on all coasts of Ireland, although their distribution on the east coast is likely lower due to human disturbances. Grey seal pups are born between September to December, and moulting takes place between November and April (O’Cadhla & Strong 2007, 4).

Harbour seals are the smaller of the two seal species and prefer sand or mudflats as their haul-out locations. Similar to grey seals, they prefer the west coast due to less human interference. Breeding takes place in June and moulting in July and August (Common Seal | National Parks & Wildlife Service, 2020).

The NWPS Seal Survey database lists 2 sightings for grey seals and 1 sighting for harbour seals between 1960 and 1980. Duck and Morris’ 2012 survey of seals in Ireland compared seal numbers between 2003 and 2012. While County Cork had over 400 harbour seals and 300 grey seals counted in 2012, none were recorded between Power Head and Youghal (Duck & Morris 2013, 23-24).

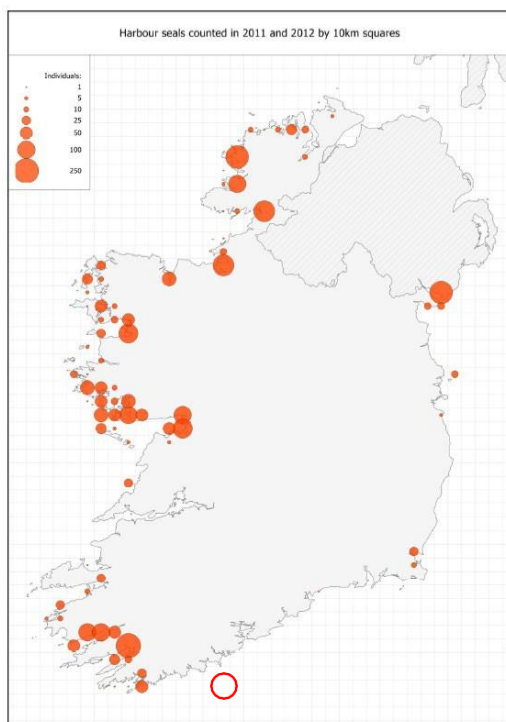


Figure 3: Harbour seal survey seal distribution. Barryroe Well-K location highlighted in red. From Duck & Morris 2013, 18.

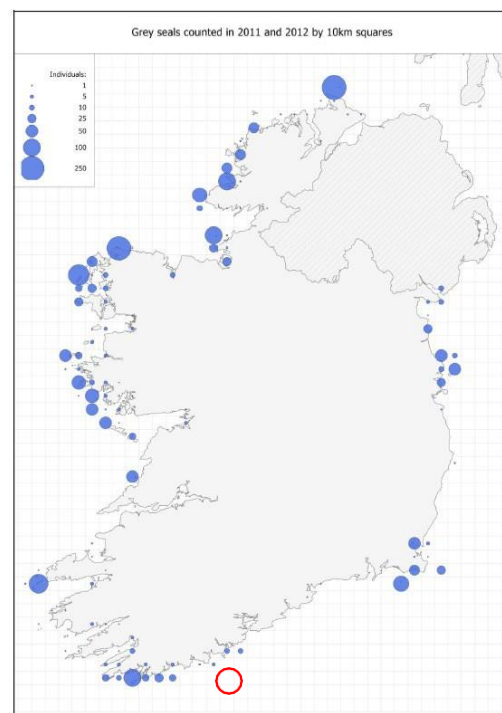


Figure 4: Grey seal survey seal distribution. Barryroe Well-K location highlighted in red. From Duck & Morris 2013, 19.

Location	Grey seal 2003 survey	Grey seal 2012 survey	Harbour seal 2003 survey	Harbour seal 2012 survey
Outer Kenmare South	0	2	5	2
Bantry Bay	1	19	341	353
Dunmanus Bay	9	36	81	10
Roaringwater Bay	55	168	52	88
Clear Island	0	1	0	0
Rosscarberry	3	29	0	0
Clonakilty Harbour	7	8	0	0
Kinsale Harbour	6	20	10	0
Cork Harbour	0	0	0	0
Power Head to Youghal	0	0	0	0

Table 3: Survey results showing seal distribution in Co Cork. Table created from data in Duck & Morris 2013, 23-24. Area relating to Barryroe Well-K highlighted in red.

2.2 Marine mammals at Barryroe K-well

Harbour seal (*Phoca vitulina*)

Harbour seals are the smaller of the seal species found in Ireland. They prefer sandy beaches for hauling out and breeding. They prefer West Cork beaches due to the lower human population, but there are frequent sightings of harbour seals in and around Cork Harbour, including at haul outs near the Ringaskiddy Basin (Mizen 2020).



Plate 1: Harbour seals. Image from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018).

Grey seal (*Halichoerus grypus*)

Grey seals breed on exposed rocky shores, on sand bars or in sea caves with ready access to deep water. Other haul-out areas for the grey seal are located on exposed rocky areas or steeply shelving

sandbanks (Ó Cadhla *et al.* 2007). Grey seals have a wide foraging range and distribution and have been known to use feeding/foraging sites more hundreds of kilometres from haul-out sites. Feeding sites are impacted by available prey (Cronin *et al.* 2011, 4).



Plate 2: Grey seal (Mizen 2020).

