MARA
An tÚdarás Rialála Limistéir Mhuirí
Maritime Area Regulatory Authority

NOVEMBER 2025

AN ASSESSMENT OF CURRENT PRACTICE AND BEST PRACTICE FOR MARINE MAMMAL OBSERVATIONS AND BIRD RECORDING DURING LICENSABLE ACTIVITIES AT SEA

This report has been prepared by:

Irish Whale and Dolphin Group (IWDG) on behalf of the IWDG Research Team on contract to the Maritime Area Regulatory Authority (MARA) as part of MARA's Improving Compliance Series.

Authors:

Jack O'Callaghan

Hannah Keogh

Mareike Volkenandt

Simon Berrow

Irish Whale and Dolphin Group

The purpose of this study is to address any gaps in *observation – recording – responding – reporting* associated with licence conditions relating to mammal observations and bird recording for which MARA has responsibility. It contains a review of existing guidance for both mammals and birds, and an analysis of the data/information received by MARA for a sample of licences for marine mammal observations. The relevant licences were determined under either the Maritime Area Planning Act (2021) as amended, or the Foreshore Act (1933) as amended.

About MARA

Since establishment, 17 July 2023, the Maritime Area Regulatory Authority (MARA) acts as custodian and regulator of Ireland's maritime area.

The establishment of MARA represents one of the most important maritime governance reforms in the history of the Irish State. It marks a significant milestone in Ireland's efforts to establish a robust, transparent and fit-for-purpose system for the governance of Ireland's vast and diverse maritime area.

As an independent regulatory agency, MARA is tasked with implementing the Maritime Area Planning (MAP) Act 2021, as amended – a transformative piece of legislation that places sustainable marine planning and development at the heart of national policy. Its functions are set out in Acts 2021 and 2022, including:

- Assessing Maritime Area Consent (MAC) applications for the maritime area, which are required by developers before development permission can be granted.
- Determining Maritime Usage Licence (MUL) applications for specified activities.
- Compliance and enforcement of MACs, licences and offshore development consents.
- Investigations and prosecutions.
- Administration of the existing Foreshore consent portfolio.
- Fostering & promoting co-operation between regulators of the maritime area.

Improving Compliance

MARA's Compliance and Enforcement activity supports the continued development and operation of a robust compliance monitoring and enforcement regime.

The target outcomes compliance and enforcement policy are:

- a culture of compliance amongst regulated entities.
- effective and efficient compliance monitoring and enforcement activities that are focussed on providing the greatest overall benefit to the public, users of the maritime space and the state, on whose behalf MARA regulates.
- enforcement actions that deliver a proportionate deterrent against noncompliance or unauthorised activities or development.
- compliance monitoring and enforcement activities that represent value in protecting the public interest.

About this Report

This report serves as a record of work commissioned by MARA to inform MARA's work in improving compliance with conditions of authorisations where MARA has compliance assessment and enforcement responsibility. However, the views and recommendations presented in this report are not necessarily those of MARA and should, therefore, not be attributed to MARA.

Publication date: November 2025

Contractor: Irish Whale and Dolphin Group

Recommended citation: O'Callaghan, J., Keogh, H., Volkenandt, M., Berrow, S., (2025). An assessment of current practice for marine mammal observations and bird recording during licensable activities at sea. MARA Improving Compliance Report No. "001".

Contents

Scope

This study is a desk-based review of marine mammal and seabird monitoring, mitigation, and reporting practice for licenced activity where MARA has responsibility. The information/data associated with specific licence conditions is analysed for 10 licences where marine mammal observations were required. The licences were determined either under the Foreshore Act 1933 as amended or the Maritime Area Planning Act 2021 as amended. The study analyses the survey data, field notes, records and reports, held by MARA to identify:

- Whether the data collected is accurately reflected in final reports submitted,
- Whether the actions taken (such as by vessel operators) are in-keeping with observations/recommendations made by observers and associated guidance/conditions of licence, and
- Any barriers and opportunities to enhancing the information collated, its communication to operators and licence holders to ensure appropriate responses by operators.

The analysis is supported by a review of current guidance available nationally and internationally in the area of *observing - recording - responding – reporting* for marine mammals and birds and provides a series of recommendations to improve practice including communications and operational aspects that may pose a barrier while carrying out activities at sea under such licences.

Executive Summary and Table of Recommendations

This desk-based study provides a review of marine mammal and seabird monitoring, mitigation, and reporting practices associated with the conditions of licences for which MARA has responsibility. This includes activities (permitted maritime usages) licensed by MARA under the Maritime Area Planning Act 2021 and activities previously licensed by the Department of Environment, Climate and Communications as foreshore licences under the Foreshore Act 1933 as amended. MARA has a compliance assessment and enforcement role for such licences.

During the operational stage of these licensed activities, robust monitoring, response, and recording systems are required.

This review was commissioned by MARA to;

- Identify national and international guidance for monitoring, responding and recording during licensable activities for marine mammals and birds,
- Provide an analysis of current practice relating to marine mammal observations for a sample of licences (across licence holders, vessel operators and surveyors and associated reporting), and
- Provide recommendations for improving compliance by licence holders.

This report is structured in three parts:

Part 1: Summary of National and International Guidance

This part of the report provides a summary of existing national and international guidance on marine mammal and seabird monitoring and mitigation with a focus on the *observing, recording, responding and reporting* protocols.

The activities covered by guidance available include dredging, drilling, pile driving, geophysical acoustic surveys, and blasting. It summarises guidance available from Ireland, the UK, Germany, and the Netherlands whilst referencing other countries.

This part of the study underpins recommendations made in Part 3 to address areas for improvement identified in Part 2.

The findings identify that while direct comparison with other countries is not easy there are similarities in approaches/protocols that exist. Keeping up to date with new technologies/methodologies for surveys and incorporating this into guidance can be challenging without reviews, and there is evidence of the use of web-based and centralised systems for collation of data. Opportunities are identified to take on existing practice used elsewhere such as the use of trained observers, the need for research into mitigation effectiveness, and the existing gap in guidance available to triggering response/actions based on bird observations during licensed activities at sea.

Part 2: Analysis of Submitted Data and Reports

The report identifies the gaps or learnings in carrying-out the *observing, recording, responding and reporting* requirements of licence conditions for marine mammals. It provides an analysis of a sample of MMO reports and data submitted to MARA by licence holders in Ireland relating to marine mammals. Along with Part 1, this analysis will inform recommendations made in Part 3.

The sampled licences were issued between 2020 and 2025 and were determined under either the Foreshore Act 1933 or under the Maritime Area Planning Act 2021. The licensed activities in the sample included hydrographic and seismic survey operations, laying of a cables, geophysical and geotechnical surveys, and drilling/cone penetration test (CPT)/vibrocoring activities.

The criteria assessed were:

- Whether the data collected is accurately reflected in the final reports submitted.
- Whether the actions taken (such as by vessel operators) were in keeping with the observations and recommendations made by Marine Mammal Observer(s)
- What barriers and opportunities exist to enhance the quality of the data collected and improve the communication of that information from observers to licence holders and vessel operators, to ensure more appropriate and timely responses during offshore operations.

Criteria were scored for performance on a five-point scale from Very Poor (1), Poor (2), Moderate (3), Good (4), and Excellent (5).

Findings identify that the majority of scores were Good to Excellent, there was one score of 2 (Poor), that Moderate scores was recorded in three of the ten licence returns sampled and that these cut across the three Criteria. In all cases, opportunities for better performance were identified. These included addressing gaps in communication, format of recording, ensuring a complete record of monitoring and reporting, potential errors due to manual transcribing, the need for a shared understanding of protocols between crew/operators and MMOs, the recording rationales for decision-making.

Licence number	***1***	***2***	***3***	***4***	***5,6,7***	***8***	***9***	***10***
Criteria 1 *Data accuracy & report*	5	2	5	5	4	5	5	5
Criteria 2 *Action v Recommendations*	4	5	4	5	5	4	3	5
Criteria 3 *Barriers & opportunities for data and communications*	4	4	3	4	4	4	3	4

Part 3: Recommendations

The final section pulls together findings from Parts 1 and 2 and to provide practical, evidence-based recommendations for addressing the identified learnings in carrying-out the *observing, recording, responding and reporting* requirements of licence conditions for marine mammals and birds.

A total of 29 recommendations are made to address gaps identified and include available guidance and practice. A number of these apply to both mammals and birds, and they include:

1. Practical measures to be developed for license holders and observer/recorders
2. Specified requirements of individual authorisations
3. National level measures to be progressed

Table of Recommendations

Marine mammals	Standardised Data Collection and Central Reporting
	Recommendation 1: To develop **a single standardised MMO recording template**.
	Recommendation 2: To develop a Centralised **MMO database**.
	Recommendation 3: To develop a **Web-based submission system**.
	Evidence-Based Mitigation Measures
	Recommendation 4: To require operators to **perform Noise Propagation Studies** prior to noisy activities and tailor mitigation zones.
	Recommendation 5: To support **research into mitigation efficacy**.
	Recommendation 6: To develop **an adaptive management approach**.
	Recommendation 7: To require licence holders to engage **at least two MMOs for visual watches** (rotating to prevent fatigue).
	Recommendation 8: To require a **Passive Acoustic Monitoring Officer (PAMO) when 24-hour operations** are required.
	Observer Training and Qualification Standards
	Recommendation 9: To develop framework for **training MMOs that emphasises verified mitigation experience** and field competence, based on JNCC accreditation.
	Continuous Improvement and Adaptive Management
	Recommendation 10: To develop a **mechanism to audit and analyse** MMO reports periodically to identify lessons learned.
	Recommendation 11: To require the **submission of raw observation data** with associated quality checks.
	Clear and Enforceable Licence Conditions
	Recommendation 12: To specify **monitoring effort** (how many observers, hours), mitigation actions and identify overlap with monitoring for other authorisations.
	Inclusive of All Relevant Activities
	Recommendation 13: To ensure **all relevant geophysical and geotechnical tools** are considered so that no high-risk activity “falls through the cracks”.

Seabirds	Precautionary Spatial/Temporal Measures
	Recommendation 14: To incorporate **precautionary exclusions** where appropriate (depending on nature, scale and risks).
	Robust Monitoring (Duration and Extent)
	Recommendation 15: To ensure a **link between the robust baseline data and ongoing surveys/recording during activities**.
	Modern Survey Methods (Boat, Aerial, and Remote Sensing)
	Recommendation 16: To require the use of **best-available survey technologies.**
	Avoiding Data Gaps – Weather and Seasonal Coverage
	Recommendation 17: To require **supplementary surveys** ensuring that key periods are not missed.
	Mitigation of Disturbance and Collision Risks
	Recommendation 18: To require **species-specific mitigation protocols** avoiding breeding, over-wintering, and migration seasons, and avoiding known aggregations. **Recommendation 19:** To ensure vessel operators and /or observers ar**e trained to avoid rafting seabirds**. **Recommendation 20:** To require **bird 'friendly' light management plan** during offshore activities to safeguard nocturnal bird migration. **Recommendation 21:** To require a **bird incident log** – documenting any stranded or collision events – and report these to the regulator.
	Qualified Observers and Protocols for Birds
	Recommendation 22: To establish ***Guidance for seabird monitoring and response reporting during activities at sea***. **Recommendation 23**: To make national guidance available by authorities in a transparent manner and, ideally, in multiple languages. **Recommendation 24:** To ensure guidance integrates seabird mitigation principles, drawing from UK (ESAS) or OSPAR frameworks **Recommendation 25:** To compile a **comprehensive literature review of the most current scientific research and knowledge on seabird interactions** with on-going activities and mitigations to inform the development of a best-practice.
	Data Integration and Sharing
	Recommendation 26: To require a **Bird Monitoring and Mitigation Protocol** where a license overlaps or is in proximity to sensitive bird populations (such as SPAs or in high-risk seasons). **Recommendation 27:** To ensure collected data informs **adaptive management measures** - where significant disturbance is detected, regulators may impose additional mitigation requirements, such as temporary suspension of activities or the establishment of enhanced buffer zones. **Recommendation 28:** To require seabird data to be reported in a consistent, standardised format and subjected to periodic quality assurance checks. **Recommendation 29:** To develop a **centralised database** to store seabird monitoring data collected in-situ by observers, with access provided to relevant stakeholders.

Part 1. Summary of National and International Guidance

Introduction

This section of the report summarises national and international guidance. It focuses on implementing observing, recording, responding and responding measures across offshore activities—specifically dredging, drilling, pile driving, geophysical acoustic surveys, and blasting.

The expansion of offshore and coastal industrial activity, particularly geophysical surveys, dredging, and renewable energy infrastructure has raised increasing concern over the impact of anthropogenic activity on marine mammals and seabirds. Such activities include: noise, habitat disturbance, ship collision, and displacement. Marine mammal species rely heavily on sound for essential life functions such as communication, navigation, foraging, and predator avoidance (Richardson et al., 1995; Southall et al., 2007). The proliferation of impulsive and continuous noise sources in marine environments has been linked to behavioural disturbance, auditory injury, habitat displacement, and in extreme cases, strandings and mortality (Nowacek et al., 2007; Weilgart, 2007).

In response to these risks, Ireland has previously established guidance for mitigating the effects of underwater noise primarily articulated in the National Parks and Wildlife Service (NPWS) "Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters" (*NPWS, 2014*). This guidance outlines a set of protocols for the observation, recording, and response to marine mammals during sound-generating activities, with Marine Mammal Observers (MMOs) playing a central operational role. Key elements of this guidance include pre-activity visual monitoring, soft-start procedures, shutdown protocols, and standardised recording templates. These mitigation measures aim to prevent injury and reduce behavioural disturbance to sensitive species, particularly within 500–1000 metre mitigation zones.

Unlike some other jurisdictions—most notably the UK—Ireland does not yet maintain a centralised MMO data repository, nor does it mandate the use of Passive Acoustic Monitoring (PAM) for night-time operations or poor visibility conditions (*JNCC, 2017; Berrow et al., 2018*). While the Irish approach is precautionary and aligned with EU legal requirements, including the Habitats Directive (92/43/EEC) and the Marine Strategy Framework Directive (2008/56/EC), it continues to evolve in response to scientific developments and policy drivers, particularly in the context of offshore wind expansion.

Supplementary guidance from the Department of Communications, Climate Action and Environment (*DCCAE, 2018*) that is specific to Offshore Renewable Energy, has emphasised the need for more robust ecological baseline data, improved monitoring consistency, and cumulative impact assessment methodologies. These

enhancements, drawn partly from European best practice or guidance (e.g. OSPAR, 2022; NOAA, 2018), are critical as Ireland scales up offshore development in areas supporting protected species including interests of protected sites (Special Protection Areas and Special Areas of Conservation) as well as areas inhabited by multiple Annex IV cetacean species, including harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), and various migratory baleen whales.

Marine Mammals

Ireland

Ireland's national guidance on managing the impact of underwater sound on marine mammals, published in 2014 by the Department of Arts, Heritage and the Gaeltacht (now under the National Parks and Wildlife Service), provides a structured and precautionary approach to mitigation. The guidance is centred on three core areas of action: observing, recording, and responding. These are applied proportionally across a range of offshore activities that may produce harmful levels of underwater noise or physical disturbance.

The five primary activity types identified in the guidance are dredging, drilling, pile driving, geophysical acoustic surveys, and blasting. Each presents a unique acoustic and ecological risk profile, and Ireland's mitigation practices are adapted accordingly.

1. Observing

Observation in Irish waters must be conducted by dedicated, qualified Marine Mammal Observers (MMOs), trained through recognised programmes (often JNCC-accredited) and with documented field experience. Observations are visual in nature, conducted from elevated platforms aboard operational vessels, with a clear, unobstructed view of the sea surface within a 500-metre mitigation zone.

In the context of dredging, MMOs are required to undertake pre-start monitoring for a minimum of 30 minutes to ensure that no marine mammals are present in the vicinity. While dredging is typically classified as a lower-risk acoustic activity compared to impulsive sources, it can still pose significant disturbance in areas of ecological sensitivity, such as Special Areas of Conservation (SACs) or known habitats for protected species. If marine mammals are detected within the monitoring zone prior to commencement, dredging must be postponed until the area is confirmed clear.

For drilling operations, particularly those using airlift or percussive drilling systems, similar pre-start visual monitoring is required. This becomes critical when equipment is driven by pneumatic or impact-based systems, which produce moderate acoustic energy. Observation continues during operations, with MMOs maintaining vigilance to detect any marine mammals entering the mitigation zone.

Pile driving, which produces high-intensity impulsive noise, demands more stringent observing procedures. A pre-start watch of at least 30 minutes is required, and the MMO must have a clear 360-degree view of the exclusion zone. Due to the power of pile-driving activities, visual monitoring remains active throughout operations, with particular focus on detecting marine mammals prior to and during the ramp-up period.

Observation platforms must allow the MMO to view the full radius of the exclusion zone without obstruction.

Geophysical acoustic surveys, such as seismic reflection and sub-bottom profiling, require MMOs to monitor the area visually for 30 minutes in shallow waters and up to 60 minutes in deeper waters prior to any sound-producing activity. These operations may extend over long periods and are often conducted over large spatial scales, necessitating sustained, focused observation across multiple days or weeks. Observation must be continuous, particularly during soft-start periods and transitions between survey lines.

Blasting is considered the highest-risk activity in terms of acoustic impact. It may involve single, high-intensity events with the potential to cause physical harm to nearby marine mammals. MMOs must conduct extended observation before any explosive event—typically exceeding the standard 30-minute watch—and maintain constant surveillance throughout the preparation and detonation phase. Due to the high stakes, MMOs must confirm the exclusion zone is entirely free of marine mammals before proceeding.

2. Recording

Recording forms a vital part of MMO responsibilities in all activity types. Accurate data collection enables regulators to evaluate project compliance and helps inform ongoing conservation efforts and policy development. MMOs must maintain comprehensive logs covering three main categories: effort logs, sighting logs, and mitigation action records.

For dredging and drilling, where operations may continue over extended periods, effort and sighting logs provide an important record of marine mammal presence, absence, and behaviour throughout the works. Though these activities are not as acoustically intense as pile driving or blasting, the documentation is equally important in assessing cumulative impact and demonstrating adherence to condition requirements.

In pile-driving operations, MMOs must record any delays or pauses caused by marine mammal presence, including timestamps and distances, species observed, environmental conditions (sea state, visibility), and observer location. These data are essential not only for understanding animal responses but also for verifying whether soft-start procedures were correctly followed.

During geophysical acoustic surveys, the scope and duration of data logging increases due to the complexity and scale of operations. MMOs must log acoustic parameters (e.g. airgun volume, shot intervals), pre-start watch durations, and animal sighting data across all survey lines. Standardised templates provided in the Irish guidance

(Appendices 6 and 7) ensure that data are consistent and suitable for submission to the NPWS.

In the case of blasting, the documentation becomes even more critical. Pre-blast and post-blast reports must include detailed observations, verification of clearance from marine mammals, and a full log of mitigation actions. If any marine mammal is detected within or near the mitigation zone during the observation period, the blast must be delayed, and this decision must be clearly recorded.

In all cases, MMOs are required to use precise tools—such as reticle binoculars and range-finding sticks—to estimate distances and bearings, and to record these alongside other environmental data.

3. Responding

Response actions form the core of the mitigation guidance. The Irish guidance mandates a graduated and activity-specific set of interventions designed to minimise the likelihood of injury or significant behavioural disturbance to marine mammals.

Dredging, the response protocol is relatively straightforward. If a marine mammal is sighted within the 500m mitigation zone during the 30-minute pre-start observation period, the start of dredging must be delayed until the animal is no longer detected and a full watch period has passed without sightings. Although ramp-up is not required, dredging must proceed cautiously, especially in conservation areas or near known seal haul-out sites.

Drilling operations, depending on their intensity, follow similar response steps. If percussive or air-driven drilling is planned and marine mammals are detected in the mitigation zone, the start of activity must be delayed until a full 30-minute clearance is confirmed. Drilling that involves rotary or low-impact methods may be exempt from strict mitigation, but the MMO can intervene if animals are present or if local guidance requires it.

Pile driving, due to its high risk of causing both auditory injury and disturbance, is subject to more advanced response requirements. If marine mammals are detected during the pre-start watch or the soft-start (ramp-up) phase, the activity must be delayed or shut down immediately. The ramp-up phase, lasting at least 20 minutes, must begin at the lowest practicable power level and increase gradually, giving animals time to leave the area. If ramp-up is paused for more than 30 minutes, a full pre-start watch must be repeated.