Walrus (*Odobenus rosmarus*)

A single juvenile walrus was sighted on Valentia Island, Co. Kerry in mid-March 2021. Walruses are rarely seen this far south of the Arctic Circle, but there have been slightly less than two dozen walrus sightings in Irish waters since the first one spotted in the Shannon in 1897 (O’Sullivan 2021). The walrus was identified on a beach in Wales in early April (O’Riordan 2021), but returned to the Irish coast in early August. He remained around the Clonakilty area for a few weeks until heading west along the Irish coast until he returned to Iceland in mid-September (RTE, 2021).



Plate 3: Walrus juvenile in Valentia Island, 14 March 2021. (Photo: Alan Houlihan).

Bottlenose dolphin (*Tursios truncates*)

Bottlenose dolphins are the most common dolphin species to be seen along the Cork coast. They have been known to use the Cork Harbour less in summer when vessel activity is increased, preferring the harbour in winter (Robinson *et al.* 2012; Ryan *et al.* 2010). Bottlenose dolphins may be attracted to vessel activity, making them potentially vulnerable to physical harm from industrial activities (Robinson *et al.* 2012).

There has been one sighting of bottlenose dolphins out at Kinsale Gas Field in 2021 (record ID 37217). There were 4 other sightings recorded off the Cork coast in the 12 months prior to the geophysical survey works.

Date	Number of mammals	Location	Record ID
09/07/2021	1	Union Hall	38067
15/06/2021	1	Kinsale	37904
14/06/2021	6	Courtmacherry Bay	37791
15/04/2021	1	Kinsale Gas Fields	37217
08/04/2021	1	Rosscarbery Bay	37183

Table 4: Recorded sightings of bottlenose dolphins in 12 months prior to geophysical survey works (data from IWDG Sightings Database).



Plate 4: Bottlenose dolphins. Image from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018).

Common dolphin (*Delphinus delphis*)

Common dolphins are not believed to be a commonly occurring cetacean in the waters of the Cork Harbour area due to their typical avoidance behaviour to excessive ambient noise (Berrow et al. 2009). However there are 35 common dolphin sightings recorded in the year prior to the geophysical survey works, 1 of which occurred at the Kinsale Gas Field (IWDG Sighting record ID 37769).

Table 5 Recorded common dolphin sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021 (data from IWDG Sightings Database).

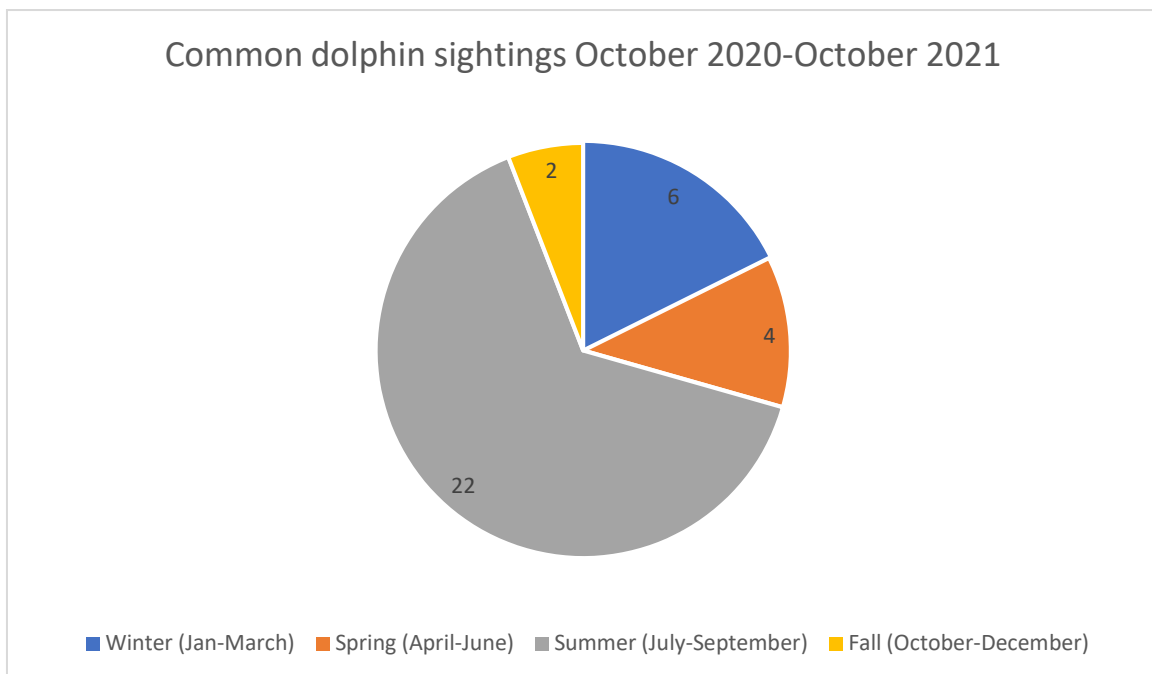




Plate 5: Common dolphin. Image from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018).

Risso's dolphin (*Grampus griseus*)

Numerous sightings of Risso's dolphins in the southwest Ireland may be an important local concentration of the species (Pollack *et al.* 1997; Hammond *et al.* 2002). These mammals tend to avoid vessels (Berrow *et al.* 2009, 35-46.). There are 3 records of sightings within the 12 months prior to works starting.

Date	Number of mammals	Location	Record ID
22/09/2021	3	Seven Heads	38952
15/07/2021	4	Old Head of Kinsale	38127
27/06/2021	5	Old Head of Kinsale	38893

Table 6: Recorded Risso's dolphin sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021. (data from IWDG Sightings Database).



Plate 6: Risso's dolphin pod. Image from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018).

Harbour Porpoise (*Phocoena phocoena*)

The harbour porpoise is abundant inshore along the south and southwest coasts and they breed in Irish waters. Offshore movement in spring between March and June may be linked to calving (Hammond *et al.* 2002). However large aggregations have been noted off the south coast in the Autumn months (O'Brien & Berrow 2015). There have been 16 recorded sightings of harbour porpoises in the vicinity of Barryroe Well-K within 12 months of the works.

Date	Number of mammals	Location	Record ID
07/09/2021	4	Rosscarberry Bay	38805
27/08/2021	8	Courtmacsherry	38624
16/07/2021	3	Rosscarberry Bay	38152
09/07/2021	2	Rosscarberry Bay	38070
27/06/2021	5	Rosscarberry Bay	38038
24/06/2021	1	Rosscarberry Bay	37882
17/06/2021	2	Clonakilty Bay	37808
02/06/2021	10	Rosscarberry Bay	37667
29/05/2021	1	Seven Heads	37676
29/05/2021	2	Clonakilty Bay	37694
12/05/2021	1	Rosscarberry Bay	37507
20/04/2021	1	Rosscarberry Bay	37269
31/03/2021	2	Seven Heads	37104
08/01/2021	3	Rosscarberry Bay	36819
06/12/2021	6	Rosscarberry Bay	36636

26/11/2021	14	Rosscarberry Bay	36600
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Table 7: Recorded harbour porpoise sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021 (data from IWDG Sightings Database).



Plate 7: Harbour Porpoise. Image from Photo from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018).

Minke Whale (*Balaenoptera acutorostrata*)

Minke whales are mainly present from April to November along all Irish coasts but tend to predominantly locate themselves on the south and southwest of Ireland (Reid *et al.* 2003; Berrow *et al.* 2010). There have been 52 recorded sightings of Minke whales in the vicinity of Barryroe Well-K in the 12 months prior to geophysical works.

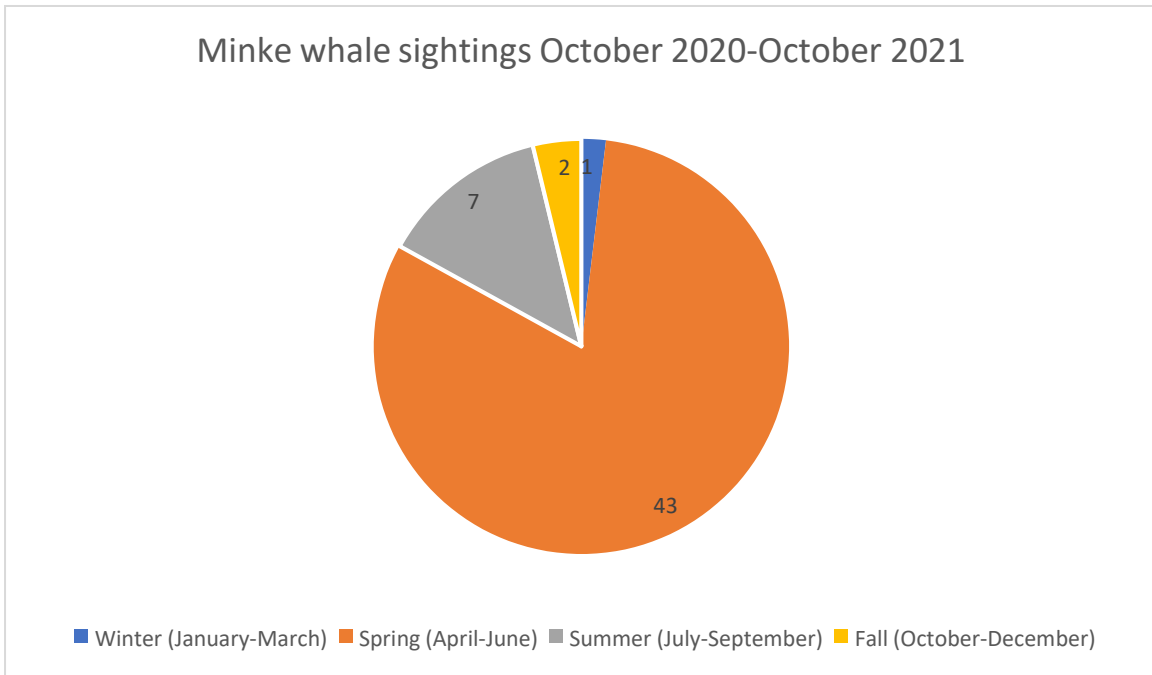


Table 8: Recorded minke whale sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021 (data from IWDG Sightings Database)..

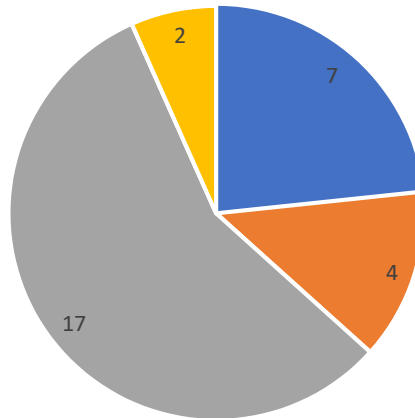


Plate 8: Minke whale. Image from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018)

Fin whale (*Balaenoptera physalus*)

Fin whales forage from June to February off the south coast of Ireland, generally moving eastwards over the season. The high level of site fidelity and inter-annual occurrence of individuals along the southern Irish coast indicate that these inshore waters are an important foraging habitat for fin whales (Whooley *et al.* 2011).