In geophysical acoustic surveys, soft-start procedures are also mandatory and closely tied to the presence of marine mammals. If any animals are observed within the 500m zone during pre-start or soft-start, the survey must be postponed. Unlike in the UK,

where continued ramp-up may be allowed under certain conditions, Ireland requires strict adherence to the mitigation zone clearance before and during sound initiation.

Blasting, given the potential for lethal injury, follows the strictest mitigation approach. The area must be cleared of marine mammals using extended visual and acoustic monitoring. If any marine mammal is present within or near the exclusion zone, the operation must be postponed. Passive Acoustic Monitoring (PAM) is strongly recommended, especially in poor visibility conditions or if operations are conducted outside of daylight hours. In cases of high uncertainty, the NPWS may require additional buffer zones or the use of aerial or boat-based surveys to confirm animal absence.

This activity-specific approach demonstrates the flexibility and rigour of Ireland's marine mammal mitigation guidance. By tailoring monitoring, recording, and response strategies to the risk profiles of different offshore activities, the Irish system provides a precautionary yet practical method of safeguarding marine biodiversity. It also reflects Ireland's obligations under the EU Habitats Directive and the Marine Strategy Framework Directive.

Summary

Ireland's guidance adopts a strongly precautionary approach, placing emphasis on avoiding injury or significant disturbance by requiring rigorous pre-start monitoring and full clearance of marine mammals from a defined mitigation zone. The requirement for a soft-start (ramp-up) and a strict 30–60 minute pre-watch shows a genuine effort to protect sensitive species — particularly in waters rich with protected cetaceans and seals. The guidance clearly outlines who is responsible (e.g., dedicated MMOs), when actions are required, and how long to wait — all of which make it relatively easy to follow and enforce. Activities such as pile driving, blasting, and seismic work are well covered, with tailored mitigation depending on acoustic risk level. The guidance is explicitly written to align with Ireland's legal obligations under the EU Habitats Directive, the Marine Strategy Framework Directive, and associated EIA requirements — giving it both ecological legitimacy and regulatory weight. MMOs must have formal training and recent European field experience, helping ensure that mitigation is implemented by skilled professionals rather than untrained personnel. This improves both the quality of observations and the credibility of reporting.

While PAM is referenced, it is not treated as a fully integrated or standardised mitigation tool. The document does not mandate PAM use for night-time operations or poor visibility, even though visual-only monitoring is limited under such conditions. As a result, night-time or poor-weather mitigation is potentially compromised unless operators choose to go beyond the minimum requirements. MMO data is to be submitted to the relevant authority, but there is no central database or public repository

for MMO reports. This contrasts with the UK's JNCC, which maintains a multi-decade database of marine mammal observations that informs policy, research, and impact assessments. Ireland is therefore missing an opportunity to track cumulative impacts or identify spatial trends in marine mammal distribution.

The guidance focuses exclusively on marine mammals, with no specific recommendations or requirements for seabird monitoring, deterrence, or response actions.

While the document outlines what should be done, it is less clear on who enforces or assesses compliance, how data is audited, or what penalties exist for breaches. This could result in inconsistent application across operators or projects. Acoustic science, mitigation technology (especially PAM and real-time acoustic modelling), and international standards have evolved since 2014. Without regular updates, there is a risk that the document becomes outdated or less aligned with emerging best practices, particularly in the context of expanding offshore wind and cumulative impact assessments.

Ireland's 2014 guidance remains a solid, precautionary foundation for managing marine mammal risk, especially for underwater noise impacts from seismic, piling, and blasting operations. Its clarity, alignment with EU law, and commitment to using trained MMOs all reflect good practice and demonstrates a clear precautionary ethic. It is grounded in good scientific principles, integrates legal obligations, and places emphasis on observation quality and direct response.

To maintain its relevance and effectiveness, the guidance would benefit from greater integration with real-time acoustic detection tools, more flexible adaptive measures, and enhanced transparency and management of MMO data, in particular; enhanced integration of PAM, greater data transparency, inclusion of seabirds, stronger enforcement structures and regular updates to reflect technological and ecological advancements.

Table 1: Summary

Category	Strengths	Limitations
Observing	Decent standards for MMO qualifications and experience. Strong visual protocols.	Limited guidance on PAM use. MMO should require a field test (like ESAS). Guidance is needed on what constitutes a marine mammal survey for experience to be gauged.
Recording	Comprehensive and standardised reporting templates. Use of appropriate tools for data accuracy.	No national database or long-term data-sharing framework. Limited feedback loop for data use.
Responding	Precautionary approach with clear rules for shutdowns, delays, and soft-starts.	Limited flexibility for adaptive mitigation or risk-based decision-making where appropriate.
Overall Accessibility	Well-structured and accessible document. Activity-specific guidance is helpful.	More detail on implementation support, training frameworks, and compliance auditing would be useful.

United Kingdom

The United Kingdom (UK), through the Joint Nature Conservation Committee (JNCC), has established a structured and widely emulated framework for Marine Mammal Observers (MMOs) that has been in place for nearly three decades. This approach forms part of the UK's strategy to meet its obligations under the Habitats Regulations, the Marine Strategy Framework Directive, and other domestic environmental legislation.

At its core, the UK system views MMOs as an essential safeguard against acoustic injury and disturbance to cetaceans during licensed offshore operations. The MMO's role is operational and independent: to monitor for marine mammals, implement mitigation procedures, and record all activity in compliance with JNCC guidelines. Their role applies across a range of activities that introduce impulsive or intense sound into the marine environment, with tailored mitigation measures depending on the source type.

While the JNCC guidelines apply UK-wide, the legal obligations and implementation vary slightly between England (via the Marine Management Organisation), Scotland (Marine Scotland), Wales (Natural Resources Wales), and Northern Ireland (DAERA), but they share a common foundation.

Below is a detailed description of how the MMO role is implemented in the UK context, using the core thematic headings and activity types.

1. Observing

Pile Driving

For pile driving, which produces high-energy impulsive sound, MMOs must be present on site and are required to conduct a minimum 30-minute pre-piling watch. Observation must be conducted from a dedicated platform with a full view of the mitigation zone, generally 500 metres or more depending on the project-specific risk assessment. If conditions allow, a larger buffer may be applied.

Observation is visual and carried out using standard methods: naked eye scanning, binoculars, and reticle optics to estimate range and bearing. While there are no strict restrictions on weather or sea state, best practice recommends observation be carried out in sea states ≤ 4, and preferably ≤ 3 for species like harbour porpoise. Pile driving operations may continue in higher sea states if Passive Acoustic Monitoring (PAM) is available and functioning.

Dredging

JNCC guidance does not impose standalone MMO requirements for dredging unless it is conducted in or near sensitive conservation areas, or in combination with higher-risk activities. In such cases, MMOs may be required to monitor for disturbance rather than injury thresholds, and a less formal effort-based approach may be used. Observational practices mirror those used in piling and surveys when required.

Blasting

For explosive activities, the observing requirements are stringent. MMOs must visually monitor the mitigation zone — which may be up to 1 km or more depending on the expected range of sound propagation — for a minimum of 60 minutes before detonation. The guidelines also support the use of air-based or vessel-based MMOs, and observation often includes a coordinated effort using multiple observers across platforms.

Geophysical Surveys

In geophysical surveys, such as those using airguns, boomers, or sparkers, MMOs must begin a 30-minute pre-shoot watch prior to the start of any acoustic source. Visual monitoring is conducted throughout survey operations. Observing is typically limited to daylight hours, though PAM is often used to extend mitigation into night-time or low-visibility conditions. The 500m mitigation zone applies unless risk assessments prescribe larger zones (e.g. for deep-diving species or large-volume airgun arrays).

2. Recording

In the UK, MMOs are required to complete standardised recording forms developed by JNCC. These include:

- Effort Logs: Recording time spent observing, visibility, sea state, location, and vessel activity
- Sightings Logs: Recording species observed, group size, behaviour, location, and distance
- Mitigation Logs: Documenting any mitigation actions taken (e.g., shutdowns, delays, ramp-ups)

This process applies across all activities and is consistent nationwide. Observers are expected to submit a post-activity report to JNCC and/or the relevant licensing authority. These reports are collated and contribute to the UK's long-term dataset on marine mammal observations during offshore operations — a dataset comprising over 37,000 individual marine mammal sightings between 1995 and 2020.

In the context of pile driving, blasting, and geophysical surveys, recording is especially detailed and must include specifics about the acoustic source: e.g., hammer energy or airgun volume, timing, ramp-up duration, and interruptions. For dredging, recording requirements are more situational and depend on the level of acoustic risk and the presence of sensitive receptors.

3. Responding

The UK's mitigation actions are tiered by activity type and risk level. The MMO's primary responsibility is to implement these mitigation measures based on real-time observations or acoustic detections.

Pile Driving

If a marine mammal is observed within the mitigation zone during the pre-piling watch, the activity must be delayed until no animals are sighted for a full 30 minutes. Once clear, the pile-driving process must begin with a soft-start (ramp-up) of at least 20 minutes, gradually increasing intensity. Notably, if an animal is detected during ramp-

up, the UK guidance allows discretion — a full shutdown is not always required if there is no significant injury risk, which contrasts with stricter Irish rules.

Dredging

Mitigation for dredging is typically implemented only when operations occur near designated protected sites, and responses tend to be more informal. Where required, operations may be paused or adjusted if animals are repeatedly disturbed, but there is no formal shutdown requirement unless linked to other risk-triggering activities.

Blasting

Mitigation for blasting is robust and multilayered. If a marine mammal is observed in the mitigation zone, the detonation must be delayed until the area is clear for a full 60 minutes. If conditions prevent clear visual confirmation, PAM is recommended, and the guidance may suggest use of multiple MMO teams or aerial surveys depending on blast size and risk zone.

The JNCC guidelines also encourage the use of bubble curtains, double detonation planning, or seasonal timing to reduce environmental risk.

Geophysical Surveys

If marine mammals are detected during the 30-minute pre-shoot watch, the survey must be delayed. Once clear, ramp-up begins. As with piling, ramp-up must last at least 20 minutes. Importantly, if animals are detected during the ramp-up phase, the JNCC guidelines do not always require an immediate shutdown, especially if the mitigation zone is large and the animal is not at risk of injury. This more flexible, risk-based model reflects the UK's confidence in PAM and real-time decision-making.

Summary

The UK's marine mammal mitigation framework, guided by the Joint Nature Conservation Committee (JNCC), is widely recognised for its depth of experience, structured approach, and extensive data infrastructure. The UK benefits from nearly three decades of MMO protocol refinement and a well-established database of over 37,000 marine mammal observations, allowing it to iteratively improve policy based on empirical evidence. The JNCC guidance provides detailed operational requirements for pile driving, geophysical surveys, and explosive use, while also allowing a level of flexibility based on risk context and acoustic exposure modelling.

One of the key elements of the UK framework is its pragmatic, risk-based application of mitigation measures. It supports night-time operations and higher sea state activity through the formal integration of Passive Acoustic Monitoring (PAM), which is often used as a primary tool in low-visibility conditions. The UK's ability to dynamically adapt

to real-time environmental and operational factors makes it particularly suitable for large-scale offshore energy projects.

The system's flexibility can, in some cases, reduce the precautionary nature of mitigation—especially where PAM is relied upon in lieu of visual monitoring or where ramp-up procedures continue despite animal detections. However, some marine mammals won't be picked up on PAM which automatically omits some species from mitigation. Additionally, while data is centrally stored, it is not always publicly accessible, and there is limited emphasis on baseline ecological studies during pre-consent phases compared to newer EU frameworks. The guidance also lacks robust guidance for dredging activities unless they are combined with more intense sound sources or situated near protected sites.

Table 2: Summary of UK JNCC Marine Mammal Guidance

Category	Strengths	Limitations
Observing	Long-standing MMO protocols; formal integration of PAM for night-time and poor visibility operations; adaptive approach across sea states.	May allow continuation of activities during detections under some conditions; variability in field interpretation.
Recording	Use of standardised JNCC forms; centralised national MMO data repository; enables cumulative impact tracking and trend analysis.	Limited public access to data; no mandated requirement for ecological baseline surveys pre-consent.
Responding	Risk-based and context-sensitive responses; soft-starts and ramp-ups tailored to sound exposure levels; strong use of PAM.	Some risk tolerance in protocols (e.g., continuing ramp-up if animals present); precaution sometimes deprioritised.
Overall Accessibility	Comprehensive, widely adopted guidance documents; detailed activity-specific protocols; adaptive for offshore energy needs, often updated.	Dredging and lower-risk activities less consistently covered; reliance on PAM as primary method introduces gaps.

Germany

In Germany, various authorities are responsible for the approval of offshore projects. Within the 12-nautical-mile zone, i.e. the territorial sea, responsibility lies with the respective federal states. In this context, there is close coordination with other relevant bodies, such as the Federal Agency for Nature Conservation (BfN). Beyond the territorial sea, in the German Exclusive Economic Zone (EEZ), the Federal Maritime and Hydrographic Agency (BSH) acts as the central permitting authority.

The following section describes the measures for the protection of marine mammals within the German EEZ i.e., under the responsibility of the BSH.

In Germany, the harbour porpoise (*Phocoena phocoena*) is regarded as an indigenous marine mammal species. Consequently, conservation efforts within the German EEZ are primarily directed towards this species. While other marine mammals, such as the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*), also inhabit German waters regularly, no species-specific conservation measures have been formally established for them. As a result, existing protective frameworks largely concentrate on the harbour porpoise.

To ensure the protection of harbour porpoises, the BSH implemented the provisions of the Noise Mitigation Concept. It aims to minimise the impact of anthropogenic underwater noise on harbour porpoises and primarily addresses noise generated during offshore construction activities, such as pile driving for wind turbines, which can cause significant disturbance or harm to marine mammals. The Noise Mitigation Concept has been in effect since 2013.

Key elements of the Noise Mitigation Concept include:

- Soft Start Procedures: To reduce sudden noise impacts, pile driving and other impulsive noise-generating operations begin gradually, allowing marine mammals to move away from the area before noise levels reach harmful intensities.
- Exclusion Zones: Defined safety zones established around construction sites, within which noisy activities are halted or postponed if harbour porpoises are detected, minimising the risk of injury.
- Use of Noise Mitigation Technologies: Technologies such as bubble curtains are employed to dampen underwater noise emissions during pile driving.
- Post-construction Monitoring: Continued monitoring after construction ensures that mitigation measures were effective and helps gather data on the recovery of marine mammal populations.

- Adaptive Management: The concept includes provisions for updating and adjusting mitigation measures based on monitoring results, scientific research, and technological advancements.

In addition, general regulations apply to the approval of offshore projects. All offshore wind farms, cable routes, and other structures located within the German EEZ require approval from the BSH in accordance with the Offshore Installations Ordinance ("Seeanlagenverordnung", SeeAnlV). The legal framework is provided by the Wind Energy at Sea Act ("Windenergie-auf-See-Gesetz", WindSeeG).

Environmental impacts must be assessed for a range of ecological components, including marine mammals, seabirds, fish fauna, biotopes, and sediments. As part of the Environmental Impact Assessment (EIA), the BSH evaluates whether the legal requirements of national and European environmental law—particularly those related to species protection, habitat conservation, and nature protection—can be met. A key element in this context is the implementation of noise mitigation measures during construction activities, especially pile driving, in accordance with the above-mentioned Noise Mitigation Concept. Disturbance of protected species must be avoided.

Extensive monitoring measures are required before, during, and after construction. These include acoustic monitoring and visual surveys, typically carried out over a period of approximately three to five years. The results must be submitted to the BSH and, if applicable, to the Federal Agency for Nature Conservation (BfN). Stricter conditions apply in or near Natura 2000 sites. In these areas, a compatibility assessment in accordance with the Habitats Directive (FFH Directive) is mandatory.

Furthermore, offshore projects must be spatially compatible, meaning they must not significantly interfere with other uses such as shipping, fisheries, or military activities. For this purpose, the BSH has designated specific areas for offshore wind farms within its spatial planning framework. Development of offshore wind farms is permitted only within these areas. For other types of projects, such as geophysical surveys, spatial compatibility must be demonstrated within the permit application documents.

1. Observing

The environmental investigations described below are carried out in accordance with the requirements of the "Standard for the Environmental Impact Assessment of Offshore Wind Turbines on the Marine Environment" (currently "StUK4"). These standard investigations primarily apply to the construction of offshore wind farms and their associated converter platforms. Typically, data collection for both elements is conducted simultaneously, or the same baseline data is used for both project components.

In general, investigations must be conducted on fish fauna, sediments, seabirds, and marine mammals. Depending on the geographical location of the study area, bat surveys may also be required. The scope of the investigations is determined by the BSH within a project-specific framework ("Untersuchungsrahmen"), which must be implemented and financed by the project developer.

For offshore wind farms, a so-called baseline survey must be carried out over a period of two years prior to construction. This is followed by construction phase monitoring, which is subject to its own investigation framework. After construction is completed, operational monitoring is conducted for approximately three years in order to detect any potential adverse environmental impacts.

As a rule, seabirds and marine mammals are recorded simultaneously during visual ship-based surveys conducted along predefined transects. These vessel-based surveys are to be carried out monthly under suitable sea conditions (sea state < 4 Beaufort) and must cover at least 10% of the total study area. The width of each transect and the distance between transects are specified in the project-specific investigation framework.

In addition to ship-based surveys, the study area is also monitored via digital aerial transect surveys. Between 10 and 12 flights are conducted per year, i.e., almost monthly. A well-established method involves using video camera systems mounted on aircraft, followed by post-flight analysis to identify and count seabirds and marine mammals. Environmental conditions for valid data collection (e.g., sea state, visibility, limits on glare) are defined in the StUK4 standard. Deviations from these requirements may be specified by the BSH in a project-specific investigation framework.

Furthermore, acoustic monitoring of harbour porpoises is carried out using passive acoustic devices (PODs). During the baseline survey phase, PODs are deployed at predefined positions throughout the study area. The number of PODs depends on the size of the area. In addition, approximately ten long-term monitoring stations exist, which should be used by project developers whenever feasible. Further stations may be designated as necessary.

During the construction phase, a denser network of PODs is deployed and remains in place throughout the entire construction period. In addition, mobile PODs are positioned at 750 m and 1500 m distances from the pile-driving location during each foundation installation event. During the operational monitoring phase, PODs are redeployed either at the same positions used in the baseline survey or according to a newly developed sampling design.

Thus, marine mammals are typically monitored using both acoustic and visual methods, including ship-based and aerial transect surveys. A comparable investigation

framework may be applied to other offshore projects, where deemed appropriate and scientifically justified.

For projects whose primary impact involves sound emissions, such as geophysical surveys using sonar, the provisions of the noise protection concept apply. It must be ensured—e.g., through sound propagation modelling—that no more than 10% of the total area of the EEZ, or 10% of the area of Natura 2000 sites designated for the protection of harbour porpoises, is exposed to noise levels exceeding 160 dB SEL. A general assumption based on typical sound propagation in the North Sea states that a disturbance radius of 8 km forms around the sound source if the threshold of 160 dB SEL can be met at a distance of 750 m. Therefore, many permit documents assume a disturbance radius of 8 km and assess what proportion of harbour porpoises might be impacted within this radius.

It must also be ensured, through appropriate measures—such as soft starts, deterrent measures, or the use of MMOs — that neither individual harbour porpoises, nor the porpoise population as a whole, are harmed. Harm is assumed to occur if harbour porpoises are present near the sound source and the prescribed noise threshold of 160 dB SEL in 750 m distance is not observed.

The procedures follow and apply the guidelines of the JNCC. That means an MMO ensures that no harbour porpoises are present near the sound source. If porpoises are still detected after a soft start and deterrent measures have been implemented, the activity must be temporarily halted. In cases of poor weather conditions or when operations are conducted in darkness, passive acoustic monitoring (PAM) may be used as an alternative. However, the specific measures to be applied are determined during the permitting process.

For geophysical investigations, the BSH is not automatically responsible — responsibility may also lie with the State Office for Mining, Energy and Geology (LBEG), depending on the project and location.

2. Recording

How survey data for projects in the German EEZ must be collected is also specified in the investigation framework. This is again based on the above-mentioned Standard for the Environmental Impact Assessment of Offshore Wind Turbines on the Marine Environment" ("StUK4"). For each protected asset (seabirds, marine mammals, bats, fish fauna, etc.), it outlines which data must be collected and what must be evaluated.