Fin whale sightings October 2020-October 2021



■ Winter (January-March) ■ Spring (April-June) ■ Summer (July-September) ■ Fall (October-December)

Table 9: Recorded fin whales sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021 (data from IWDG Sightings Database).



Plate 9: Fin whale. Fin whale. Image from National Biodiversity Data Centre (NWPS National Biodiversity Data Centre 2018).

Humpback whale (*Megaptera novaeangliae*)

Humpback whales have been recorded in small numbers inshore off all coasts, with the majority of sightings occurring along the Cork coast (Berrow *et al.* 2002, 34). Singing individuals have been recorded between October and March moving south-westerly, suggesting that the offshore waters off

the west coast of Ireland are a migratory route (Charif *et al.* 2001; Charif & Clark 2009). There have been 18 sightings of humpback whales in the vicinity of Barryroe Well-K during the 12 months prior to geophysical works.

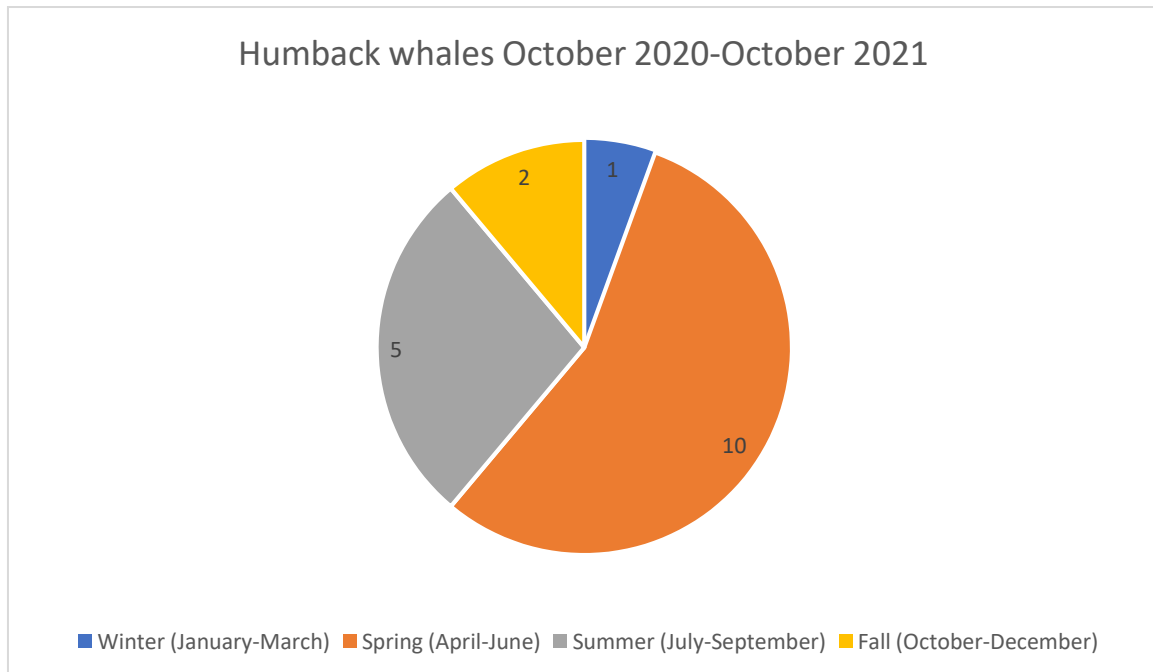


Table 10: Recorded humpback whale sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021 (data from IWDG Sightings Database).



Plate 10: Humpback whale. (Mizen 2018).

Basking Sharks (*Cetorhinus maximus*)

The basking shark is the second-largest shark in the world and is one of three plankton-eating species. Basking sharks are migratory and are present in Irish waters from April to September, often in shallow coastal habitats. Large groups are often sighted at 'hotspots' particularly in West Cork and Co Kerry (Irish Basking Shark Group, 2021). However there were 24 basking shark sightings in the vicinity of Barryroe Well-K in the 12 months prior to geophysical survey works, one of which was in the Kinsale Gas Field (Record ID37768).

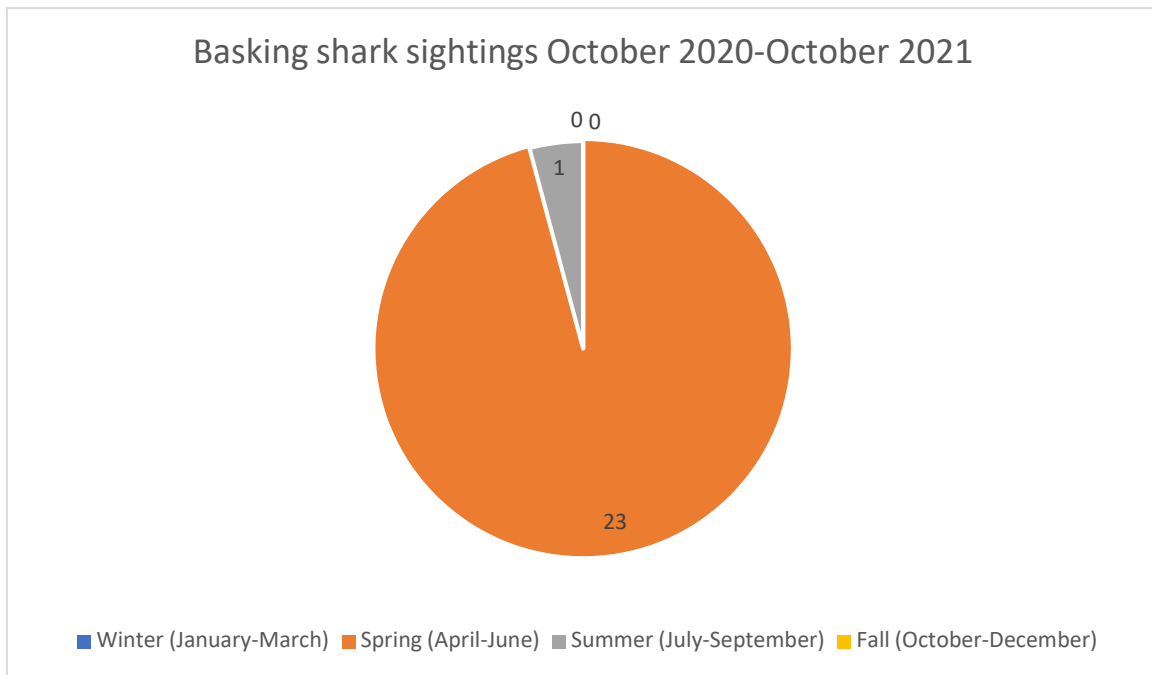


Table 11: Recorded basking shark sightings in vicinity of Barryroe Well-K under the period 20/10/2020-20/10/2021 (data from IWDG Sightings Database).



Plate 11: Basking shark (Photo by: Ireland's Wildlife Tours, 2013).

2.3 Details of Marine Mammal Observers

The observation was carried out by experienced JNCC marine mammal observer Caitlyn Haskins. Thomas Devaux remained on stand-by but his services were not required as the survey was completed in a shorter time than expected.

2.4 Platforms involved in the project

Research vessel *Celtic Voyager* operated by the Marine Institute was utilized for this survey.



Plate 12: RV Celtic Voyager (Marine Institute).

3. Details of the observation platform used for marine mammal monitoring

Monitoring took place from the bridge and from the working decks of the *Celtic Voyager*. The bridge has a height of 6.9m above the seabed and offered unimpeded views of the mitigation zone. The working deck is 4.4m above sea level and also offered unobstructed views of the mitigation zone.

4. Details of all sound-producing operations undertaken during the period of works

A total of 1 sound-producing operation took place from 25 October to 26 October 2021. The operations were carried out on a 24-hour basis. All monitoring took place during daylight hours. All operations commenced once a pre-watch of 30 minutes deemed the 500m mitigation zone clear of marine mammals. The MMO scanned the area by eye and 7x50 reticule binoculars. VHF radios were utilized to keep in contact with the survey crew. Full details of the operation can be found in Appendix II.

5. Details of monitoring watches conducted for marine mammals

A total of 2 hours and 50 minutes of monitoring effort was completed for the project. Of this, a total of 1 hour and 30 minutes of effort was conducted while survey operations produced sound. All remaining monitoring effort occurred prior to any operations starting. Full details of monitoring effort carried out during the project can be found in Appendix III.

Marine mammal observations were undertaken during all operations during daylight hours for the entire duration of the project. No operations were recorded as non-compliant.

Environmental data were recorded at the beginning and end of each watch, including sea state using the Beaufort scale, as well as wind directions and speed. All relevant forms were completed at the end of each working day as well as a detailed log of operations.

Monitoring conditions 25 October to 26 October 2021 were good.

Visibility was generally good during the project with the mitigation zone always clear for observation. High visibility (>5km) accounted for 100% of operations. Poor visibility was logged 0 times during geophysical operations.