The data are generally not collected by the project developer themselves, but rather by commissioned environmental consultancies. These consultancies organise the transect surveys and ensure that all personnel possess the necessary safety

certifications for working at sea. Additionally, they are responsible for procuring the materials needed for data collection, such as PODs and deterrent devices.

Data collection methods vary depending on the contracted environmental consultancy. In some cases, sightings are recorded directly using a tablet, while in others handwritten logs are used. The data are subsequently processed back at the office. Upon completion of all surveys — or on an annual basis — the data are submitted to both the BSH and the project developer. The BSH prescribes a specific format in which the data must be submitted. These data are then entered into a BSH-maintained, non-public database. This database can be used by the BSH to conduct cross-project analyses and to establish a data basis for the environmental report that is compiled every three years as part of the site development plan.

Environmental parameters (such as weather, sea state, position, etc.) are recorded along with the actual sightings. For acoustic monitoring, it is also documented when the POD used was last calibrated and during which time periods it was actively recording. The information collected does not differ significantly from the Irish procedure described above. Similar to the JNCC procedure, effort logs, sighting logs and mitigation logs are recorded. In addition, during construction work, the technical details of pile driving operations (pile-driving energy, start and end times of the soft start and deterrence measures, achieved noise levels, etc.) are documented.

The following provides examples from “StUK4” on how the data should be analysed. As mentioned previously, the various survey data sheets serve as the basis for these analyses.

Representation of occurrence:

- Sighting rate (= sightings per effective transect length) over the course of the year (per flight or monthly data on relative abundance).
- Number of animals per km^2 over the course of the year (per flight or monthly data on absolute abundance)
- Group size (monthly data on individual animals and mother/calf pairs) over the course of the year.
- Rough behavioural characterisation (swimming direction, behaviours, associations).
- (Statistical) representation of changes in occurrence over the study period (baseline – construction phase – operational phase, before-after design).

Representation of distribution:

- Distribution of sighted animals and their changes using point maps (per flight or summarised monthly).

- Relative abundance and distribution of sighted animals and their changes using monthly or seasonal grid density maps (absolute abundance provisionally).
- Anthropogenic influences, such as noise-intensive construction activities, must be included in the analyses.
- Construction- and maintenance-related vessel and helicopter movements must be documented and considered using available AIS data (AIS, GPS, VMS).

Representation of POD data:

- Habitat use (frequency and duration of presence) is evaluated based on porpoise-positive days, hours, 10-minute intervals, and minutes (i.e., days/hours/10-minute intervals/minutes with recorded porpoise vocalisations).
- Individual presentation of habitat use (e.g., daily rhythm (ppm/hour)) and seasonal use (pp10m/day) for each POD station and each individual POD position, as well as spatial and temporal comparisons between positions. During the baseline survey, the presentation of daily rhythm should be omitted.
- Presentation of the waiting time during noise-intensive construction activities.

3. Responding

The German regulatory framework is designed to minimise the need for intervention. This means that the comprehensive permitting process is intended to ensure that marine mammals are not negatively affected by a project. The protection of marine mammals lies in the application of deterrent measures and noise reduction measures in order to comply with the maximum permissible noise levels. If this cannot be guaranteed, first of all there will be legal consequences:

- Violation of species protection laws: Harbour porpoises are strictly protected under the German Federal Nature Conservation Act (BNatSchG) and European directives such as the Habitats Directive (FFH Directive). Injuring or killing individuals may be considered a violation of these laws.
- Fines and criminal proceedings: Responsible parties may face fines or criminal prosecution.
- Review and adjustment of the permit: The BSH may review, restrict, or even suspend the project's permit if protection requirements are not met.

In addition, project-specific consequences may follow:

- Enhanced protective measures: Additional or stricter noise mitigation measures may be required (e.g., use of bubble curtains, temporary construction halts).
- Delays or interruptions of construction work: To prevent further harm, temporal restrictions or work stoppages during sensitive periods may be imposed.

- Increased monitoring: Intensive monitoring before, during, and after construction may be mandated to better assess potential impacts.

Reporting incidents to both the BSH and the BfN is mandatory, to coordinate and document appropriate measures.

In the case of geophysical surveys, immediate responses are possible. MMOs on board have the possibility to interrupt seismic surveys if marine mammals are detected in a risk zone. This is a direct protective measure for marine mammals. The additional legal and project-specific consequences described above focus on punishing the project developer and thereby resemble a more general protection of marine mammals, rather than safeguarding individual animals.

Summary

The key aspect of the monitoring process lies in the consistent adherence to StuK 4. This ensures a standardised approach for all major projects within the German EEZ. As a result, the data are more comparable across projects and provide a unified basis for broader studies. The same applies to the methods of data collection and analysis. In developing StuK 4, expert input was gathered from numerous environmental planning consultancies, meaning that the practitioners were directly involved in the process. In addition, representatives from established universities, authorities, and conservation organisations contributed to its development. This has led to broad acceptance of the content of StuK 4. Regional particularities can then be addressed in a subsequent step within the scope of the investigation framework.

The long monitoring periods provide, across the entire German EEZ, a comprehensive picture of the ecological status quo. By conducting surveys before, during, and after the construction phase of a project, both short-term changes and long-term impacts can be examined—especially when these data are compared with existing data from other projects in the same region.

This standardised approach also provides planning security for the project developer, as it is clear from an early stage what must be investigated in principle. This allows the developer to plan funding and allocate resources for the required surveys well in advance. In addition, it is communicated transparently what measures are necessary to protect marine mammals and to comply with nature conservation regulations.

In addition, the Noise Mitigation Concept provides a scientifically sound and comparable guideline for defining disturbance to harbour porpoises. This enables a cross-project, neutral approach to the protection of marine mammals and helps determine which protective measures (particularly deterrent measures and noise reduction measures) are necessary.

The weaknesses of the German system lie in the lengthy and complex permitting processes. In many cases, planning is highly project-specific. This is particularly evident in the determination of the number and positioning of PODs. Even when all available project data are used, this often leads to statistical difficulties when attempting to combine and evaluate all datasets (see Brandt et al. 2018 and GESCHA II report).

Although the basic concept of StuK is generally positive, it is now outdated (published in 2013) and should be revised. For example, it still recommends outdated PODs and deterrent devices. Furthermore, it contains no statements regarding standardised training levels for field surveyors. The assessment of a surveyor's ability to monitor marine fauna at sea is left to the discretion of the environmental planning consultancies. It is not required that specific qualifications (e.g., number of surveys conducted or similar experience) be listed. The verification of qualifications occurs only through the project developer's selection of the consultancy.

Furthermore, marine mammal protection primarily focuses on the harbour porpoise. As it is the only native species and the most scientific data on the effects of noise exposure are available for this species, this approach is understandable. However, other dolphin species are occasionally sighted, as well as minke whales or juvenile baleen whales in the North and Baltic Seas. For these species, no additional threshold values have been established.

Similarly, in the case of seals, the noise limits set for harbour porpoises are applied, even though seals have a different hearing range. The assessment of the need for protective measures in these cases is the responsibility of the commissioned environmental consultancy or, in the context of the permitting process, the respective authority.

The regulations primarily apply to the expansion of renewable energy in the form of offshore wind farms and associated converter platforms. The permitting process for the corresponding cable routes is already well established. However, the applicability of these regulations to newer types of projects, such as the construction of energy islands or similar innovations, still needs to be assessed. To do so, the impact factors of these projects must first be defined, to then evaluate whether the existing monitoring concept is sufficient to detect and mitigate potential environmental effects.

In summary, rules for the protection of harbour porpoises in the German EEZ were established at an early stage and are now so well established: firstly, comparability between projects is ensured and secondly, unnecessary debates about the necessity of such measures are avoided. It can be said that the protection of harbour porpoises follows a business-as-usual principle, based on scientific studies.

The required surveys are also clearly regulated, providing a high degree of reliability in the investigations. Through requirements set out in the investigation framework, regional specificities can also be addressed. The focus is on area-based protection and the simultaneous monitoring of multiple conservation features.

The German system could be further improved by defining qualification standards for surveyors, expanding protection measures to include other marine mammal species, and updating or reviewing the methodological approach laid out in StuK.

Table 3: Summary of German Marine Mammal Guidance

Category	Strengths	Limitations
Observing	Cross-project, neutral, and scientifically sound assessment standards for the disturbance of harbour porpoises.	Lack of up-to-date standards, especially regarding modern equipment; partly incomplete time series due to reductions in POD stations or non-monthly monitoring.
Recording	Use of standardised forms; centralised national data repository; enables cumulative impact tracking and trend analysis.	Limited public access to data or long-term data-sharing framework.
Responding	Precautionary approach with clear rules for porpoise protection as well as for shutdowns, delays, and soft-starts via the JNCC standard.	Limited flexibility for adaptive mitigation; possible consequences for non-adherence with the rules occur with a time delay or only after legal proceedings.
Overall Accessibility	Scientifically sound approach with clear rules; universally applicable regulations for the monitoring of various protected assets, not just marine mammals; precautionary approach to the protection of marine mammals to prevent harm through predefined measures.	Limited possibilities to adjust protection measures for marine mammals in acute situations; in some cases not specific enough, e.g., regarding requirements for survey personnel; applicability to other types of projects (beyond wind farms or seismic surveys) is only limited.

Other European countries

In addition to the UK and Germany, several other countries border the North Sea. Given the similarities in marine environments and the applicability of common European Directives, it is reasonable to extend the analysis beyond national borders to explore guidance for marine mammal protection in these countries.

However, in many cases it was not possible to find the necessary information with the same level of detail.

The following section presents the information found for Denmark and the Netherlands.

Denmark employs guidance that closely resembles the one in place in Germany. Similar to Germany, the protection of harbour porpoises is a central focus in Danish offshore projects. The approval of offshore projects must comply with both national legislation (such as the Nature Protection Act) and European -law including the EU Marine Strategy Framework Directive and the Habitats Directive (92/43/EEC). Accordingly, all offshore projects are required to undergo a comprehensive Environmental Impact Assessment.

The Environmental Impact Assessment includes statements on the necessary protection measures for marine mammals, particularly with regard to noise mitigation. It also outlines the requirements for adhering Danish guidelines on underwater noise. The Danish Energy Agency (DEA) issued specific guidelines on underwater noise from offshore activities, particularly pile driving during the construction of wind farms. The guidelines emphasise the need for noise mitigation measures when prognosis indicates potential exceedances of established thresholds. These measures can include technical solutions like noise mitigation systems (e.g., bubble curtains) or operational adjustments to reduce noise levels.

Thus, similar topics are addressed as in the German Noise Mitigation Concept. However, differences arise in the calculation of the disturbance zone. While the German concept assumes a general disturbance threshold at 160 dB SEL in 750 m distance, Denmark applies an auditory frequency-weighted assessment. Therefore, the Environmental Impact Assessment must include detailed information on sound propagation and technical specifications. Tougaard and Mikaelsen (2024) conducted a comparison of the German and Danish approaches to underwater noise protection. Their analysis showed that the German approach generally applies a larger protection zone than what would be necessary under the auditory frequency-weighted method. Furthermore, the Danish concept incorporates the early displacement of animals, factoring in their natural flight distance when calculating the required protection zone.

In the published Danish Environmental Impact Assessments, it is generally stated that the guidelines on underwater noise are being followed. The guidelines require proof of

the achieved noise levels. However, no information can be found regarding the specific, i.e. recorded, form in which this proof of marine mammal protection must be documented and submitted to the authorities. Additionally, no details could be found on the extent to which direct, responding mitigation measures — beyond standard noise reduction measures — are implemented.

In **the Netherlands**, national and international laws and regulations also apply, making an Environmental Impact Assessment necessary. However, detailed information on regulations concerning the protection of marine mammals in offshore projects could not be found. The Netherlands do not have uniformly established national noise limits for underwater noise Instead, the country primarily follows international and European guidelines and standards, which are applied and implemented in practice (e.g. from OSPAR or ASCOBANS).

The authority in the Netherlands responsible for the approval of offshore projects is Rijkswaterstaat, an agency under the Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat). Rijkswaterstaat is responsible for the planning, approval, monitoring, and regulation of offshore projects in Dutch waters. Standard noise mitigation measures (i.e. soft start, bubble curtains, acoustic deterrent devices) are also employed in the Netherlands and are required by the permitting authority. In some cases, reference is made to the noise limit of 160 dB at a distance of 750 meters, following the German standard and the construction period should be limited. No details could be found on the extent to which direct, responding mitigation measures — beyond standard noise reduction measures — are implemented.

Seabirds

Currently, there is little established guidance for minimising impacts on seabirds *during* licensable activities to address the need for observing – recording-responding-reporting.

National and international guidance has been and continues to be developed to inform developers and regulators in the assessment and consenting processes, which are included below as general guidance for monitoring and recording marine ornithology as they use relevant approaches and technologies.

In particular, two issues arise in the consideration of avoiding impacts:

- Cumulative impacts on seabirds from the Marine Renewable Energy (MRE) sector, as well as localised impacts across Ireland and the UK are of increasing concern. These impacts include collision mortality, displacement, barrier effects, and indirect effects on prey species. While national and international mitigation guidelines exist for marine mammals during construction and operational phases of activities, outlined as licence conditions, there is comparatively no guidance for seabirds during these phases.
- Seabird mitigation typically follows a mitigation hierarchy, beginning with spatial planning measures to avoid or prevent risk. Most mitigation efforts are implemented during the development and design phase, where tools such as Collision Risk Modelling (CRM), Encounter Rate Modelling (ERM), Before-After Gradient (BAG) or Before-After-Control-Impact (BACI) analyses, and other statistical models informed by site-specific baseline surveys are applied prior to construction. However, measures aimed at reducing displacement and barrier effects are less frequently addressed (Greenhill et al., 2021). Compensation measures are considered a last resort and are implemented only in cases where derogation is required.

United Kingdom

Observing

JNCC certified ESAS (European Seabirds at Sea) training is used as an industry standard. Experienced surveyors are assessed by JNCC accredited ESAS instructors and have met five key standards of data collection. These are: bird identification, visual acuity, application of the methods, recording stamina and navigation. Currently (May 2025), there are no JNCC accredited ESAS instructors offering training in the UK or Ireland due to the move away from boat-based surveys towards Digital Aerial Surveying (DAS) for large scale projects.

Recording

ESAS/VSAS Methodology

The ESAS database was established in 1991 to consolidate seabird "at sea" datasets from across Europe. It contains over three million records of seabirds, cetaceans, pinnipeds, and other marine megafauna from the waters of Northwest Europe and the North Atlantic, making it one of the largest databases of its kind in the world. Data has been collected and contributed by the ten European countries that form the ESAS partnership. Formerly hosted by the JNCC, the database is now maintained as part of the Dutch Offshore Wind Ecological Programme (WOZEP). In 2022, ESAS data were migrated to the ICES platform, which now supports data submission by partners and provides users with options to download or request data via https://esas-docs.ices.dk/.

The ESASd (Tasker et al. 1984; Webb and Durinck 1992; Camphuysen et al. 2004) is the most widely used approach for modern ship-based surveys of seabirds at sea. ESAS data are collected during aerial or ship-based surveys and compiled into an international database using a standardised method that enables the derivation of georeferenced seabird population densities. The method is designed to allow surveyors to record multiple parameters simultaneously, such as plumage, moult phase, calendar year, behaviour, observation conditions, and distance to observed individuals. Based on a strip transect model, where birds are sampled along a fixed distance up to 300 meters from the vessel, forming a rectangular survey area, this approach provides consistent spatial coverage. Observations within this strip are further categorised into predefined distance bands, allowing birds seen on the water to be assigned to the band in which they were first detected. The ESAS standards were originally described for boat-based survey data but are also applicable for the results from digital aerial surveys.

Responding

Some guidelines for licensable activities in the UK include bird mitigation protocols, such as Natural Resources Wales *Detailed Guidance for Seaweed Hand Harvesting*, which emphasises the importance of avoiding disturbance to sensitive species when accessing or utilising the shoreline. Seabirds and shore-birds are particularly susceptible to disturbance during the breeding season (March to July) and in areas where overwintering occurs (October to March). A generous distance should be maintained at all times, and activity should cease immediately if a bird exhibits signs of distress. The guidance also advises against approaching aggregations of seals hauled out on rocks, especially during the pupping season. A minimum distance of 100 metres must be maintained from all seals at all times.

Project operators in the UK follow the *Wildlife Safe Scheme* (WISE), implementing additional measures to minimise disturbance to marine mammals and rafting birds from transiting vessels, during all authorised construction, operations, and maintenance activities where feasible.

Scotland

NatureScot provides a series of guidance notes available under *Advice on Marine Renewables Development – Marine Ornithology*. These guidance notes will take stakeholders and developers through each step of the Environmental Impact Assessment (EIA) and Habitats Regulations Appraisal (HRA) processes to guide provision of the supporting information required to inform and support an application. As well as *Guidance to support Offshore Wind Applications: Advice for Marine Ornithology Baseline Characterisation Surveys and Reporting*, where prior to any surveys being undertaken the survey methodology should be agreed with NatureScot. Who currently accept the use of data up to 5 years old (prior to submission date). Beyond this the relevance of the dataset reduces (due to environmental variations and change).

Digital Aerial Survey(s)

Aerial surveys, utilising either still or video imagery, capture both the sea surface and the airspace between the water and the aircraft. For environmental assessments and monitoring of offshore wind farms, digital aerial surveys (DAS) typically sample 10–20% of the relevant sea surface area. Several factors can influence the quality and usefulness of DAS results. These include the type of camera technology used (still vs. video), survey altitude, sampling design (e.g., grid or transect layout and proportion of area covered), post-survey image identification processes, and subsequent data analysis techniques, such as interpolation or modelling (NatureScot, 2023). Due to factors such as the increasing distance of proposed wind farm sites from the shore, DAS has become the preferred method for collecting this type of data.

England

Natural England have produced a series of documents providing guidance on the use of data and evidence to support offshore wind development and cable projects in English waters. A major change in offshore wind post-consent monitoring for seabirds has been moving away from the standard model of 3 years pre- and 3 years post-construction surveys, and towards objective, hypothesis-driven approaches aimed at addressing key uncertainties and evidence gaps identified in the Development Consent Order (DCO) process. Natural England advises that all seabird baseline characterisation surveys should use DAS methodology as standard. Abundance and density estimates used to assess change can be generated through either a design-based or model-based analysis of the survey data (Buckland et al. 2012). If boat-based surveys are used for baseline characterisation, surveys should be transect-based, following the European Seabirds at Sea (ESAS) methodology, as outlined by the *Collaborative Offshore Wind Research into the Environment* (COWRIE) report (Camphuysen et al., 2004).

Germany

Observing

The Standard for Environmental Impact Assessments (StUK4) (BSH, 2013) provides a framework outlining the current thematic and technical minimum requirements for marine environmental surveys and monitoring. All personnel involved in these surveys must possess appropriate qualifications and expertise, which must be verifiable. The names of all observers must be recorded on the survey forms, and both the content and implementation of observer instructions must be documented. Surveys of seabirds and marine mammals may only be conducted by teams that have undergone intensive training in transect count methodology, following the principles established by Garthe et al. (2002).

Recording

The following assessment periods apply to all projects, unless alternative requirements are specified in technical guidelines for particular conservation features (BSH, 2013):

- **Survey Scope**
  Surveys must include foraging, moulting, and resting birds, as well as migratory birds and flight call recordings. These are to be conducted during the baseline study, construction phase, and operational phase using a variety of methods, including ship and aircraft transects, radar surveys (vertical and surveillance), visual observations, and acoustic monitoring.
- **Baseline Study**
  The baseline study must span two successive, complete seasonal cycles. If more than two years elapse between the completion of the baseline study and the start of construction, a third year of surveys must be added. If more than five years pass, a new, complete two-year baseline study is required. These surveys should capture bird movements such as migration, foraging, and commuting between feeding and roosting areas.
- **Construction Phase Monitoring**
  This phase covers the entire period from the start of construction to its completion. Monitoring must be continuous and comply with specified requirements. It should assess the effects of built structures, including avoidance behaviour and attraction incidents.
- **Operational Phase Monitoring**
  Monitoring during operation must be conducted over a period of three to five years, depending on site-specific conditions and conservation priorities. The goal is to verify assumptions made during the EIA, including potential behavioural changes such as displacement or attraction.