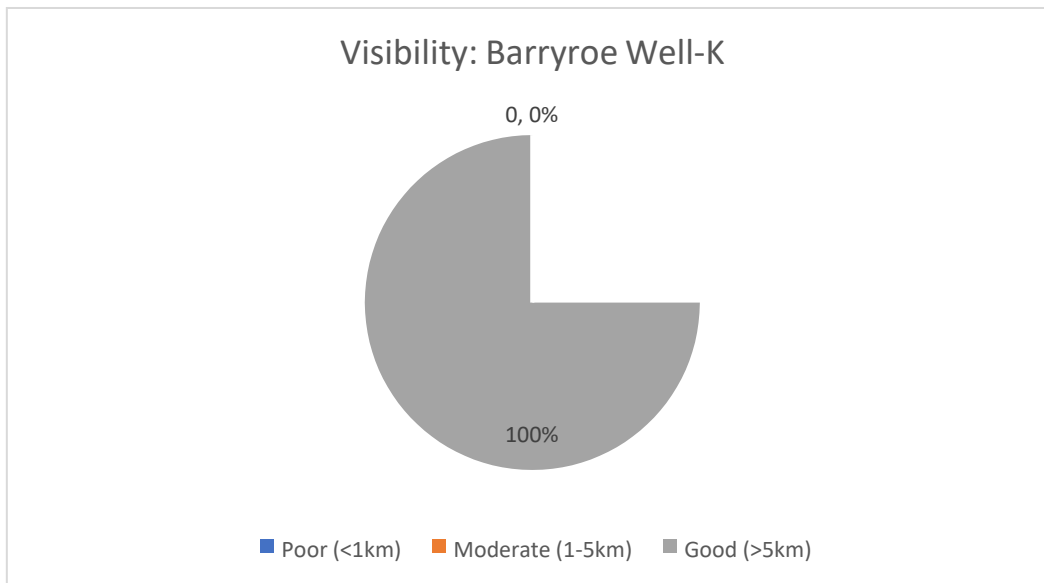


Table 12: Visibility during the period of works 25/10/2021-26/10/2021

Sea state was adequate for all of the observations during the project. All observations (100%) were carried out in a sea state of 4 with a moderate swell.

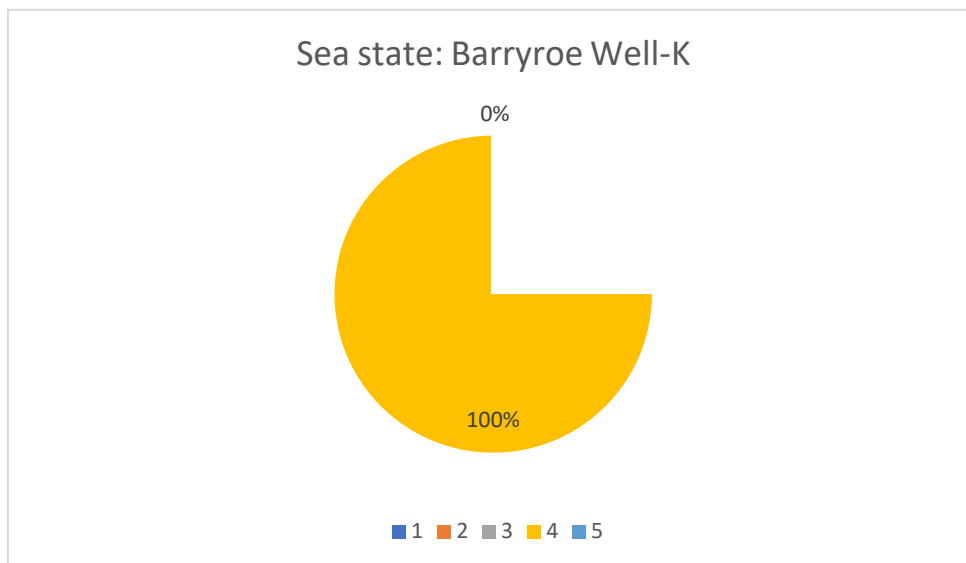


Table 13 Sea state during the period of works 24/10/2021-26/10/2021.

6. Details of all marine mammals sightings recorded

There was only one sighting of marine mammals during the geophysical survey operations. A bottlenose dolphin pod consisting of 5 individuals was sighted bow riding the vessel before operations could begin on 25 October. This sighting resulted in a delayed start of geophysical operations.

There were no other sightings during sound-producing activities. No further actions were required.

One incidental sighting of a pod of dolphins was recorded on 26 October, but operations had ceased and the *Celtic Voyager* was returning to port.

Geophysical survey operations were delayed once due to marine mammals sighted within the 500m mitigation zone. The incidental sighting was not in the mitigation zone and sound-production was at a stop, therefore no further action was necessary.

Species	Number of sightings	Number of individual sightings	Number of group sightings
Bottlenose dolphin	1	0	1
Dolphin, unidentified	1	0	1
TOTAL	2	0	2

Table 14: Sightings of marine mammal divided by individuals and groups.

Species	Sightings with mitigation zone	Sightings outside mitigation zone
Bottlenose dolphin	1	0
Dolphin, unidentified	0	1
TOTAL	1	1

Table 15: Sightings within and outside of the 500m mitigation zone.

Species	Sightings pre-start	Sightings operation at stop	Sightings operations ongoing	Incidental sightings
Bottlenose dolphin	1	0	0	0
Dolphin, unidentified	0	0	0	1
TOTAL	1	0	0	1

Table 16: Production of sound during sightings.

6.1 Details of all marine mammal sightings recorded during the monitoring watches

There was 1 sighting of marine mammals during the geophysical surveys at Barryroe Well K.

The single pre-watch sighting that occurred before geophysical operations was within the 500m mitigation zone and required a delayed start. There were no other sightings within the mitigation zone.

Species	Number of sightings	Number of individual sightings	Number of group sightings
Bottlenose dolphin	1	0	1
TOTAL	1	0	1

Table 17: Sightings of marine mammal during monitoring watches, divided by individuals and groups.

Species	Sightings with mitigation zone	Sightings outside mitigation zone
Bottlenose dolphin	1	0
TOTAL	1	0

Table 18: Sightings of marine mammals during monitoring watches, within and outside of the 500m mitigation zone.

Species	Sightings pre-start	Sightings operation at stop	Sightings operations ongoing	Incidental sightings
Bottlenose dolphin	1	0	0	0
TOTAL	1	0	0	1

Table 19: Production of sound during sightings during monitoring watches.

6.2 Details of all marine mammal sightings recorded outside of monitoring watches

(e.g., incidental observations), including records from additional personnel on board

There was 1 sighting of marine mammals outside of monitoring watches for geophysical survey operations. This sighting took place on 26 October after operations had ceased and the *Celtic Voyager* was returning to port. The pod of dolphins was far outside of the mitigation zone.

Species	Number of sightings	Number of individual sightings	Number of group sightings
Dolphin, unidentified	1	0	1
TOTAL	1	0	1

Table 20: Incidental sightings of marine mammals, divided by individuals and groups.

Species	Sightings with mitigation zone	Sightings outside mitigation zone
Dolphin, unidentified	0	1
TOTAL	0	1

Table 21: Incidental sightings of marine mammals within and outside of the 500m mitigation zone.

Species	Sightings pre-start	Sightings operation at stop	Sightings operations ongoing	Incidental sightings
Dolphin, unidentified	0	0	0	1
TOTAL	0	0	0	1

Table 22: Production of sound during incidental sightings.

7. Details of any problems encountered during marine mammal monitoring, start-up procedures, ramp-up (soft-start) procedures or during full scale operations

No problems affecting the MMO and the monitoring effort were encountered under the period 25 October to 26 October 2021.

8. Conclusions

A total of 2 hours and 50 minutes of monitoring effort was completed from 25 October to 26 October 2021. A total of 1 pre-start watches were carried out prior to geophysical survey operations.

Bottlenose dolphins were sighted once within the mitigation zone throughout the survey works. Another pod of dolphins were sighted incidentally 1 time outside of the mitigation zone after operations had ceased. A delayed start was required once.

Mizen Archaeology was engaged by the Marine Institute on behalf of its client, Exola DAC, to conduct Marine Mammal Observations for a shallow geophysical survey which also included a seabed environmental baseline and habitat assessment survey at the K well location on Barryroe in the Celtic Sea. Compliance with National Parks and Wildlife Service (NWPS) guidelines and project permit conditions was achieved for the site investigation works running between 25 October and 26 October 2021.

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Appendix I: Cover Sheet

Country	Ship/platform name	Client	Contract or	Survey type (site, 2D, 3D, 4D, OBC, VSP, etc.)	Start date	End date	Number of source vessels	Source depth (metres)	Frequency (Hz)	Intensity (dB re. 1µPa or bar metres)	Visual monitoring equipment used	Magnification of optical equipment	Height of eye (metres)	How was distance of animals estimated?	Number of dedicated MMOs	Training of MMOs	Was PAM used?
Ireland	Celtic Voyager	Providence Resources Ltd	HydroMaster LTD	other	25/10/2021	26/10/2021	1	60	455 and 800	200-240	Binoculars	350	4.7	b	1	i	n

Appendix II: Record of Operations/Activity

Ship/ platform name	Date	Reason for firing	Time soft start/ ramp-up began (UTC)	Time of full power (UTC)	Time of start of line (UTC)	Time of end of line (UTC)	Time pre-shooting search began (UTC)	Time search ended (UTC)	Was it day or night in the period prior to firing?	Was any mitigating action required?	Comments
Celtic Voyager	25/10/2021	x		9:15	9:15	5:51	7:55	9:15	d	y	Delay due to bottlenose dolphins bow riding

Appendix III: Record of Monitoring Effort

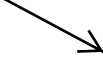
Ship/ platform name	Date	Visual watch or PAM?	Observer's / name	Time of start of watch (UTC)	Time of end of watch (UTC)	Start position - degrees latitude	Start position - minutes latitude	Start position - north/ south	Start position - degrees longitude	Start position - minutes longitude	Start position - east / west	Depth of water at start position (metres)	End position - degrees latitude	End position - minutes latitude	End position - north/ south	End position - degrees longitude	End position - minutes longitude	End position - east / west	Depth of water at end position (metres)	Speed of vessel (knots)	Source activity	Wind direction	Wind force (Beaufort)	Sea state	Swell	Visibility	Sun Glar e
Celtic Voyage	25/10 /2021	v	Caitlyn Haskins	7:5 5	9:1 5	51	12	n	8	14	w	80	51	11	n	8	11	w	90	6	f	var	4	4	m	g	s
Celtic Voyage	25/10 /2021	v	Caitlyn Haskins	12: 00	12: 30	51	13	n	8	14	w	82	51	12	n	8	11	w	86	6	f	var	4	4	m	g	s
Celtic Voyage	25/10 /2021	v	Caitlyn Haskins	13: 30	13: 45	51	12	n	8	14	w	88	51	11	n	8	11	w	82	6	f	var	4	4	m	g	s
Celtic Voyage	25/10 /2021	v	Caitlyn Haskins	14: 45	15: 00	51	13	n	8	14	w	81	51	12	n	8	11	w	90	6	f	var	4	4	m	g	s
Celtic Voyage	25/10 /2021	v	Caitlyn Haskins	15: 45	16: 00	51	12	n	8	14	w	90	51	11	n	8	12	w	87	6	f	var	4	4	m	g	s
Celtic Voyage	25/10 /2021	v	Caitlyn Haskins	16: 45	17: 00	51	12	n	8	14	w	87	51	12	n	8	11	w	89	6	f	var	4	4	m	g	s