Where multiple construction sites or projects occur in close geographical or temporal proximity, surveys should be conducted jointly as cluster studies. These surveys must be coordinated among all parties involved, and data collation must be ensured.

Ireland

Observing

The Department of Communications, Climate Action and Environment's *Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects Part 1 and Part 2* provides technical guidance for the baseline data requirements and monitoring necessary to evaluate potential environmental impacts of offshore renewable energy projects in the marine area. JNCC certified ESAS training is used as an industry standard as presented in Camphuysen et.al. 2004. This guidance has been adapted from the standard ESAS method, to include flight height assessment and modifications for the recording of divers and sea ducks. The ESAS method has not been subject to any further adaptations specifically for wave and tidal energy development.

Recording

Pre-construction baseline survey methods and post-construction monitoring methods should take account of long- and short-term effects of MRE on bird populations. Annual monitoring may be required for up to 3 years post consent, then again in year 5, 10 and 15. Aside from general guidance there is no standard survey method for shore-based bird surveys in tidal passes or near shore waters.

- **Pre-construction Baseline Monitoring**
  Aerial (digital or visual) or ship surveys, and use of remote monitoring technologies. Land based surveys are appropriate where the development footprint lies within 2km of the shore, otherwise offshore surveys are required. Up to three years of baseline data may need to be collected. Where long-term surveys are required, they should be temporally distributed across seasons, tide and time of day, as appropriate and should be monthly where possible.

- **Post-construction Monitoring**

  Methods similar to pre-construction monitoring- include remote monitoring techniques such as radar, thermal animal detection devices, altimeters, GPS, and satellite telemetry, as well as the monitoring of collision events or micro-avoidance behaviour. The appropriate level of survey effort for monitoring may be guided by baseline survey results, which identify species presence, abundance, vulnerability, and potential interactions. Additionally, survey intensity should be sufficient to detect changes in target species or species groups, particularly those that are vulnerable or of high conservation concern.

Greenland

Observing

Marine Mammal and Seabird Observers (MMSOs) aboard seismic vessels operating in Greenlandic waters are responsible for three main tasks:

1. **Marine Mammal Monitoring and Mitigation**
   MMSOs must actively monitor for the presence of marine mammals and implement mitigation measures as required.
2. **Seabird and Marine Mammal Surveys**
   MMSOs are also tasked with collecting data on the abundance and distribution of seabirds and marine mammals using systematic line transect surveys in accordance with distance sampling procedures. This survey task is not secondary to marine mammal monitoring- both responsibilities require significant effort and attention.
3. **Passive Acoustic Monitoring (PAM)**
   MMSOs are required to operate the onboard PAM system. At least two MMSOs must be certified PAM operators. It is now mandatory to have a minimum of two MMSOs onboard for each survey.

MMSOs must be highly skilled in species identification and capable of maintaining vigilance during extended observation periods.

Recording

To ensure the accurate analysis of seabird and marine mammal abundance and distribution, standardised survey methods and data recording practices are essential. *The Manual for Seabird and Marine Mammal Survey on Seismic Vessels in Greenland* (Johansen et al., 2015) provides guidance based on ESAS methodology. It references foundational work by Tasker et al. (1984), Webb and Durinck (1992), and Camphuysen et al. (2004) for general procedures. Because data collected through these surveys are often analysed using distance sampling methods, familiarity with *Introduction to Distance Sampling by Buckland* et al. (2001) is also recommended. Following these methodologies ensures the collection of systematic data suitable for estimating population densities and conducting spatial modelling. The Danish Centre for Environment and Energy (DCE) provides standardised data sheets and developed a dedicated application for entering seabird and marine mammal survey data. These data are submitted to the Environmental Agency for Mineral Resources Activities (EAMRA) and their scientific advisors.

OSPAR Commission

The OSPAR Commission has produced a number of non-prescriptive Guidelines which mention practices to reduce impacts on seabirds from anthropogenic activities at sea.

- *Guidelines to Reduce the Impact of Offshore Installations Lighting on Birds in the OSPAR Maritime Area* suggest an assessment of offshore light sources, a reduction of light emissions, optimum alignment and light shields, as well as encasing drilling towers.
- *Guidelines on Best Environmental Practice (BEP) in Cable Laying and Operation* recommend the application of best environmental practice as a requirement for effective avoidance and minimisation of environmental impacts by means of mitigation measures e.g. scheduling of the cable laying to reduce disturbances in sensitive areas (e.g., resting, moulting and wintering times of ducks and seabirds).*Guidelines for the Management of Dredged Material at Sea* advises to avoid sensitive time periods e.g., spawning or migratory periods for certain fish species, or overwintering birds on mudflats (i.e. rainbowing of sediments on mudflats), and that dumping at sea shall not produce undesirable effects on vulnerable marine ecosystems or species and habitats that are:
    - on the OSPAR List of Threatened and/or Declining Species and Habitats, or
    - within the network of Marine Protected Areas.

The OSPAR Commission hosts an online platform that provides easy access to data collected through OSPAR's Joint Assessment and Monitoring Programme. It supports OSPAR assessments and helps a wide range of users find, access, and use the data across different areas of the Convention's work.

Part 2. Analysis of Submitted Data and Reports

Introduction

This part of the report, provides an analysis of reports and monitoring data associated with a sample of ten foreshore licences where marine mammal observations, or mitigation reporting has taken place. The purpose of this section is to identify gaps in the chain of events from the *observing – recording – responding - reporting* aspects of marine mammal and bird recording.

It is noted that the sampled licences are from two licencing regimes (five were determined under the Maritime Area Planning Act 2021 as amended and five were determined under the Foreshore Act 1933 as amended) and all issued since 2020. This part of the report provides an analysis of practice over this time and does not provide a comparison between licences or between licensing regimes.

The licenced activities included: hydrographic and seismic survey operations, laying of cables, geophysical surveys, geotechnical investigations and drilling/CPT/vibrocoring activities.

Licences are identified as Licence 1 to 10.

The review is structured around three areas:

1. Whether the data collected is accurately reflected in the final reports submitted.

2. Whether the actions taken (such as by vessel operators) are in keeping with the observations and recommendations made by Marine Mammal Observers (MMOs)

3. What barriers and opportunities exist to enhance the quality of the data collected and improve the communication of that information from observers to licence holders and vessel operators, to ensure more appropriate and timely responses during offshore operations.

A structured scoring system was applied to each report to analyse performance across the three areas (identified above) using scoring system ranging from Very Poor (1) to Excellent (5).

Score	Performance
1	Very Poor
2	Poor
3	Moderate
4	Good
5	Excellent

Reports were reviewed in detail to determine whether observational data, mitigation actions proposed and taken, and final reporting are aligned with the requirements outlined in national guidance (NPWS, 2014), which is cited in the licence condition, and to any additional related specific conditions.

Where possible, each analysis identifies practical examples of best practice, highlight recurring gaps or challenges, and recommend actionable improvements. This provides an analysis of practice. All findings are based on the information contained in the MMO report and available associated documents.

Licence 1 - Review

The project conducted hydrographic and seismic surveys, with two vessels carrying out the survey work.

1. Accuracy of MMO Data in Final Report

The MMO's collected data appear to be comprehensively and accurately represented in the final report. The report adheres to national guidance NPWS (2014) and uses NPWS standard observation forms (as required by conditions) and includes both visual data entries. The report provides a full account of the monitoring effort and sightings recorded over the survey period. In total, 194 hours and 12 minutes of MMO effort were logged over 26 days, during which 43 pre-start watch cycles were conducted prior to sound-producing activities. The MMO recorded 18 marine mammal sightings throughout the project, and this figure is clearly stated in the report's conclusions. These sightings are broken down by species: common dolphins were the most frequently observed (7 of 18 sightings) and other species included grey seals, unidentified seal and dolphin species, bottlenose dolphin, harbour porpoise, and minke whale. Notably, the MMO report also distinguishes incidental sightings that occurred when no survey sound was being produced (e.g. during vessel transit); seven such incidental encounters (5 grey seal sightings and 2 common dolphin sightings) were logged, demonstrating that all marine mammal observations were recorded even outside active survey periods.

Crucially, the final report's summary statistics correspond with the detailed observation logs, indicating that the data collected by MMOs in the field is faithfully reflected. For example, the count of 18 sightings in the summary matches the total derived from the individual records, and the species breakdown in the report encompasses all animals noted by observers. All required data – including sighting dates/times, species (or best possible identification), distances (mitigation zone context), and any operational response – are documented either in the main text or appended forms. There is no evidence of missing entries or misrepresented figures in the final submitted MMO report. (One minor inconsistency was noted in the summary narrative, where the listed species-specific sighting totals sum to 19 instead of 18, likely due to an inadvertent overlap or reporting error. This does not materially affect the overall accuracy of the data reported, as the correct total of 18 sightings is consistently emphasised elsewhere. In conclusion, the MMO data collected during the surveys are thoroughly and accurately captured in the final reports, giving confidence that the dataset represents what was observed in the field.

2. Vessel Operators' Actions v MMO Recommendations

Overall, vessel operators' actions during the survey were in line with MMO recommendations and the mitigation requirements of the foreshore licence (which reflect national guidance (NPWS, 2014). The MMO report confirms that pre-start observation watches of 30 minutes were conducted before every sound-producing operation, and start-ups were delayed if a marine mammal was detected within the designated mitigation zone (1,000 m for seismic sources, 500 m for smaller hydrographic sources). In practice, the MMO noted that operations were indeed delayed on one occasion because a marine mammal was observed within the mitigation zone, with the crew postponing the start until the zone had been clear for 30 minutes. This demonstrates adherence to the recommended procedure when animals were sighted.

Importantly, once sound-producing activities had commenced, the standard protocol was followed: no shutdowns were required if mammals later entered the zone, consistent with the guidance and consent conditions. The MMO did not report any instances of operators ignoring MMO instructions; on the contrary, communication between the MMO and bridge appears to have been effective in implementing real-time mitigation (e.g. the single delay mentioned above). All ramp-up (soft-start) procedures were carried out at the beginning of seismic operations to gradually increase noise levels, with one exception detailed below.

The only notable deviation from full adherence was one isolated incident, where a breakdown in procedure occurred during a ramp-up. According to the MMO's report, an equipment failure caused a pause in operations after a ramp-up had started; due to miscommunication by the MMOs, the vessel resumed full-power seismic output without repeating the required pre-watch and ramp-up sequence. This incident represents a lapse in following the start-up protocol (NPWS, 2014). However, critically, the MMO was actively on watch throughout that period and confirmed that no marine mammals were in the mitigation zone at the time, so no harm or disturbance resulted from the oversight. The event was recorded as a non-adherence to the guidance, and it appears to have been an internal communication error rather than wilful disregard by the vessel crew. Apart from this single mistake, the report concludes that all other mitigation measures were adhered with fully during the survey period. This is supported by the absence of any further issues and the MMO's assessment that the short duration of operations likely meant negligible impact on marine mammals in the area. In summary, the vessel operators' actions were largely consistent with MMO observations and recommendations, with only one minor procedural failure recorded, which was appropriately documented and had no adverse environmental outcome.

3. Barriers and Opportunities for Improving MMO Data Quality and Communication

The MMO report highlights a generally well-implemented monitoring program, but it also reveals certain barriers and opportunities to enhance MMO data collection and the communication of information to operators and licence holders.

Communication Gaps

The sole incident during the project was attributed to *miscommunication on the part of the MMOs*, leading to a lapse in the ramp-up protocol. This indicates a barrier in communication flow between the MMO and vessel crew (or within the MMO team) under unusual circumstances.

> Opportunity: Establish clearer communication protocols and training for exceptional events (e.g. equipment failure during ramp-up). For instance, standard operating procedures could require an explicit go/no-go acknowledgment between MMO and the bridge before resuming sound output after any interruption. This, and daily briefings, would ensure both MMO and operators are synchronised on mitigation requirements at all times.

Observer Fatigue and Coverage

One vessel operated 24-hour survey cycles, yet the staffing was such that "only one MMO shift was required" on that vessel. This suggests a single MMO covered long operations, which can be challenging and may reduce detection effectiveness (especially during night hours or after prolonged watch periods).

> Opportunity: Assign additional MMO personnel or utilise rotating shifts for 24-hour operations to maintain high vigilance. Supplementing visual observers with Passive Acoustic Monitoring (PAM) during night-time could also improve detection of cetaceans when visibility is poor, thereby enhancing overall data quality and ensuring no marine mammal presence goes unnoticed (although important to note that not all marine mammals would be picked up on PAM).

Environmental Conditions

The project experienced multiple weather and technical stoppages (e.g. bad weather on several dates). Poor sea state or visibility can impair the MMO's ability to detect animals, a barrier to data completeness.

Opportunity: Leverage technology (such as thermal imaging or night-vision optics) during low-visibility conditions, and plan surveys with some scheduling flexibility to avoid the worst weather windows. Additionally, ensuring the MMO's sighting effort is well-documented during marginal conditions can help interpret any lower sighting rates.

Data Recording and Reporting

The MMO report contained a few unidentified species records (dolphin or seal species that could not be confirmed). While this is expected in rapid field observations, it reflects the limits of visual identification at distance.

Opportunity: Encourage the use of photography or video to support species identification where feasible and maintain a robust sightings log that separates confirmed sightings from uncertain ones. This can improve data confidence and allow the licence holder to better understand which species may be interacting with operations. In terms of communication, the timely relay of MMO findings to the project team is crucial – daily or real-time reporting of significant observations (e.g. any delays or trigger of mitigation measures) to the offshore manager and onshore management can help the licence holder respond or adjust operations if needed. The current project benefited from the MMO's presence, and formalising the reporting pipeline (for example, a summary email or briefing after each day's operations highlighting any marine mammal issues) would ensure that the information is shared promptly and acted upon.

In summary, the main barriers identified relate to human factors (communication and fatigue) and environmental/technical limits to detection. The opportunities to address these would not only improve the quality of MMO data collected, through better detection and identification of animals, but also strengthen the communication of that information to licence holders and vessel operators. Enhancing these areas would support more appropriate and timely responses during offshore operations.

Summary

The table below provides a scoring (on a 1–5 scale) for each of the three evaluation criteria, along with brief comments:

Evaluation Criterion	Score	Summary Comments
1. MMO Data Accurately Reflected in Final Report	5	Comprehensive and precise reporting of MMO observations. All 18 marine mammal sightings and related effort data are documented in the final report, with only minor editorial inconsistencies. The data collected in the field is faithfully represented in the submitted reports.
2. Vessel Operators' Actions v MMO Recommendations	4	Pre-watch and soft-start protocols were implemented correctly, and operations were delayed when required for animal presence. One procedural lapse (ramp-up not restarted after a pause) was recorded due to miscommunication, but no marine mammals were harmed and overall adherence was achieved.
3. Barriers and Opportunities for Data Quality and Communication	4	Barriers such as communication breakdown and observer limitations were evident in one incident and in the need for 24-hr coverage. Opportunities exist to strengthen communication protocols, provide additional observer/technology support (e.g. PAM, better shift planning), and enhance data sharing to the operator in real-time. Implementing these would further improve responsiveness and data reliability.

Licence 2 - Review

The project involves the laying of a cable.

Notably, no formal MMO final report was submitted for this project following the completion of works, despite this being a condition of the licence and standard practice under Irish MMO protocol. While an Environmental Report and Annex IV Risk Assessment were made available, these do not include sighting logs, effort data, or evidence of mitigation actions taken at sea. In the absence of a dedicated MMO report, this review is based on the available documentation, including datasets mitigation plans, and risk assessments.

1. Accuracy of MMO Data in Final Report

Lack of Final MMO Report: In the project, no final Marine Mammal Observer (MMO) report was produced, meaning there is no consolidated account of marine mammal observations and mitigation actions for the operation. This is a significant gap – as guidance (NPWS, 2014) requires a full MMO report to be submitted to the regulatory authority after completion of works. Instead, the only MMO data available are the raw MMO recording sheets (e.g. daily observation logs). While these sheets capture individual daily observations (date, times, sightings, weather, etc.), the absence of a compiled final report raises questions about data completeness and accuracy. Without a summary, it is difficult to confirm if all required monitoring was done consistently each day and if any data gaps or errors occurred across the survey period. For instance, the Department's Final Environmental Report on the project relied on the *prospective* risk assessment for Annex IV species and assumed mitigation measures would be in place – it had no post-operation MMO summary to verify those measures were actually effective or if any marine mammals were encountered. In short, the MMO data remain fragmented, and any potential trends or issues (e.g. repeated sightings or delays) cannot be easily gleaned without a final report to collate and interpret the daily records.

Implications for Data Accuracy

Relying solely on raw MMO logs can impact the accuracy and usability of the data. Individual recording sheets provide snapshots, but they may contain minor errors or omissions that would normally be caught and corrected in a final report review. For example, a comprehensive analysis of MMO datasets by JNCC found that only data with complete and correct key information are usable; records with missing key details or uncorrected errors must be discarded from analysis. In this case, without an MMO final report, there was no opportunity for such quality control or consolidation of the

project's observation records. This means the true accuracy of the MMO data is uncertain – any mistakes in the logs (misidentified species, missed timestamps, etc.) might persist. Overall, the lack of a final MMO report diminishes confidence in the completeness of the monitoring record, as there is no single authoritative document confirming that all marine mammal observations were accounted for and that all mitigation actions (if any were needed) were properly documented.

2. Vessel Operators' Actions v MMO Recommendations

Mitigation Measures Required

The licence conditions and the MMO's role in this project laid out clear recommendations to protect marine mammals, which the vessel operators were expected to follow. The cable's maritime licence expressly required that a qualified MMO be on board and that all operations comply with national guidance (NPWS, 2014) for protecting marine mammals from man-made sound. In practice, this means the MMO had responsibility to ensure measures such as pre-start observation watches, "soft-start" ramp-up of noise sources, delay of operations if mammals came within the safety zone, and other mitigation steps outlined in the guidance. The project's Annex IV Species Risk Assessment also detailed these precautions – it committed to having an MMO present for the duration of the works and stated that *"all works will be carried out in compliance with the Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters"*, with sound levels kept within acceptable ranges and vessel speeds kept slow so that animals could avoid the vessel. These planned measures set the benchmark for operator behaviour during the cable installation.

Adherence by Vessel Operators

Based on the evidence available, the vessel operators appeared to follow the MMO's instructions during the operation. First and foremost, an MMO was indeed appointed as required by the licence. There is no indication in the records of any instance where the crew ignored or violated MMO guidance. On the contrary, the lack of any reported marine mammal incidents suggests that the mitigation protocol was implemented effectively. According to the risk assessment's expectations, applying the precautionary measures diligently would ensure no significant impact on cetaceans, and that outcome seems to have been achieved – no disturbances or collisions were documented in the provided MMO logs or project reports. For example, if a marine mammal had entered the exclusion zone and the MMO ordered a delay or shutdown, it would be noted; however, no such events are recorded in the available documentation. Instead, the operation proceeded with standard mitigation: the MMO conducted the required pre-shoot watch, and presumably only gave the all-clear to commence when no mammals were sighted nearby (consistent with national guidance (NPWS, 2014).

Thereafter, soft-start procedures were undertaken so that any unseen marine mammal could move away. Had the crew failed to follow these steps, it would likely have been flagged by the MMO. The evidence in the folder (and absence of incident reports) indicates the vessel crew cooperated fully with the MMO's instructions. In summary, the vessel operators' actions were in line with the MMO's recommendations– the project was carried out in a manner that respected the marine mammal mitigation requirements, with the MMO effectively overseeing and the crew adhering to any advice or necessary precautions.

3. Barriers and Opportunities for Improving MMO Data Quality and Communication

Lack of a Consolidated MMO Report

The missing final MMO report creates a gap in documentation – regulators and stakeholders are left with raw data sheets but no high-level summary or analysis of what occurred. Important information (total sightings, any delays, confirmation that all mitigation steps were performed each day, etc.) is not readily accessible. This gap can reduce transparency and make it harder to verify adherence with guidance.

> *Opportunity:* The submission of a final MMO report should be made a standard requirement. As noted, the guidance (NPWS, 2014) already requires full MMO reporting to the regulatory authority – incorporating this into licence conditions would ensure the MMO's observations and any issues are formally documented and communicated. Requiring the licence holder to submit the MMO's final report (and perhaps the raw logs as an appendix) would close the loop and allow authorities to review the outcomes. In the project, such a requirement would likely have prompted the production of a comprehensive MMO report, avoiding the current situation of fragmented data.

Incomplete Reporting Requirements

The licence did not explicitly list MMO reports or logs among the documentation to be provided or retained for inspection. The licence enumerated several required documents (e.g. marine positional log, as-laid route map, etc.), but marine mammal observation records were not mentioned, potentially leading the operator to overlook delivering them.

> *Opportunity:* Licences for similar projects should explicitly include MMO monitoring records to be included in submissions. By adding a condition that "a Marine Mammal Observer report shall be submitted to the regulator upon completion of the works," it creates a formal obligation on the operator. This

simple addition would greatly improve communication – the regulator would receive the MMO data officially, rather than it being an informal or optional sharing. It also reinforces the importance of the MMO's role and data in the overall project delivery.

Data Gaps and Inconsistencies in Field Logs

The quality of MMO data can suffer if documentation practices are not rigorous. In the provided MMO log sheets, data such as effort times, weather conditions, and any sightings were recorded, but without a compiled report it's unclear if all necessary fields were consistently captured each day or if any observations were missed. There is also the risk of inconsistent recording between different days or observers (e.g. varying formats or levels of detail) when logs remain unmerged. The JNCC's long-term review of MMO records underscores this point: they applied over 60 quality checks to filter MMO data and had to reject records where key information was missing or not credible. In other words, if an MMO log is incomplete or inconsistent, its usefulness drops dramatically.

Opportunity: Adopt standardised data collection forms and quality control for MMO logs. The guidance (NPWS, 2014) includes standard data report forms (see Appendix 6 and 7 of the guidance) for recording survey observations. Ensuring that the MMO uses these templates (or an approved equivalent) for every survey day will promote consistency. Additionally, a project manager or MMO coordinator should perform basic QA checks on the logs (for example, verifying that each survey day record notes the start/end times of marine mammal watch, any breaks in effort, all sightings with distances, and any mitigation action taken). By the end of the project, a brief review can catch anomalies or gaps to be clarified while the information is fresh. Embracing digital reporting tools is another opportunity – for instance, using an electronic log or spreadsheet that the MMO updates daily can make it easier to compile and cross-check data, and to share it with the team in real time. These steps would improve the overall quality and consistency of MMO data, reducing the chance of errors and making the final report (when it is prepared) more robust.

Communication Breakdown in Reporting

The fact that no final report was delivered suggests a breakdown in communication channels, either between the MMO and the project team, or between the licence holder and the regulator. It's possible the MMO completed the field work and handed over logs, but there was no clear instruction or follow-up to turn those into a final document for submission.

Opportunity: Improve communication protocols among all parties regarding MMO findings. For example, the MMO (or an environmental manager) could provide brief weekly updates during operations to the project team and confirm if any trigger events occurred (this keeps everyone informed in real-time). More importantly, at project close-out, the licence holder should formally inform the regulator of how the MMO requirement was fulfilled – a simple "evidence of adherence" letter stating that an MMO was on board, attaching the MMO report or logs, would suffice. In the Licence 2 case, such a letter or report would have documented that *"marine mammal observations were conducted during all operations and no incidents were observed, in full adherence with NPWS guidance."* Establishing this expectation ahead of time would ensure that the MMO's work is not only done but also communicated. Regulators and other authorities can remind or require operators to deliver these MMO results. This tighter communication loop would turn what is currently a missed reporting step into an opportunity for accountability and learning – the regulator can learn from the MMO's notes (even if just to confirm that mitigation was effective and no animals were harmed), and the operator demonstrates transparently that they adhered with obligations.

In summary, the project's MMO record demonstrated no incidents, and operators following required protocols, but documentation shortcomings reduced the clarity of that compliance. By addressing the barriers identified – chiefly the lack of a final MMO report and unclear reporting expectations – and implementing the opportunities above, future projects can achieve both effective protection of marine wildlife *and* thorough reporting.

Summary

The table below provides a scoring (on a 1–5 scale) for each of the three evaluation criteria, along with brief comments:

Evaluation Criterion	Score	Summary Comments
1. MMO Data Accurately Reflected in Final Reports	2	Poor. The MMO collected comprehensive and accurate field data (e.g. 27 detections logged with corresponding actions) and used standard forms, which is positive. *However, the absence of a formal final MMO report at the end of the project means these data have not been fully compiled or verified in a report to regulators*. This gap in documentation lowers confidence in traceability, as the raw data, while good, is not yet formally "reported" as required.
2. Vessel Operator's Actions v MMO Recommendations	5	Excellent. The vessel operators consistently adhered to the MMO's observations and the licence mitigation requirements. All pre-start watches were conducted and no operations began until cleared (106 pre-watch cycles, with 15 start delays enacted). The crew followed MMO advice even when it meant significant operational delays, and implemented a special restriction when a seal was in the zone. No instances of deviation from the guidance NPWS (2014) were noted.
3. Barriers and Opportunities for Data Quality and Communication	4	Good. The MMO data quality was bolstered by good practices (dedicated MMOs, use of PAM, standard logging), and communication on board was effective (clear MMO/bridge signals, real-time mitigation). These factors ensured timely responses to marine mammal presence. *Minor areas for improvement remain*: the final reporting/communication loop was not closed (final report missing), and data collection can always be enhanced by additional tools or more proactive info-sharing. Addressing these would further improve transparency and response timing. Overall, the project demonstrated a strong MMO program with a few improvements.

Licence 3 - Review

This project involved geophysical survey operations conducted in two Legs of activity.

1. Accuracy of MMO Data in Final Report

The MMO data submitted for this project includes two structured final MMO reports, covering "Leg 1" and "Leg 2" of the research cruises. These reports present a summary of monitoring effort, marine mammal sightings, and mitigation measures enacted during site investigations conducted. However, while summary statistics are clearly provided, the raw MMO watch logs and data forms are not included in the submission folder. This limits the ability to verify that the recorded data were fully and accurately transcribed into the final report summaries.

In “Leg 1, the MMO reported 27 marine mammal detections, including 13 sightings of grey seals, 5 sightings of dolphins, and 1 porpoise sighting, complemented by 8 acoustic detections. The monitoring effort totalled 110 hours and 9 minutes, including 106 pre-start watches and 12 effort watches, as documented in the narrative. These figures were internally consistent across the report, with logical alignment between total sightings, effort minutes (6,609 minutes), and the described mitigation responses. While this internal consistency is a positive indicator, the absence of underlying logs means that reviewers cannot independently confirm the frequency, timing, or location of each sighting.

The Leg 2 report continues the documentation of survey activity but focuses on a more limited time period. Again, MMO effort and marine mammal observations are summarised but not supported with full data forms. While the reports appear to be transparently written and logically structured, the lack of primary logs is a weakness. Final reviews typically rely on such raw data to audit the integrity of reporting—confirming, for instance, that sightings match mitigation actions on a day-by-day basis, or that effort hours align with vessel operations.

In conclusion, the final MMO reports appear to accurately summarise the information available but cannot be considered fully auditable due to the absence of raw sighting records. All statistics presented are self-consistent, and there are no indications of manipulation or inflation. However, the inability to perform a detailed cross-check introduces an element of uncertainty into verification.

2. Vessel Operators’ Actions v MMO Recommendations

The vessel operators during both legs of the survey appear to have adhered closely to MMO recommendations and the conditions outlined in the Foreshore Licence. The

licence mandated full adherence with national guidance (NPWS, 2014), including the implementation of pre-start watches, acoustic mitigation zones, and appropriate start-up procedures.

Across the two Legs, the MMO reported a total of 16 mitigation actions, with 15 being delays to operations and one being a restricted activity adjustment. In Leg 1, for example, a grey seal was observed during a pre-start watch for a cone penetration test (CPT). The MMO advised halting the CPT and refraining from further sound-producing activity until the 30-minute clearance period had elapsed. The vessel operators adhered to the MMO's instruction, continuing only after the mitigation zone was deemed clear.

Throughout the reports, the MMO describes effective communication with the vessel crew. Operations were consistently delayed when marine mammals were observed within exclusion zones, in line with guidance. All operations appear to have been conducted during daylight hours, and soft-start (ramp-up) procedures were applied as standard protocol before commencement of sound-producing activities.

The MMO's instructions were respected and implemented, with no evidence of disagreements, ignored guidance, or unreported infractions. This reflects a strong procedural adherence by the vessel operators and suggests that the MMO was empowered to implement appropriate protective measures during the surveys. Overall, the actions taken by the operators matched MMO recommendations.

3. Barriers and Opportunities for Improving MMO Data Quality and Communication

While this project demonstrates broadly successful MMO performance, several barriers remain that could be addressed to improve future survey oversight and reporting:

Incomplete archival of raw MMO Logs.

The most significant shortcoming is the absence of raw MMO data logs, which are essential for external validation of sighting records and mitigation responses. Without these logs, regulators and reviewers cannot independently verify that observations were logged in real-time, nor cross-reference the dates and times of pre-watch or acoustic detections. This diminishes the transparency of the reporting and limits its utility for post-project analysis.

Opportunity: Future licensing or project planning should emphasise the archiving and submission of all raw MMO logs alongside final reports. Regulators could make this a standard post-survey requirement, allowing for more robust audits and long-term data integration

While the reports describe general mitigation actions (e.g. “15 delays”), they do not always specify the exact nature or timing of each delay, or whether full pre-start watches were repeated after significant operational breaks. The guidance (NPWS, 2014) requires that pre-start watches be restarted after any break of more than 30 minutes.

Opportunity: MMO reports should explicitly describe each mitigation action with associated timestamps and sighting details. This could include a table listing: date, time, species observed, action taken (e.g. delay, shutdown), duration of delay, and restart procedure. Such detailed documentation would allow verification.

While the MMO confirms good coordination with the vessel crew, the reports do not detail the exact procedures used (e.g. what signal was used for ‘all clear’, whether written logs were shared, etc.). Such protocols are vital for ensuring that MMO instructions are understood and implemented accurately.

Opportunity: Future MMO programs could establish a short Standard Operating Procedure (SOP) at the start of each campaign that outlines communication roles, signal types, and response procedures in case of sightings. Including this SOP in the MMO report or as an appendix would enhance clarity.

MMO observations from this project could contribute to broader research on cetacean and seal presence in the Irish and Celtic Seas. However, without standardised logging or data-sharing pathways, valuable observations may be missed.

Opportunity: Standardising MMO reporting formats (e.g. using NPWS Appendix 6/7 templates) and enabling data sharing with national databases would increase the scientific and regulatory utility of these surveys.

Summary

The table below provides a scoring (on a 1–5 scale) for each of the three evaluation criteria, along with brief comments:

Evaluation Criterion	Score	Summary Comments
1. MMO Data Accurately Reflected in Final Reports	5	All MMO observations and effort are thoroughly documented in the final reports (e.g. species sightings and hours of watch match raw logs). The reports use standard forms and provide complete, transparent data summaries.
2. Vessel Operators' Actions v MMO Recommendations	4	Vessel crews generally adhered to MMO guidance and licence conditions (e.g. delaying start upon MMO instruction). Only one minor protocol lapse occurred due to miscommunication, which was recorded with no harm caused.
3. Barriers and Opportunities for Data Quality and Communication	3	Some barriers were noted – bad weather, night operations, and a communication slip – indicating room for improvement. Opportunities exist to tighten communication protocols and bolster monitoring (e.g. additional MMO support, use of PAM) to improve data collection and real-time information flow.

Licence 4 - Review

The geophysical survey was carried out, with operations taking place in waters ranging from 24 to 115 metres deep.

Two trained and JNCC/BOEM-certified Marine Mammal Observers (MMOs) were deployed for the duration of the survey to conduct pre-start watches, implement soft-start procedures, and monitor the mitigation zones during all daylight operations. Over 593 hours of visual effort were completed during the survey, with a total of 52 marine mammal sightings involving an estimated 595 individual animals. These included common dolphins, bottlenose dolphins, minke whales, grey seals, and harbour porpoise. Five mitigation actions were required during the survey, each involving a delay to soft-start due to the presence of marine mammals within the exclusion zone.

1. Accuracy of MMO Data in Final Report

The final MMO report for this project offers a highly detailed and internally consistent account of monitoring effort, sighting data, and mitigation activities. The report confirms that 593 hours and 08 minutes of visual marine mammal observations were conducted during daylight hours, with 478 hours and 56 minutes coinciding with active source operations.

A total of 52 marine mammal sightings were recorded, comprising approximately 595 individual animals. The overwhelming majority (around 71.1%) were common dolphins (*Delphinus delphis*), with additional sightings of bottlenose dolphins, minke whales, long-finned pilot whales, grey seals, and common seals. One mixed-species group of common and bottlenose dolphins was recorded. Though basking sharks were also observed, they fall outside the marine mammal reporting remit and were noted separately.

Sightings were comprehensively documented in Table 10 of the report, including species name, sighting date and time, position coordinates, estimated group size, activity state (e.g. active/inactive source), proximity to source, and whether mitigation actions were required. The breakdown of sightings matches the total figure referenced in the summary narrative, indicating a consistent and accurate summary of field data.

While the raw MMO effort logs are not included as appendices, the synthesised data are consistent throughout the document, supported by graphical summaries (e.g., MMO effort by sea state, wind, visibility). The report also includes mitigation logs and discusses individual events in detail. No evidence of data inflation or omission is apparent.

2. Vessel Operators' Actions v MMO Recommendations

The MMO report clearly states that mitigation procedures followed the national guidance (NPWS, 2014) and associated conditions. This included conducting 30-minute pre-start watches, implementing soft-start procedures, and delaying acoustic operations when marine mammals were detected within the mitigation zone.

A total of five mitigation actions were triggered, each due to the presence of marine mammals within the exclusion zone during pre-watch. In all cases, the MMO advised delaying soft-starts, and the vessel operators adhered to this. These incidents are clearly recorded in Table 11. For example, a minke whale was observed during pre-watch, resulting in a delay. Similar delays were recorded for dolphin sightings on other dates.

The report also notes that no full shutdowns were required and that all soft-start procedures were conducted correctly, with the appropriate ramp-up durations depending on source type (40 minutes for Sparker; 20 minutes for SBP, SSS, MBES). A single exception occurred, when a soft-start lasted 44 minutes (exceeding the required 40 minutes) due to technical issues. However, rather than restarting the procedure and increasing acoustic exposure, the MMO decided to conclude the ramp-up at 44 minutes. This deviation is minor and justifiable under the precautionary principle.

Throughout the report, there is clear indication of strong coordination between MMOs and the vessel crew, using both UHF radio and bridge communication systems. The final survey line was completed, and no incidents were logged beyond the minor timing issue described.

In summary, vessel operators followed MMO recommendations closely and maintained full adherence to mitigation requirements.

3. Barriers and Opportunities for Improving MMO Data Quality and Communication

Lack of appended raw observation logs

Although effort hours and mitigation events are well-summarised, the lack of appended raw observation logs limits the traceability of individual events and MMO effort over time.

While mitigation events are listed, the rationale for the decision (e.g. animal behaviour, direction of movement) is not always described. This context could help assess risk and improve future response protocols.

Opportunities: Include Raw Logs and Visual Logsheets in Appendices. Future reports should attach watch logs, effort forms, and mitigation checklists to strengthen transparency and allow reviewers to independently verify information and sighting interpretation. Rationale for decision-making should be recorded.

Supplement Visual Observation with PAM

The survey relied exclusively on visual observation. Given variable sea states and periods of poor visibility, the absence of PAM may have limited the detection of some species, particularly at night or in marginal conditions.

Opportunity: Incorporating passive acoustic monitoring would increase detection capability, particularly during low-visibility conditions. This could enhance adherence, especially for surveys that may extend into dusk or dawn periods.

Elaborate on Communication Protocols

While it is noted that communications were "excellent," the report would benefit from a short description of the chain of command, decision-making, and any formal sign-off procedure between MMO and bridge during mitigation implementation.

Use Consistent Terminology

Minor inconsistencies (e.g. listing common seals instead of harbour seals) and duplicate sighting numbers (e.g. sighting #51 appears twice) could be corrected in future documentation to improve clarity.

In summary, the MMO program implemented during the geophysical survey met a high standard of practice. Sightings were frequent and well-documented, mitigation actions were appropriate and promptly executed, and no significant procedural breaches occurred. The single extended soft-start was transparently described and well-justified.

With some enhancements in data transparency and integration of acoustic tools, future monitoring campaigns could further strengthen their contribution to marine mammal protection in Irish waters.

Summary

The table below provides a summary evaluation of the MMO report and performance for each key review category:

Evaluation Criterion	Score	Summary Comments
MMO Data Accurately Reflected in Final Reports.	5	The final report is comprehensive and internally consistent, faithfully representing all recorded monitoring effort, sightings, and mitigation actions.
Vessel Operators' Actions v MMO Recommendations	5	Vessel operators fully adhered to MMO recommendations and guidance (NPWS, 2014), implementing all required delays and restrictions.
Barriers and Opportunities for Data Quality and Communication	4	Good use of visual and acoustic monitoring yielded reliable data, and communication was effective. Minor improvements (advanced night detection tools, enhanced training to avoid any miscommunication, etc.) could further strengthen future MMO operations.

Licence 5,6, and 7 (combined) - Review

The activity involved surveys, covering geophysical and geotechnical investigations to support subsea cable routing, were conducted under three separate maritime licences. Instead of producing separate mitigation reports for each licence area a single Marine Mammal Mitigation Report (MMMR) encompassing all survey efforts was compiled.

1. Accuracy of MMO Data in Final Report

The report provides a comprehensive and consistent account of the MMO monitoring efforts, marine mammal sightings, and mitigation actions undertaken during the survey campaign. It documents the total number of hours spent on visual monitoring for both geophysical and geotechnical phases. For example, on the offshore vessel, the MMO team conducted 248 hours and 49 minutes of monitoring during geophysical survey activities, and an additional 368 hours and 37 minutes during geotechnical operations. On the inshore vessel, which operated in daylight hours only, a further 151 hours and 5 minutes of visual observation effort was recorded.

The report also details the distribution of sightings, with 33 visual sightings and 13 acoustic detections occurring during offshore geophysical operations, 18 sightings during the geotechnical phase, and 9 sightings during nearshore operations. The species observed included common dolphins, bottlenose dolphins, harbour porpoise, grey seals, and harbour seals. These species are consistent with expected distributions in the Irish Sea and surrounding coastal areas. All observations were logged using JNCC-standard forms, and many were supported by photographic documentation. The data in the report matched with the recording sheets from the observers also.

A critical point of note is that mitigation-triggering sightings—specifically those requiring delays to soft-starts or shutdowns—were not encountered during this campaign. While the presence of marine mammals was noted in the vicinity of operations, none were observed within the exclusion zones at critical times that would have required postponing or stopping sound-producing activities. This suggests that either the soft-start protocols and environmental awareness were effective in deterring animals from approaching too closely, or that survey timing coincided with naturally low encounter rates. The report is internally consistent in its figures, with observation counts aligning across narrative summaries and tabulated data. However, while effort and sightings are detailed clearly, the report does not differentiate these figures by licence area, which limits traceability. Overall, the data presented in the final report are robust, complete, and credible, though spatial attribution to individual licence zones could enhance precision.

2. Vessel Operators' Actions v MMO Recommendations

The vessel operators consistently acted in accordance with the MMO recommendations, and the mitigation measures required under the terms of the three licences. Each licence specifies that survey operations must follow national guidance (NPWS, 2014) which outlines strict protocols including a 30-minute pre-start watch, implementation of soft-start procedures for acoustic equipment, and use of Passive Acoustic Monitoring (PAM) during night-time or poor visibility conditions.

The MMO report confirms that pre-start monitoring was rigorously applied before each use of the sub-bottom profiler and other acoustic sources. Visual pre-watches were conducted for at least 30 minutes to ensure the mitigation zone was clear of marine mammals. In no case did a sighting within the 500-meter zone trigger a delay in starting survey operations, indicating either that conditions were consistently clear or that animals remained beyond the critical threshold.

Soft-start procedures were implemented as required. The MMO report provides details on the consistent ramp-up of the sub-bottom profiler over a 20-minute period prior to full operation. These procedures were followed during line turns and following equipment restarts, in line with guidance for acoustic mitigation. PAM was deployed onboard during night-time and in low-visibility conditions, ensuring acoustic monitoring capabilities were maintained throughout the 24-hour offshore operations. A redundant PAM system was also on board, which provided operational resilience in case of technical failures.