Appendix IV: Sightings of marine mammals

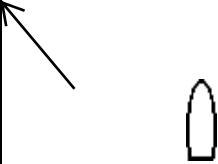
Sighting Number	Date	Time at start of encounter (UTC)	Time at end of encounter (UTC)	Were animals detected visually and/or acoustically?	How were the animals first detected?	Observer's/operator's name	Position - degrees latitude	Position - minutes latitude	Position - north/south	Position - degrees longitude	Position - minutes longitude	Position - east/west	Water depth (metres)	Species or species group	Description (visual sighting only)	Range of animal (metres)	Total number	Number of adults (visual sightings only)	Number of calves (visual sightings only)	Behavior (visual sightings only)	Direction of travel (relative to ship)	Direction of travel (compass points)	Air/un/sou rce activity when animals first detected	Air/un/sou rce activity when animals last detected	Time of closest approach (UTC)	What action was taken?	Length of power-down and/or shut-down (if relevant)
1	25/10/2021	8:08	8:35	v	v	Caitlyn Haskins	51	12	n	8	14	w	98	Bottlenose dolphin	Dark grey colour, dorsal fin half way along back, lighter belly	10	5	5	0	bow riding	c	var	n	n	8:20	d	30
2	26/10/2021	8:00	8:05	v	i	Caitlyn Haskins	51		n	8		w	87	Dolphin	Dolphin pod	800	8			jumping at surface	a	var	n	n	8:00	n	0

Appendix V: Sighting Forms

DATA FORM FOR COASTAL/MARINE WORKS - MARINE MAMMAL SIGHTING RECORDS*Options in italics should be circled or underlined as appropriate. Complete 1 record per sheet.*

Operation/Activity (please tick) Geophysical		Dredging <input type="checkbox"/>	Drilling <input type="checkbox"/>	Pile Driving <input type="checkbox"/>	Blasting <input type="checkbox"/>	Other (<input checked="" type="checkbox"/> fy)
Date (dd/mm/yyyy) 25/10/2021	Time (Local) 08:08	Time (GMT/UTC) 08:08		Sighting Record no. 1		
How did this sighting occur? (please tick)						
While you were keeping a continuous watch for marine mammals					<input checked="" type="checkbox"/>	
Spotted incidentally by you or someone else					<input type="checkbox"/>	
Other (please specify)					<input type="checkbox"/>	
Details:.....						
Platform type & name (e.g. ship, rig, headland) Celtic Voyager				Observer's name Caitlyn Haskins		
Observer's position (Latitude/Longitude or 6-figure Grid reference) 51°12 08°14				Water depth (metres) (if available) 98m		
Species recorded Tursiops truncatus (bottlenose dolphi)			Certainty of identification (underline) <i>Definite / probable / possible</i>			
Total number of animals (best estimate) 5		No. of adults 5	No. of juveniles	No. of calves		
Maximum number (estimated total) 7		Minimum number (estimated total) 5				
Description (include features such as overall size; shape of head; position, shape and size of dorsal fin; colour and patterning; height, direction, shape of blow) Dark grey colour Dorsal fin half way along back Lighter coloured belly 2.6m length				Photograph or video taken Yes / <u>No</u>		
				Direction of travel of animals in relation to platform/vessel (draw arrow) 		
Behaviour Bow riding				Direction of travel of animals (compass points or degrees) SW		
Activity of platform/vessel Geophysical surveys		Operation/activity under way (when animals first seen) <i>Yes / No / <u>Pre-Start watch</u></i>		Closest distance of animals from platform/vessel (metres) (Record even if not operating) 3m		

DATA FORM FOR COASTAL/MARINE WORKS - MARINE MAMMAL SIGHTING RECORDS*Options in italics should be circled or underlined as appropriate. Complete 1 record per sheet.*

Operation/Activity (please tick) Geophysical		Dredging <input type="checkbox"/>	Drilling <input type="checkbox"/>	Pile Driving <input type="checkbox"/>	Blasting <input type="checkbox"/>	Other (<input checked="" type="checkbox"/> fy)
Date (dd/mm/yyyy) 25/10/2021	Time (Local) 08:08	Time (GMT/UTC) 08:08		Sighting Record no. 1		
How did this sighting occur? (please tick)						
While you were keeping a continuous watch for marine mammals					<input checked="" type="checkbox"/>	
Spotted incidentally by you or someone else					<input type="checkbox"/>	
Other (please specify)					<input type="checkbox"/>	
Details:.....						
Platform type & name (e.g. ship, rig, headland) Celtic Voyager				Observer's name Caitlyn Haskins		
Observer's position (Latitude/Longitude or 6-figure Grid reference) 51°12 08°14				Water depth (metres) (if available) 98m		
Species recorded Tursiops truncatus (bottlenose dolphi)			Certainty of identification (underline) <i>Definite / probable / possible</i>			
Total number of animals (best estimate) 5		No. of adults 5	No. of juveniles	No. of calves		
Maximum number (estimated total) 7		Minimum number (estimated total) 5				
Description (include features such as overall size; shape of head; position, shape and size of dorsal fin; colour and patterning; height, direction, shape of blow) Dark grey colour Dorsal fin half way along back Lighter coloured belly 2.6m length				Photograph or video taken Yes / <u>No</u>		
				Direction of travel of animals in relation to platform/vessel (draw arrow) 		
Behaviour Bow riding				Direction of travel of animals (compass points or degrees) SW		
Activity of platform/vessel Geophysical surveys		Operation/activity under way (when animals first seen) <i>Yes / <u>No</u> / Pre-Start watch</i>		Closest distance of animals from platform/vessel (metres) (Record even if not operating) 3m		