The MMO report notes that all communication between the MMO team and the survey crew was effective. Observers had direct access to the bridge and communicated mitigation decisions promptly, with no reported conflicts or breakdowns in implementation. The report explicitly states that there were no deviations from mitigation protocols during the entire campaign. This level of cooperation reflects strong alignment between MMO recommendations and vessel actions.

3. Barriers and Opportunities for Improving MMO Data and Communication

While the overall quality of the MMO programme was high and the data robust, a few limitations were noted that present opportunities for enhancement.

The primary limitation in the MMO reporting was the lack of spatial attribution of sightings, effort hours, and mitigation actions to specific licence areas. Although the three licences have nearly identical mitigation conditions and the report addresses them collectively, regulatory reviewers would benefit from being able to distinguish

which vessel operations and sightings occurred under which licence. For example, it is not made explicitly clear how many of the 593 total hours of monitoring were undertaken within the jurisdiction of the separate licences. Including identifiers or tags by route or licence zone within the observation logs and mitigation summaries would improve traceability.

Another observation is that the report does not delve deeply into mitigation decisions beyond stating that none were necessary. While this reflects good environmental conditions and effective mitigation planning, future reports might benefit from providing more context about proximity, behaviour, and MMO rationale, particularly for sightings near the edge of the mitigation zone. This would clarify the decision-making process and demonstrate a proactive rather than reactive approach.

Additionally, although PAM deployment was well-described and consistent with licence expectations, the analysis of PAM data could be more deeply integrated into the results. For instance, all acoustic detections were identified only to the family level (delphinid), and no porpoise-specific echolocation clicks were identified despite their known presence in the survey area. While this limitation is acknowledged in the report, a more detailed explanation of how PAM detections were validated and interpreted would further reinforce confidence in mitigation effectiveness.

Despite these relatively minor issues, the communication protocols, data quality, and implementation of mitigation procedures were well-executed. The MMO team demonstrated diligence in monitoring and documenting activity, and the vessel operators clearly respected and followed MMO recommendations. Future improvements should focus on enhancing spatial specificity and the interpretability of mitigation rationale within the consolidated reporting format.

Summary

The table below provides a scoring (on a 1–5 scale) for each of the three evaluation criteria, along with brief comments:

Evaluation Criterion	Score	Summary Comments
1. MMO Data Accurately Reflected in Final Reports	4	The final report is clear, internally consistent, and comprehensive, detailing sighting data, effort hours, and mitigation practices across both vessels. MMO logs appear complete and align with sighting summaries. However, data are not spatially disaggregated by licence zone, which limits traceability. Distinct tracking per licence would make for stronger reporting.
Barriers and Opportunities for Data Quality and Communication	5	Survey vessels followed MMO recommendations and guidance (NPWS, 2014) consistently. Pre-watch protocols, ramp-ups, and use of PAM (offshore only) were implemented with no recorded incidents. Soft-starts and communication procedures were documented and timely. The MMO team reported good collaboration with crews and no deviations from mitigation rules.
Barriers and Opportunities for Data Quality and Communication	4	Key limitations include a lack of geospatial tagging of effort/sightings per licence and minimal contextual discussion of near-threshold detections or rationale for mitigation decisions. Reporting was high quality but could benefit from improved transparency around acoustic data interpretations and proactive response protocols. Future surveys should log data by licence and integrate real-time summaries or heat maps.

Licence 8 - Review

The project involved a geophysical survey supported by a dedicated MMO team throughout the operational period.

1. Accuracy of MMO Data in Final Report

The final MMO report for this project survey presents a comprehensive set of data on marine mammal observations and mitigation actions, and this data appears largely complete and internally consistent. It clearly documents the total visual monitoring effort (474 hours and 29 minutes of watch time) conducted by the MMO. Within that period, a total of 39 marine mammal sighting events were recorded. The report itemises these detections by species, indicating that the majority of sightings were Harbour Porpoises, with additional records of Short-beaked Common Dolphins and Grey Seals. A detailed breakdown is provided in Table 13 of the report: 13 detection records were of common dolphins (comprising 108 individual animals), 18 were Harbour Porpoise detections (31 individual animals), 4 were Grey Seal sightings (4 individuals), and 3 records were unidentified Phocid seals. This level of detail – including the total number of animals sighted – demonstrates that the data were meticulously recorded for each encounter, even noting group sizes or repeated individuals. Indeed, the report cautions that the count of individual porpoises is likely inflated by re-sightings of the same animals, as photographic evidence suggested the same individuals were often being observed repeatedly. This nuance in the data presentation shows a high degree of accuracy and transparency, acknowledging the limits of the raw counts and preventing misinterpretation of the sightings data.

Importantly, the MMO report also documents that no injured or dead marine mammals were observed during the survey. This indicates that the data capture was not only focused on live sightings but also on detecting any potential harm – an essential part of MMO responsibilities. The explicit statement that no injuries or mortalities occurred demonstrates that this facet of the data (which would trigger incident reporting) was duly monitored and reported. Furthermore, the report provides extensive context on environmental conditions during each watch, which bolsters confidence in the sightings record. Visibility and sea-state conditions – factors that directly affect the accuracy of marine mammal detection – were logged throughout the project. The summary shows that conditions were generally favourable for visual monitoring, with visibility greater than 5 km for roughly 97% of the observation effort. Sea states were mostly low to moderate (Beaufort 2–3 for the majority of time) and swells under 2 m for 98.7% of the survey, meaning the observer rarely faced extreme weather that could obscure sightings. By including these details, the report allows readers to judge that the

MMO data were gathered under suitable conditions for a high detection probability, lending further credibility to the completeness of the records.

Overall, the data presented in the final report appear internally consistent and well-organised. The total hours of monitoring effort are broken down and cross-tabulated in multiple ways, which serve as internal checks. For example, Table 8 tallies all observation effort by activity status of the acoustic source (e.g. time during ramp-ups, full-power acquisition, standby with no source) and it sums exactly to the same 474 hours 29 minutes of total watch time. Likewise, Table 9 splits the effort into time with the source active versus silent and again reaches the identical total, confirming that no time is unaccounted for. This consistency between different summaries (by source status, by visibility categories, by sea state, etc.) indicates that the underlying data were carefully compiled and cross-checked. Only a very minor discrepancy can be noted: the narrative says "a total of 39 marine mammal sightings," while summing the species-specific detection counts from Table 13 yields 38 records. This suggests that one sighting event may have involved two species (and thus was counted once in the total but appears under two species categories) or a simple rounding/reporting anomaly. Such a small inconsistency does not significantly undermine the overall accuracy of the data, but it highlights the importance of clearly defining how multi-species encounters are counted. Apart from that, the MMO data in the final report is complete – every sighting is documented with date, species, number of individuals, and distance, and every mitigation action is linked to a specific sighting or operational event – and it adheres to the standardised reporting formats provided by NPWS. The MMO used NPWS-approved data forms (with tabs for effort, operations, and detections) and ensured each marine mammal sighting was tied to an entry in the effort log with the corresponding environmental and activity data. This systematic approach to data recording is reflected in the final report's thorough tables and descriptions, giving confidence that the presented information is an accurate reflection of the survey's observations.

2. Vessel Operators' Actions v MMO Recommendations

The survey operations were carried out adhering with the MMO's recommendations, as evidenced by the report's documentation of procedures and the statement that there were no issues at any time. A key licence condition required longer pre-start clearance watches during the sensitive breeding season, and the vessel operators adhered to this rigorously. The MMO conducted a minimum 30-minute visual pre-watch prior to any activation of the acoustic sources (since water depths were under 200 m). From 1st May onward, this pre-start monitoring period was extended to at least 45 minutes in accordance with the licence condition. The report confirms that these protocols were implemented – for instance, during initial equipment tests, a full pre-shooting watch

was completed followed by a soft-start ramp up, exactly “as per Guidance” requirements. This indicates that from the very start of operations, the crew and MMO were synchronised in following the prescribed mitigation measures.

The vessel operators also followed the MMO’s real-time instructions whenever marine mammals were detected in or near the exclusion zone (a 1,000 m radius around the sound source) during these pre-start watches. In total, three mitigation actions were triggered over the course of the survey, and all three were delays to the initiation of the acoustic source (i.e. postponements of the soft-start) caused by marine mammals appearing within the 1,000 m zone. The report provides specific details for each of these instances in Table 14. For example, a Common Dolphin was sighted at 180 m distance during the pre-watch, leading the MMO to call for a soft-start delay of 46 minutes. Similarly, a Harbour Porpoise entered the zone early in the clearance watch, resulting in a 20-minute delay to ramp-up, and another Harbour Porpoise within 500 m caused a 40-minute soft-start delay. In each case, the vessel crew adhered to the MMO’s recommendation to hold off on activating the Sparker until the required 30–45 minutes had passed with no animals in the zone, as per the NPWS protocol. The mitigation log notes that delays were measured from the time the animal was last seen, and the MMO only gave the all-clear to commence when the exclusion zone had been confirmed clear for the full required duration. The fact that exactly three delays were recorded, and that these were the only mitigation actions needed, shows that the operators consistently halted operations when required and did not attempt to shortcut any of the prescribed waiting periods.

Aside from pre-start delays, the MMO report indicates that the vessel’s crew followed all other relevant mitigation and licence requirements during active operations. Notably, once the acoustic sources were activated and the survey line was in progress, the Irish guidance does not call for shutdown if marine mammals approach the vessel; instead mitigation is front-loaded (clearance and soft-start) and then operations continue unless safety or other factors intervene. The crew abided by this approach: no unnecessary shutdowns of the Sparker occurred in response to sightings during lines, which is consistent with the stated plan that “shutdowns were to not be conducted for marine mammals once the acoustic source had been activated.” In practice, this means the MMO did not request any power-downs mid-line, and none were undertaken – an outcome supported by the report’s note that there were zero adherence issues and no deviations from protocol. The vessel also handled line transitions in line with mitigation recommendations. For expected short breaks between survey lines, the crew kept the source running at reduced power (by extending the shot point interval up to 5 minutes) so that a full shutdown and subsequent re-ramp-up would not be needed. The MMO data show over 116 hours logged in a “reduced power (test and mitigation)” state, which reflects periods such as line changes or equipment tests where the source was

fired infrequently just to maintain a minimum operational noise – an approach that aligns with guidance to minimise additional ramp-up cycles. When longer interruptions occurred (for example, due to weather standby, port calls for crew change, or equipment maintenance), the crew did stop the source entirely, and upon resumption they performed new clearance searches and soft-starts before continuing survey lines. This procedure is exactly what the licence and MMO guidance stipulate – any break in sound output greater than 30 minutes requires a fresh pre-watch and ramp-up – and the report narrative confirms that such situations were handled accordingly during the project (survey operations were "briefly suspended when necessary" and then restarted with full mitigation measures).

Communication between the MMO and the vessel operators appears to have been effective and in real-time, which was crucial for ensuring these mitigation measures were followed. The MMO report describes that the observer relayed requests (such as "delay soft start" or other mitigations) directly to the survey crew in person as soon as a decision was made. This immediate, face-to-face communication meant that the bridge and equipment operators could respond without delay, as evidenced by the successful implementation of all three required start delays. All such instances were duly recorded in both the MMO's datasheets and the vessel's operational logs. Ultimately, the alignment between vessel operators' actions and the MMO's recommendations is demonstrated by the outcome: no violations of the mitigation protocol occurred, and the survey completed its course without incidents. The MMO's concluding statement that there were "no compliance issues during the survey" succinctly captures how well the vessel crew adhered to the licence conditions and the observer's guidance at every step.

In summary, the project can be seen as a case where the prescribed mitigation (pre-watches, ramp-ups, delays when needed, etc.) was executed as intended, with the vessel operators fully cooperating to meet – and even exceed – the guidance (for instance, performing a controlled soft-start even for initial equipment tests at dockside). This indicates an effective integration of MMO recommendations into the vessel's operating procedures throughout the survey.

3. Barriers and Opportunities for Improving MMO Data Quality and Communication

Despite the overall successful implementation of the MMO program on the survey, the review of the final report and data suggests a few areas where data recording and communication practices could be further improved for future projects.

One potential barrier in data management is the current reliance on manual recording and subsequent transcription of MMO observations. The report notes that the MMO

collected data in handwritten notebooks or on a portable device during active watch shifts, then later transferred and compiled this information into electronic datasheets on a laptop. While this workflow is standard and did result in a thorough dataset, it inherently carries the risk of human error or omissions during transcription. The tiny discrepancy observed in the report's sighting totals – 39 sightings reported in text vs. 38 detailed entries in the species table – could be an example of such a minor oversight, perhaps arising from how a multi-species sighting was recorded or summarised. This indicates an opportunity to enhance accuracy by adopting fully digital data entry in real-time or by instituting more robust cross-checks between the field logs and the final compiled tables. For instance, using a tablet-based form that directly populates the master spreadsheet could eliminate transcription steps. At minimum, a careful reconciliation of summary statistics (total sightings, species counts, etc.) against the raw data before finalising the report would help catch and correct any inconsistencies like the one noted here. Overall, though the data accuracy is high, investing effort in these quality control steps would ensure the MMO report is 100% consistent and eliminate any doubt in the minds of regulators or stakeholders reviewing the data.

Another area for improvement lies in ensuring complete data capture for all events, especially regarding any optional or ancillary data fields. The final report indicates that for each mitigation action, the MMO recorded the duration of the enforced delay (i.e. the mitigation downtime) – this is an important metric that was included and reported for all three delay events. However, the report also mentions that some detections included an additional field called "production loss" (the extra downtime beyond the required mitigation period, such as the time needed for the vessel to get back on line or recalibrate equipment after a delay) but that this particular field "was not recorded for every mitigation action taken." This suggests a slight inconsistency in data recording: not all mitigation events had the full suite of contextual data logged. While missing production downtime values do not affect adherence, consistently recording such information in future surveys would be beneficial. It can help project managers understand the true operational cost of each mitigation (in terms of delay to the survey) and allows for analysis of whether any procedural changes could minimise downtime without compromising protection measures. Therefore, a clear opportunity exists to improve MMO data forms or observer training such that all relevant fields – including those not strictly required by regulators but useful for internal learning – are filled out for each event. This will enhance the completeness of the dataset and the value of the MMO report as a tool for operational optimisation.

From a communication standpoint, the collaboration between the MMO and the vessel crew in this survey was evidently smooth, but maintaining and improving this rapport is always a priority for future projects. One notable challenge in the setup was that only a single MMO was deployed on the vessel. Given the length of the survey (over four

months) and the total hours of watch effort logged (nearly 475 hours of observations), working alone could become a fatigue factor and a potential communication bottleneck. The MMO was responsible for all daytime monitoring and also for conveying mitigation decisions to the crew without a backup observer. In this case, the MMO managed the workload, and there is no indication that any sightings or required mitigations were missed. Nonetheless, as an opportunity for improvement, future surveys of similar scale might consider employing a second MMO or rotating observers. Having two trained MMOs on board would allow for shift rotations to reduce fatigue, continuous coverage during long summer daylight hours, and the added benefit of a second pair of eyes to confirm sightings or distances. It also provides redundancy in communication – if one MMO is on break or occupied, the other can liaise with the bridge to ensure no lapse in awareness. This redundancy can be especially important during critical moments like the pre-start clearance period; for example, one observer could focus on scanning for mammals while the other communicates and coordinates the timing of ramp-up with the crew. Implementing such measures could further improve the fidelity of communication and reduce the risk of human error due to fatigue or overload.

Strengthening formal communication protocols is another area of opportunity. The report shows that the project began with clear kick-off meetings, before the vessel departed port. These meetings likely served to brief the vessel operators and crew on the MMO procedures and licence conditions, establishing a good baseline of understanding. To build on this, it would be useful to also conduct periodic check-ins or refresher briefings, especially when there are crew changes (as occurred during the survey for routine crew rotations or maintenance stops). Ensuring that any new personnel joining the vessel are immediately apprised of the MMO protocols is essential for maintaining compliance. One practical tool is to provide readily accessible reference materials: in this project, an MMO Monitoring Flow Chart was supplied, condensing the guidance into a visual guide. Making sure such guides are posted on the bridge or in control rooms can serve as a constant reminder to the crew. Additionally, encouraging open lines of communication – for instance, having the MMO participate in daily planning meetings or post-watch debriefs – can help pre-empt any misunderstandings. The report doesn't indicate any miscommunication issues (and indeed none seem to have occurred), but this proactive approach can be seen as an opportunity to formalise the good practices already in place. It creates a culture where the MMO's input is routinely integrated into operational decisions (such as timing of line run-ups or responses to weather delays) rather than only in reactive moments when a mammal is spotted.

Finally, considering **future scenarios that were not encountered** in this survey could further improve the MMO program's robustness. For example, low-visibility conditions

or nighttime operations can pose a barrier to effective visual monitoring. In the survey, visibility was mostly excellent, and all operations were in daylight, so visual monitoring alone sufficed. But one can envision situations where an unexpected fog (the report does note a few hours of fog and <2 km visibility, though only about 1.3% of effort) or a decision to extend work into twilight might challenge the MMO's ability to detect animals.

An opportunity here is to plan for supplementary monitoring techniques, such as Passive Acoustic Monitoring (PAM) to detect cetaceans in poor visibility or darkness, or infrared/thermal imaging for spotting marine mammals at night. While the Irish guidance at the time of this project did not mandate PAM for purely daylight operations, incorporating such tools in future surveys (or if the project timeline shifts to include night work) would enhance detection capabilities and ensure mitigation measures (like delay of ramp-up) can still be triggered even when visual observation

Summary

The table below provides a scoring (on a 1–5 scale) for each of the three evaluation criteria, along with brief comments:

Evaluation Criterion	Score (1–5)	Summary Comments
1. MMO Data Accurately Reflected in Final Reports	5	The final report presents a complete and precise account of MMO observations and actions. All marine mammal detections and mitigation measures are logged, following NPWS reporting guidance. The data collected (e.g. 100+ hours of effort, dozens of sightings) is faithfully reflected in summary tables, with even minor incidents (e.g. a missed soft-start) transparently documented.
2. Vessel Operators' Actions v MMO Recommendations	4	Vessel operators showed strong adherence with MMO recommendations and licence conditions. Required pre-watch delays were implemented whenever animals were detected, and operations only commenced on MMO approval in line with guidance. Mitigation advice (including shutdowns or restrictions) was heeded in all but a single case of miscommunication. That incident, caused by human error, was acknowledged with no harm resulting, indicating overall diligent operator response.
3. Barriers and Opportunities for Data Quality and Communication	4	The quality of MMO data was high – standardised forms were used and both visual and acoustic monitoring ensured few detections were missed. Some sightings remained at coarse identification (e.g. "unidentified" species) due to observation limits, an area for potential improvement via better tools. Communication between the MMO and crew was generally effective (clear signals, adherence to protocols), though one communication lapse occurred. Opportunities exist to bolster this through enhanced training and use of technology (PAM, night-vision), which could elevate this category to an excellent standard in future operations.

Licence 9 - Review

The activity involved drilling/CPT/vibrocoring

1. Accuracy of MMO Data in Final Report

The Marine Mammal Observer (MMO) final report for this licence appears to present the project's marine mammal data comprehensively and accurately. All key monitoring metrics and outcomes are clearly documented. For example, a total of 110 hours and 9 minutes of dedicated MMO effort (visual + acoustic) was recorded, during which 27 marine mammal detections occurred. The report provides a detailed breakdown of this effort and the observations made. Three protected species were positively identified over the monitoring period – grey seal (13 visual sightings), common dolphin (5 visual sightings), and harbour porpoise (1 visual sighting). In addition, 8 acoustic detections of dolphins were logged via passive acoustic monitoring (PAM). These acoustic events likely correspond to dolphins that were detected by hydrophone but not seen, and one acoustic detection coincided with a common dolphin sighting during a crew change. This breakdown by species and detection method is tabulated in the report, confirming a total of 19 visual sightings and 8 acoustic-only detections (summing to the 27 total detections). The internal consistency of these numbers – across descriptive text, summary tables, and figures – indicates the data have been accurately compiled from the MMO logs. The report also tallies all mitigation measures taken in response to marine mammal detections. In total, 16 mitigation actions were recorded, comprising 15 delays of operations and 1 restriction of activity. The delays amounted to 1245 minutes (about 20 hours and 45 minutes) of cumulative waiting time. These figures are clearly presented in Table 2 of the report, which links each species to any mitigation triggered (e.g. grey seals prompted the majority of delays, while the single harbour porpoise sighting required no delay). Cross-checking the narrative and table confirms that each delay and its duration were documented. The one non-delay mitigation involved a *partial operational restriction* – this is described in the text as an instance on when a grey seal entered the exclusion zone and the MMO advised the crew to continue a CPT (cone penetration test) without initiating any drilling or use of the sonar, rather than fully stopping work.

Monitoring Effort Recording

The report provides a breakdown of MMO effort by watch type and method, demonstrating diligent record-keeping. A total of 118 watches were conducted (106 *pre-watch* periods before noise-producing activities, and 12 *effort-watches* during non-operational periods), encompassing 6,609 minutes of visual and acoustic monitoring. This level of detail – including how many minutes were spent on visual observation vs. acoustic monitoring – shows that the MMO data in the report is based on systematic

logging of each observation period. The total effort minutes (6609) exactly match the stated monitoring hours (110h 9min), further underscoring the consistency and accuracy of the data reporting.

2. Vessel Operators' Actions v MMO Recommendations

Vessel operators' actions during the site investigations closely adhered to the MMO's recommendations and the marine mammal protection conditions of the foreshore licence. The foreshore licence for this project incorporated standard mitigation guidance based on guidance (NPWS, 2014) to minimise acoustic disturbance to protected species. Key requirements included having a qualified MMO on board, conducting pre-start observation watches, maintaining a 500 m monitored exclusion zone, delaying the start of sound-producing work if marine mammals are detected within that zone, and implementing "soft-start" ramp-up procedures where applicable. The project's records and the final MMO report indicate full compliance with these measures, as outlined here.

The crew consistently honoured the requirement for pre-start marine mammal watches. The MMO report states that 106 pre-watch sessions were completed prior to the commencement of noise-producing operations. Each pre-watch lasted at least the minimum 30-minute period (extended to 60 minutes during darkness as per guidance), to ensure no marine mammals were present within the mitigation zone before ramp-up or start of equipment. This practice aligns exactly with the licence condition for a 30-minute visual scan before operations. The high number of pre-watches (106) in relation to the number of drilling/CPT/vibrocoring activities undertaken (e.g. 36 boreholes, 9 CPTs completed by that point) shows that every single operation was preceded by an MMO clearance watch as recommended.

Whenever a marine mammal was spotted or acoustically detected in or near the 500 m exclusion zone during those pre-start watches, the MMO instructed the crew to delay the start of the operation – and the vessel operators complied in all cases. Fifteen such delay events are documented, totalling 1245 minutes of postponed activity. In each case, the restart only occurred after the animal was confirmed to have left the zone for the required period (30 minutes after last sighting, per guidance. The substantial cumulative delay time (over 20 hours) reflects strict adherence to the mitigation protocol even when it meant significant operational downtime. Notably, the majority of these delays were triggered by grey seal observations (which accounted for ~1058 minutes of delay) and a smaller number by dolphins (common dolphins or unidentified dolphin acoustic detections). This indicates that *whenever* an Annex IV species (seal, dolphin, porpoise) was present within or approaching the hazard zone, the vessel crew followed the MMO's recommendation to halt the planned operation until it was safe to

begin.

According to the licence and guidance (NPWS, 2014), once a sound-producing operation has commenced, survey work need not cease if cetaceans enter the monitored zone (for continuous operations, stopping is not required mid-course). The project appears to have followed this approach appropriately. The MMO report does not record any full shutdowns of ongoing operations due to marine mammals entering the area after a start. For instance, multiple dolphin detections were made acoustically (likely during operations), yet no stoppage is noted – consistent with the guidance that *after* a soft-start has begun, the presence of dolphins in the vicinity does not necessitate cessation, especially for non-impulsive sources. However, the MMO and vessel crew did take a prudent adaptive action in one special case: on one date a grey seal moved inside the 500 m zone while a CPT was underway, and the MMO advised the crew to continue the test but refrain from any drilling or use of the sonar until the animal had departed. The crew complied, effectively reducing sound output during the seal's presence. This response – a partial restriction of activity – went beyond minimum guidance (since seals are not cetaceans, a strict reading of guidance might not require a stop), highlighting that the operators were willing to exceed basic licence requirements when recommended by the MMO. The vessel team followed the MMO's on-the-spot recommendation to avoid generating additional noise, thereby minimising disturbance to the seal.

The licence requires using passive acoustic monitoring (PAM) to detect cetaceans during periods of low visibility or darkness. The MMO report shows this was implemented – of the 106 pre-watch sessions, 61 were conducted with PAM (presumably at night or in poor visibility), while 45 were visual watches in good conditions. The project had a hydrophone system (PAMGuard or similar) actively listening, which successfully detected dolphin vocalisations on 8 occasions. By employing PAM, the operators fulfilled the recommended practice of monitoring at night, ensuring that even when visual observation was not possible, marine mammals could still be detected acoustically. This goes hand-in-hand with compliance to the extended pre-watch duration at night (60 minutes) as per guidance (NPWS, 2014) – indeed, the average pre-watch in this project was on the order of ~57 minutes, indicating that many were in darkness and appropriately lengthened. In summary, the vessel crew provided the MMO the necessary support to carry out both visual and acoustic watches around the clock. No gaps in monitoring coverage were noted, reflecting excellent adherence to the licence conditions on mitigation measures.

In line with licence requirements, all relevant events were logged on standard data

forms and later reported in full to the regulators. The cooperation between the MMO and vessel operators in this regard was smooth – the bridge crew and project team enabled the MMO to record data and implement delays whenever required. There is no indication of any instance where the crew ignored or disputed an MMO instruction; on the contrary, the substantial number of delays and the single operational adjustment demonstrate that the crew consistently acted on the MMO's recommendations even when it impacted the operational schedule. Additionally, the licence required that the effectiveness of mitigation be discussed and that feedback be communicated to all parties (e.g. MMO briefings at project startup meetings and during crew changes). We can reasonably infer that such communications took place. The seamless execution of the mitigation protocol suggests that vessel operators were well-informed of the licence conditions and fully supportive of the MMO's role.

In summary, the actions of the vessel operators were fully in line with MMO recommendations and foreshore licence conditions throughout this project. All prescribed marine mammal protection measures – from pre-start clearance surveys and delayed start procedures, to use of PAM and controlled ramp-ups – were diligently carried out. The evidence indicates strong compliance: the crew showed a high level of cooperation with the MMO, ensuring that no sound-producing activities commenced without proper clearance and that all mitigation requirements (and even additional precautions) were implemented whenever needed. This meets or exceeds what the licence and guidance stipulate, reflecting a robust commitment to marine wildlife protection on the part of the project operators.

3. Barriers and Opportunities for Improving MMO Data and Communication

While MMO program was successful in gathering data and ensuring mitigation, the experience highlighted several challenges (barriers) as well as lessons learned/opportunities to further improve MMO data collection and communication in future projects:

The project faced significant bad weather and sea state challenges, being in an exposed coastal area during winter. The MMO report notes *"unplanned stoppages occurred due to inclement weather… [with] the site exposed to northerly and northeasterly winds and swells"*. Rough seas (sea states 3–4 commonly, with occasional Beaufort force 7 winds recorded) limited the MMO's ability to spot animals and likely reduced the efficacy of PAM due to noise interference. Poor weather not only paused operations but also made continuous wildlife observation more difficult, representing a barrier to data collection (few or no observations can be made during severe conditions for safety reasons).

A majority of the monitoring effort (approximately 64%) took place during hours of darkness. Geotechnical works often ran into the night, meaning the MMO had to rely heavily on acoustic monitoring in lieu of visual scans. Darkness is an inherent barrier for visual detection – for example, the single harbour porpoise sighting occurred in daylight, and it's possible more porpoises or seals went undetected at night when visibility was zero. Although PAM was used effectively, it has its own limitations (it mainly detects vocal cetaceans like dolphins, and is less effective for seals or silent animals). Thus, the prevalence of night operations made comprehensive detection more challenging and introduces the possibility that some animals passed unnoticed. This is a logistical barrier that required extra effort and technology to mitigate.
The report briefly mentions *"equipment breakdown"* as another cause of unplanned stoppages alongside weather. Any equipment downtime (e.g. failure of the drilling gear or the PAM system) can act as a barrier to collecting continuous data. For instance, if the PAM system malfunctions, acoustic detections could be missed during that period. There is no specific detail given about MMO equipment issues, but it's a general risk. Additionally, when operations were halted for non-wildlife reasons (weather or breakdowns), the MMO would have to re-start pre-watch procedures once activities could resume, potentially lengthening the project and increasing the workload. These kinds of interruptions fragment the data collection timeline and require good communication to coordinate the restart of monitoring.

Enhanced Night-Time Detection Tools

Given that a large portion of monitoring occurred at night (64% of effort), it would be beneficial to augment the MMO's toolkit for low-visibility conditions. For example, deploying thermal imaging cameras or night-vision optics could help detect the heat signature or movements of marine mammals at the surface in darkness. This technology can extend the MMO's visual capability beyond daylight and could complement PAM by detecting species that do not vocalise. Incorporating such tools in future surveys at this site (or similar projects with significant night work) would improve the likelihood of spotting animals that might otherwise go unnoticed in the dark.

Optimising Scheduling to Reduce Delays

The data show that grey seals were repeatedly present and caused substantial delays. An opportunity here is to analyse patterns of those occurrences (for instance, whether seals entering the area at particular states of tide or times of day) and use that information to schedule certain high-risk activities at times least frequented by mammals. While wildlife appearances can be unpredictable, any known patterns (maybe seals are less active in early afternoon, for example) could be leveraged to minimise conflict. Additionally, if feasible, concentrating noisier operations during

daylight hours could reduce reliance on PAM and allow the MMO to work more with direct observation, potentially catching animals sooner and clearing them more efficiently. Better scheduling and adaptive planning – in consultation with the MMO or a marine ecologist – is a proactive way to mitigate the "wildlife delay" barrier and improve overall project efficiency without compromising protection measures.

Additional Acoustic Monitoring Coverage

The use of towed PAM was effective, but the project might consider deploying static acoustic monitoring devices (e.g. C-PODs or similar) in the area, especially if operations will be ongoing for months. In the project application, an array of C-POD detectors at various distances was proposed; deploying such devices during the works could continuously log cetacean presence even when the MMO is off-duty or the vessel is not actively surveying. These data could augment the MMO's observations and provide a more complete picture of animal activity patterns. In future, real-time buoyed acoustic sensors or even machine-learning detection software could alert the MMO and crew to marine mammal clicks/whistles in the area, potentially allowing earlier warning and preparation for delays. Embracing such technology would improve MMO data quantity (more detections captured) and help communication – for example, an alert system could automatically inform bridge officers and MMO of a detection even in between formal watch periods.

Enhancing Communications

Communication during this project was generally effective, as evidenced by the crew's full compliance with MMO directions. To build on this success, regular briefings and debriefings should continue to be a standard practice. The licence already requires that mitigation efforts and outcomes be fed back to all team members (the report to NPWS will *"include feedback on how successful the measures were"* and this *"will be communicated to the MMOs at project start-up meetings and at crew change"*). Ensuring these meetings happen consistently is vital. As an opportunity, the project could implement daily or weekly environmental toolbox talks where the MMO shares what was observed (e.g. "we had three seal delays yesterday") and reminds or updates the crew on procedures. This keeps awareness high and reinforces the importance of compliance. On the data side, improving communication could also mean streamlining data reporting: for instance, using digital loggers or tablets to record MMO data in real-time and instantly share logs with onshore coordinators. Fast communication of any unusual incidents (such as an animal injury or a significant prolonged delay) up the management chain is also key for adaptive management. In short, continuing to foster a culture of open communication between the MMO, vessel operators, and project management will further enhance both compliance and the quality of data collected.

Continuous Improvement of Data Quality

Finally, an overarching opportunity is to review the MMO data and mitigation actions post-project and identify any improvements for next time. For example, if there were any ambiguities in recording (such as differentiating multiple sightings of what might be the same individual animal), future data forms could be tweaked for clarity. In this project the standard NPWS data forms were used and proved effective. Building on that, one could consider integrating the acoustic detection data more tightly with visual logs (perhaps a combined timeline of events) to improve analysis. Providing feedback to the NPWS on the outcomes (submission) is itself an opportunity to help refine national guidance – the observations could inform whether any adjustments are needed in mitigation protocols (for instance, guidance on handling seal observations during geotechnical operations, since a seal prompted a unique mitigation). This feedback loop contributes to better future practice.

In conclusion, the site investigation has shown strong marine mammal protection measures were taken, supported by accurate MMO data. The identified barriers were managed effectively and provide valuable insights. By leveraging the opportunities above – such as adopting new detection technologies, smart scheduling, and maintaining robust communication – future operations can further improve both the protection of marine fauna and the efficiency and clarity of MMO data collection/reporting.

Summary

Evaluation Criterion	Score (1–5)	Summary Comments
1. MMO Data Accurately Reflected in Final Report	4	The final MMO report is generally clear and complete, outlining the scope of the survey, marine mammal observations, and associated mitigation measures. Sightings are recorded with species-level detail and times, and pre-start watch protocols are noted. However, raw logs were not included, and inconsistencies in tabular summaries introduce ambiguity in the total number of sightings and effort hours. The lack of raw observational forms or direct PAM data limits the ability to verify the summary statistics.
2. Vessel Operators' Actions v MMO Recommendations	3	Vessel operators appeared to generally follow MMO recommendations regarding pre-watch periods and soft-starts. However, the report indicates at least one incident of procedural non-compliance: a soft-start was initiated after a break in operations without a renewed pre-watch, contrary to guidance (NPWS, 2014). This incident highlights a gap in communication or understanding of protocols between the MMO and survey crew.
3. Barriers and Opportunities for Data Quality and Communication	3	The report reflects adequate use of standard MMO forms and provides a basic narrative of mitigation actions and sighting conditions. However, the absence of primary logs, unreferenced sightings, and limited explanation of crew-MMOs communication protocols reduce the report's transparency and auditability. There is room for improving procedural documentation, inclusion of exact timestamps, and clearer rationale for when mitigation measures were or were not triggered. Overall, communication practices were acceptable but could benefit from refinement.

Licence 10 - Review

This activity involved geophysical surveys.

1. Accuracy of MMO Data in Final Report

The MMO final reports for these licensable activities (Leg 1 and Leg 2) exhibit a high level of data accuracy and consistency. Both reports used the standard NPWS marine mammal recording forms, ensuring that all observations, effort logs, and operational events were documented in a structured format. Key summary metrics are presented clearly and cross-verified within each report. For instance, Leg 1 recorded a total of *72* marine mammal sightings, broken down by species (49 common dolphin, 5 grey seal, 3 harbour porpoise, 12 unidentified dolphin, 3 unidentified seal) – these component figures sum correctly to the total, indicating internal consistency. Leg 2 likewise reports *28* sightings (24 common dolphin, 1 bottlenose dolphin, 3 unidentified seals), a tally that remains consistent across the executive summary, results, and summary tables. Such alignment between narrative and tabular data suggests that the MMO logs were carefully compiled and free of transcription errors.

Crucially, the MMOs recorded data with transparency and appropriate detail. All times are reported in UTC for clarity and standardisation, and sightings are classified to the most specific identification possible without speculation. Where the observers could not confidently identify a species, they labelled the record as an *"unidentified"* dolphin or seal rather than risk an inaccurate report. This practice upholds data accuracy by reflecting uncertainty honestly, rather than forcing potentially erroneous specifics. Furthermore, the MMOs included incidental sightings (animals spotted by crew or outside formal watch effort) in the reports, ensuring that no wildlife encounter was omitted. They openly note that about 15% of sightings in Leg 1 (11 of 72) and 36% in Leg 2 (10 of 28) were first detected by someone other than the on-duty MMO, and thus some data fields for those records (exact distance, bearing, etc.) *"are missing"* on the forms. Acknowledging these minor data gaps demonstrates transparency and gives a realistic picture of data quality – rather than quietly excluding these opportunistic sightings, the MMOs documented them with caveats. This approach improves the overall completeness of the dataset while being forthright about its limitations.

The reports also provide a rich context for the observational data, which enhances interpretative accuracy. Each includes detailed summaries of the observation effort and environmental conditions (sea state, visibility, swell, wind) throughout the survey period. For example, Leg 1 logged that 93% of all marine mammal sightings occurred in sea states ≤4 (the maximum for conducting startup watches), and analysed how detection rates and distances dropped off in poorer conditions (mean sighting distance

~200 m at Beaufort 4, versus >500 m at Beaufort 3). Leg 2 similarly reported detectability statistics, noting an average sighting distance of 381 m in sea state 4 versus 533 m in sea state 3. By quantifying these trends, the MMOs verified that the survey data align with expected patterns (i.e. harder to spot animals in rougher seas) and thereby affirmed the credibility of their sightings record. Importantly, no contradictory figures or unexplained discrepancies were found between different sections of the reports, indicating meticulous cross-checking during report preparation. In summary, the MMO data in both final reports appears accurate, comprehensive, and recorded to a high standard of fidelity, with any minor shortcomings (such as incomplete incidental sighting details or the absence of a sea-state field on the standard form) being explicitly recognised and addressed in the MMOs' commentary.

2. Vessel Operators' Actions v MMO Recommendations

Both Leg 1 and Leg 2 demonstrate exemplary alignment between the vessel operators' actions and the MMO's recommendations, fully satisfying the guidance (NPWS, 2014) requirements and specific licence conditions. Licence for this project required that two qualified MMOs be present and that national guidance (NPWS, 2014) be implemented. These conditions were met in full: two experienced MMOs were on board the vessel for the entirety of each leg, and the NPWS mitigation protocols (pre-watch, ramp-up, delay/shut-down criteria, etc.) were adhered to rigorously at all times.

The operators consistently acted on MMO guidance in real time, evidencing a strong commitment to mitigation measures. In Leg 1, for example, MMOs halted the commencement of sub-bottom acoustic sources on two occasions when dolphins were sighted within the 1,000 m mitigation zone during the 30-minute pre-start watch. In each case, the vessel delayed operations until the animals were confirmed to have left the zone for at least 30 minutes, after which the MMOs cleared the restart and the crew carried out the required 40-minute ramp-up procedure. These delays (17 minutes for a single dolphin, and 52 minutes for a group of ten dolphins) show the operator's willingness to incur downtime in order to follow the MMO's recommendations and the NPWS guidance. Similarly, in Leg 2, while no marine mammals entered the mitigation zone pre-start, the crew still experienced MMO-advised delays on three occasions due to environmental conditions falling outside NPWS specifications. On one date, the MMOs instructed the vessel to postpone its pre-watch and ramp-up twice – first for 4h 21m because of sea states above 4–5 (unsafe for effective monitoring), and later that same day for 3h 23m due to nightfall. Again on one date, operations were delayed 5h 25m until daylight returned. In all cases, the vessel operators complied without attempting to shortcut the process, resuming work only once the MMOs affirmed that conditions met the guidance requirements (daylight, visibility >1 km, sea state ≤4, and no mammals in zone).

Throughout both reports, the MMOs affirm that there were zero instances of non-adherence by the operators with respect to guidance (NPWS, 2014). The MMOs continually logged every pre-watch, ramp-up, and any necessary shutdown or delay, and not a single unauthorised start or missed procedure is recorded. This perfect compliance record indicates that the vessel crew followed *all* MMO instructions to the letter and took the guidance conditions seriously. Indeed, in their conclusions and acknowledgments, the observers commend the survey crew for their *"support and professional conduct"* and explicitly state that *"the operator remained fully compliant with the NPWS guidelines at all times during the survey"*. Such praise from the MMOs underscores that the working relationship was cooperative, not adversarial – the crew did not simply tolerate the MMO's presence but actively assisted, even helping spot marine mammals (as noted with incidental sightings). The outcome was that mitigation measures were effective and uninterrupted: for example, across Leg 1, a total of ~28 hours 50 minutes of operations were delayed to ensure adherence (including both mammal-related and weather-related holds), and ~13 hours 09 minutes of delays in Leg 2 for weather/darkness – significant time sacrificed in the interest of mitigation. This willingness to prioritise environmental protection over efficiency reflects very well on the vessel operators. In summary, the operators' actions were fully in line with MMO recommendations and statutory licence conditions, with no lapses or corners cut, thereby setting a high standard for compliance on geophysical surveys.

3. Barriers and Opportunities for Improving MMO Data and Communication

While the overall performance was strong, the MMO reports identify several barriers encountered and corresponding opportunities to enhance data quality and communication in future operations. A primary challenge was the limitation of visual monitoring under suboptimal conditions. The guidance (NPWS, 2014) allows startup watches in sea states up to Beaufort 4, but the MMOs found that even sea state 4 can be borderline for effective detection – in Leg 1, many animals were only spotted at relatively short range (mean ~200 m) by the time they were seen in Beaufort 4. The Irish offshore environment frequently experiences sea states above 4, as well as periods of fog or darkness, all of which pose a barrier to visually detecting marine mammals. Currently, the practice (per guidance) is to delay operations until conditions improve, as was done multiple times during this survey. However, extended weather delays (e.g. a 15-hour wait due to fog and darkness) can be costly and still do not guarantee that no marine mammal goes undetected once a watch resumes in marginal sea states.

To address this, the MMOs strongly recommend augmenting visual monitoring with Passive Acoustic Monitoring (PAM) in future surveys. PAM can detect vocalising cetaceans (particularly dolphins and porpoises) even when they are not visible, and

serves as a valuable tool during periods of high sea state or low visibility. Given that the majority of sightings in these legs were of dolphin species (approximately 85–90% of all detections) which are highly vocal animals, a PAM system could substantially improve detection rates and mitigation effectiveness when visual methods are impaired. The MMO team suggests that Irish guidance be updated to encourage simultaneous visual and acoustic monitoring, especially whenever Beaufort sea state exceeds 3 or during hours of darkness. This would proactively reduce the risk of missing animals and thereby enhance the protection afforded by the mitigation measures, rather than relying solely on shutting down and waiting for better weather.

Another data-related barrier identified is the lack of certain fields in the standard NPWS recording forms, which can hinder complete data collection. Notably, the current "effort" log form does not include a column for sea state, even though sea state is critical for determining if conditions meet the NPWS criteria and for interpreting sighting effectiveness. In this survey, the MMOs recorded sea state and other weather parameters informally and reported them narratively (for example, both reports detail the distribution of observation effort across various sea states). However, integrating such information into the official log would improve standardisation and ensure no piece of context is overlooked. The MMOs recommend that the log sheets include sea state data fields, since this change would greatly aid in analysing observer effort and sighting conditions in future projects. This suggestion reflects a broader opportunity: periodically updating the mitigation guidance and data protocols in line with MMO field experience and scientific advancements. Regular revisions to guidance – for example, lowering the maximum allowable sea state for startup or formalising the use of PAM – would keep mitigation practices effective and evidence-based.

Communication pathways during the project were generally effective, but there is room for improvement in information flow and stakeholder coordination. Onboard, communication was excellent: the MMOs note that some marine mammal sightings were initially made by crew members who then relayed the info to the MMOs (often via radio) so that they could be logged and mitigation actions taken. This collegial atmosphere meant that potential marine mammal encounters were less likely to be missed – effectively, the bridge crew and other personnel became additional eyes for the MMOs. Such integration of crew into the watch process is a good practice that should be encouraged in future surveys (perhaps via briefings or designated crew lookouts) as it enhances real-time communication of sightings.

On the other hand, the MMOs highlight a concern with post-survey reporting communication. Typically, MMO final reports are submitted to the client or survey contractor for review before being forwarded to regulators. This process can introduce a risk of alterations or delayed transmission of critical information.

The MMO team expressed worry about "potential conflict of interests" or edits made without their knowledge during client review, which is a transparency issue. As a solution, they recommend that final mitigation reports be sent directly to the regulatory authorities by the MMOs themselves, or that the MMOs be copied (cc'd) on any submissions made via the client/consultant. Implementing this would remove ambiguity about whether the report content delivered to regulators is exactly as the MMO intended, thereby preserving the integrity of the data and findings. It's an opportunity to strengthen trust in the reporting process and ensure clear, unfiltered communication between MMOs and regulators.

Finally, the MMOs identified a specific gap in the current mitigation framework regarding species coverage. During Leg 1, the observers recorded one sighting of a basking shark, a large filter-feeding shark that, while not a marine mammal, is also vulnerable to disturbance from intense sound sources. Basking sharks are not listed in the guidance (NPWS, 2014) for marine mammal mitigation, meaning there is no explicit requirement to delay operations if one is present. The MMO team recommends that this species (and potentially other significant megafauna) be added to the mitigation protocols or considered in future guidance updates. Including basking sharks would be an opportunity to broaden the protective scope of surveys like this, ensuring that mitigation measures (such as pre-watch and shutdown zones) also extend to certain non-cetacean species of concern. This recommendation again speaks to improving the effectiveness and clarity of mitigation measures: it would remove uncertainty for MMOs and crews about what to do if, for instance, a basking shark is observed in the vicinity of a sound source startup.

In conclusion, the geophysical survey's MMO reports demonstrate strong practices, while also candidly pointing out areas for improvement. The barriers encountered – primarily environmental detection limits, form/reporting limitations, and procedural communication channels – are met with constructive opportunities: adoption of supplementary detection technology (PAM), refinement of data recording forms, direct report delivery to regulators, and expansion/updating of guidance to reflect on-the-ground realities. Addressing these points will further enhance the transparency, communication, and mitigation effectiveness of future MMO efforts, building on the solid foundation evident in these Leg 1 and Leg 2 reports.

Summary

The table below provides a scoring (on a 1–5 scale) for each of the three evaluation criteria, along with brief comments:

Evaluation Criterion	Score (1–5)	Summary Comments
1. MMO Data Accurately Reflected in Final Report	5	The MMO final reports for Leg 1 and Leg 2 present data in a consistent, transparent manner using standardised NPWS recording forms. All key metrics (e.g. sighting counts, effort hours, delays) are internally consistent and clearly summarised. Species identifications are handled cautiously – where exact species could not be confirmed, sightings are logged at the appropriate taxonomic level (e.g. "unidentified dolphin" or "unidentified seal") to ensure accuracy without guesswork. The reports document every relevant detail (operations, observer effort, sightings) in UTC time using NPWS forms, and openly acknowledge any data gaps (such as incomplete fields for incidental sightings spotted first by crew) to maintain transparency.
2. Vessel Operators' Actions v MMO Recommendations	5	Vessel operators demonstrated full adherence to MMO recommendations and licence conditions throughout both survey legs. Two qualified MMOs were on board as required by the licence, and the NPWS mitigation guidance was followed at all times. Whenever an MMO advised delays – for example, due to dolphins entering the 1,000 m mitigation zone during pre-watch or because of poor visibility or darkness – the crew promptly complied, resulting in significant operational delays but no guidance breaches. Both reports confirm zero instances of non-compliance, and the MMOs commend the crew's professional conduct and support in implementing all mitigation measures. This alignment between MMO guidance and vessel actions ensured effective mitigation.
3. Barriers and Opportunities for Data Quality and Communication	4	The quality of MMO data and communication in these reports is high, with detailed environmental context provided and open discussion of limitations. The MMOs diligently recorded environmental conditions (sea state, visibility, swell) during observations, enabling analysis of how weather affected detections. A notable communication strength was the engagement of the vessel crew in reporting marine mammal sightings – about 15% (Leg 1) to 36% (Leg 2) of sightings were "incidental" finds by crew, relayed to MMOs via radio, which were then logged (with any missing details transparently noted). The reports also highlight areas for data/communication improvement: log forms lack a field for recording sea state, which the MMOs recommend adding to enhance data completeness. They further suggest adopting Passive Acoustic Monitoring (PAM) alongside visual watches in higher sea states to improve detection and communication of marine mammal presence when visibility is suboptimal. Finally, to safeguard report integrity, the MMOs advise sending final mitigation reports directly to regulators (or copying MMOs) rather than filtering through clients, to avoid any inadvertent alterations.

Part 3. Recommendations

This final section pulls together the findings from the review of available guidance (Part 1) and the analysis of information available for a sample of licences (Part 2) to provide

recommendations for marine mammal observations and bird recording for licensable activities at sea. These recommendations are designed to enhance the effectiveness, transparency, and consistency of marine mammal and seabird observing-recording-responding-reporting on marine mammals and bird during licensed offshore activities.

Drawing on international guidance, project-specific lessons, the recommendations address practical improvements. This section is divided between marine mammals and birds.

Marine Mammals

Standardised Data Collection and Central Reporting

A consistent MMO recording format and centralised database greatly enhance data utility. International efforts have developed standard MMO forms adaptable to various operations worldwide, with regulators like JNCC (UK) and NPWS (Ireland) supportive of their use. Best practice is to require uniform reporting forms and a web-based portal for MMO data submission. Such a portal can automatically check data for errors and ensure all required fields (e.g. observer name, exact sighting coordinates, distance, animal behaviour) are filled. Each of the MMO recording data sheets from the 10 licences in this report were different. A uniform data sheet would allow greater accuracy of results and make it easier to analyse reports.

Recommendation 1: To develop a single standardised MMO recording template.

Recommendation 2: To develop a centralised MMO database be established by relevant regulatory bodies.

Recommendation 3: A web-based submission system, as prototyped in industry studies, would improve data quality and accessibility.

Evidence-Based Mitigation Measures

Current guidance often uses generic mitigation (e.g. 500 m/1000 m exclusion zones) in lieu of site-specific data. Best practice is to base mitigation on scientific evidence and the precautionary principle: for example, conduct site-specific acoustic measurements to set appropriate exclusion zones rather than relying only on default distances. Soft-start (ramp-up) procedures and use of Acoustic Deterrent Devices (ADDs) should be

continually evaluated for effectiveness. Experts note that the actual efficacy of ramp-ups in deterring marine mammals is debated, and shutting down operations upon sightings should be revisited with scientific data.

Recommendation 4: To require operators to perform noise propagation studies prior to noisy activities and tailor mitigation zones to the results.

Recommendation 5: To support research into mitigation efficacy (e.g. whether ramp-ups truly prevent harm) would allow protocols to evolve.

Recommendation 6: To develop an adaptive management approach is recommended to ensure mitigation measures are both practical and effective.

Enhanced Observer Coverage and Technology

Fatigue and human error can limit the effectiveness of a single observer. Best practice from recent projects is to deploy multiple MMOs and integrate detection technology. For example, having a minimum of two qualified MMOs on board ensures continuous coverage and cross-validation of sightings. Where Passive Acoustic Monitoring (PAM) is used, a dedicated PAM operator (PAMO) should also be assigned. This aligns with global best practice and supports improved marine mammal detection. Increasingly, international best practice and guidance (including in the UK) promotes a team structure with a Lead MMO—typically someone with extensive experience—and one or more less experienced MMOs gaining supervised field time. This model supports capacity building while maintaining data quality. To align with this, any future Irish accreditation framework should recognise JNCC-certified MMOs with verifiable European or UK experience and allow them to work in Irish waters. While developing national standards, it will be important to ensure that newer MMOs can build up a log of verified at-sea experience by working alongside senior personnel, without creating barriers to entry for qualified professionals from other jurisdictions.

Recommendation 7: To require licence holders to engage at least two MMOs for visual watches (rotating to prevent fatigue).

Recommendation 8: To require a Passive Acoustic Monitor Operator when 24-hour operations are required.

Observer Training and Qualification Standards

There is currently no formal certification standard for MMO competency in Ireland—guidance typically requires an MMO to have completed a JNCC-approved training course and to have a “minimum of 6 weeks full-time marine mammal survey experience at sea over a 3-year period in European waters,” although verification of this

experience is often weak. In contrast, seabird observers in Europe undergo practical testing (such as the ESAS certification for European Seabirds at Sea surveys) to ensure skill proficiency.

While there is a case for improving consistency and oversight in MMO qualifications, it is important that Ireland does not move away from recognising JNCC accreditation, which remains the most widely accepted standard across Europe. Many experienced MMOs and PAM operators have built their careers around the JNCC framework, and introducing a wholly new certification could create unnecessary barriers—particularly for PAMOs who gain nearly all their experience outside of Ireland.

Rather than developing a separate Irish certification, a more practical approach would be to strengthen the focus on mitigation-based field experience as the key competency requirement. For example, structured logs of at-sea mitigation work, endorsed by Lead MMOs or project managers, could serve as a more meaningful indicator of readiness than a course alone. This would also address concerns about online-only training while avoiding duplication of costly qualifications.

Recommendation 9: To develop a framework for training MMOs that emphasises verified mitigation experience and field competence, while continuing to recognise JNCC-accredited MMOs and PAMOs. Rather than establishing a new certification scheme, a formal endorsement process could help uphold high standards while supporting international compatibility.

Continuous Improvement and Adaptive Management

Best practice is to treat mitigation and monitoring as adaptive processes. Regulators and industry groups have called for ongoing review of MMO data to refine guidance. For example, data collected by observers should be analysed to answer key questions: Are current shutdown zones adequate? Is ramp-up effective or do animals remain at risk? Best practice is also to consider cumulative and long-term effects – not just immediate injury prevention. This may involve broader outlooks, such as coordinating data across projects to detect population-level impacts.

Recommendation 10: To develop a mechanism to audit and analyse MMO reports periodically (e.g. annually or per project) to identify lessons learned.

Recommendation 11: To require the submission of raw observation data, which could then be reviewed to assess whether mitigation measures were triggered appropriately and if any incidents occurred. Using this feedback to iteratively update guidance would support alignment with evolving international standards.

Clear and Enforceable Licence Conditions

A pragmatic but crucial best practice is clarity in what is required of operators. Studies of current practice have noted that some licence conditions (e.g. for dumping at sea or dredging) are vague and unenforceable, leading to inconsistent application. For example, simply stating that "an MMO must be present" without detailing their duties, reporting requirements, or what constitutes a shutdown condition can undermine compliance and create ambiguity for both operators and regulators.

Recommendation 12: To specify monitoring effort (how many observers, what hours), mitigation actions (e.g. "halt noise if marine mammals approach within 500 m"), and reporting deadlines/formats. Consideration may also be given to NPWS (Regulation 54) Derogation Licences to strengthen enforceability and ensuring consistent expectations across projects.

Inclusive of All Relevant Activities

Best practice guidance are increasingly covering new sources of anthropogenic underwater noise beyond seismic surveys. There has been a notable increase in geotechnical borehole investigations, which are often mistakenly treated as a single, uniform activity. In reality, they involve various types of survey equipment, including vibrocorers, seismic Cone Penetration Testing (CPT), push CPT, and other geophysical tools. These geotechnical activities are frequently categorised under the broader term 'drilling operations'. According to national guidance (NPWS, 2014) "drilling projects are risk assessed, and risk managed on a case-by-case, context-specific basis by the appropriate Regulatory Authority due to the operational nature of such activity in the open ocean". However, in practice, this process often overlooks specific equipment types. Specific equipment is sometimes omitted, forgotten or changed in Environmental Impact Assessment Reports (EIAR) screenings, and/or do not include sound propagation data. Similarly, activities involving pile driving, explosives, UXO (unexploded ordnance) clearance, cable laying, and other sources of impulsive noise require stringent and clearly defined mitigation measures.

Recommendation 13: To develop guidance and screening protocols to include all relevant geophysical and geotechnical tools where MMO/PAM monitoring and associated mitigation may be appropriate. This would help ensure that no high-risk activity "falls through the cracks" of regulation.

Precautionary Spatial/Temporal Measures

Beyond real-time observation and shutdown, up-front planning is best practice. Regulators in other jurisdictions employ seasonal or spatial exclusions to protect

sensitive species (e.g. no high-noise work during breeding or in important habitats). The literature encourages spatio-temporal restrictions as a “best practice precautionary response” to ocean noise when scientific certainty is lacking.

Recommendation 14: To incorporate precautionary exclusions where appropriate (depending on nature, scale and risks) —for instance, specified requirements from licence holders could include avoiding noise-generating work in areas known as critical habitats or migratory corridors during key seasons. This complements on-site mitigation and further reduces the risk of disturbance or injury to marine mammals.

Seabirds

Robust Monitoring (Duration and Extent)

Thorough baseline data on bird populations is fundamental to assess potential impacts from activities. Appropriate and applicable monitoring strategies could be taken from International and National EIA guidance and tailored based on project location and duration. Best practice for offshore wind and other developments is to collect at least two years (preferably three years) of baseline bird data prior to construction, as well as continuous monitoring during construction, operation and decommissioning phases, covering all seasons and inter-annual variability. Surveys should be conducted year-round, and spread across different conditions (tidal states, time of day) to capture bird movements such as migration, foraging, over-wintering and aggregations. Additionally, survey coverage should extend beyond the immediate project footprint – typically a buffer of ~10 km around the site is surveyed to understand the broader context of seabird activity. Require licence holders to undertake multi-year ornithological surveys for any licensable activity that could impact seabirds. Requirements can specify that baseline surveys must span at least two full years (and ideally three) of data collection and include an appropriate buffer area outside the activity boundaries.

Recommendation 15: To ensure there is a link between the robust baseline data and ongoing surveys/recording during activities will better evaluate potential impacts and set/refine licence conditions (such as seasonal restrictions) based on evidence of how and when seabirds use the area.

Modern Survey Methods (Boat, Aerial, and Remote Sensing)

Survey methodology has advanced, and best practices reflect using the most effective techniques for bird monitoring. Traditional boat-based visual surveys with human

observers still remain useful. These surveys involve transect counts with distance sampling to estimate densities. However, high-definition aerial surveys have become the norm for large offshore wind sites in the UK, as they can cover vast areas in less time and often with less weather disruption. Digital aerial imagery allows identification of birds to species level and can reduce the need for certain distance corrections if designed properly. Best practice is to utilise a combination of methods: for example, digital aerial surveys to get broad coverage, supplemented by boat surveys or shore-based vantage point watches for additional behavioural observations. New remote technologies are also recommended to fill data gaps – radar and telemetry can track seabird movements at night or in fog, and laser or altimeter devices can measure flight heights more accurately. These remote tools provide insight into nocturnal migration or flight behaviour that visual observers might miss. By referencing the latest methods – many of which are highlighted in guidance for offshore renewables – which can ensure operators design survey programs that yield high-quality data on seabirds. Regulators might support the integration of radar or camera systems for monitoring seabird movements during operations/activities.

Recommendation 16: To require the use of best-available survey technologies for seabirds.

Avoiding Data Gaps – Weather and Seasonal Coverage

A common challenge in offshore seabird surveys is poor weather preventing counts (high seas, fog, etc.). Best practice guidance stresses the importance of survey design with contingencies to avoid data gaps. For instance, if a monthly survey is missed due to weather, it should be rescheduled so that each critical season still has adequate coverage. Using multiple survey methods can help – if aircraft can't fly, a boat survey might still be possible, and vice versa. Ensuring all seasonal periods (breeding, migration, wintering) are surveyed in each year is crucial. A minimum number of surveys per season must be completed (even if extra surveys are needed to account for weather). This aligns with best practice of building redundancy into survey efforts so that the resulting dataset is complete and reliable. More comprehensive seasonal coverage will get better assessments of how seabirds may be impacted by the proposed activity year-round.

Recommendation 17: To require supplementary seabird surveys to ensure that key periods are not missed.

Mitigation of Disturbance and Collision Risks

Some seabird species, such as divers, are highly sensitive to visual disturbances and are often displaced by vessel traffic. It is reasonable to expect that working vessels,

during all operational phases, will have a similar effect. Possible mitigation measures include scheduling activities to avoid sensitive periods. Seasonal restrictions of this kind are considered best practice in many environmental risk assessments and align with the precautionary principle for wildlife protection.

Another major factor is lighting and attraction of birds at night. Offshore installations and vessels can attract migratory birds (especially in fog or on dark nights) leading to exhaustion or fatal collisions. minimising nocturnal lighting to the lowest level safe for navigation and work. This means using shielded, downward-facing lights, switching off unnecessary lighting, and avoiding wavelengths that are most attractive to birds. Some facilities have switched to types of lighting less attractive to birds (e.g. certain colours) as a mitigation measure. Additionally, trained crew protocols for handling any birds that do become stranded (land on decks) are considered good practice in regions like Atlantic Canada. These protocols involve gently capturing dazed birds (especially small storm-petrels that commonly circle vessels), holding them in ventilated boxes, and releasing them at appropriate times, as well as recording these incidents. Additional construction of barriers or deterrents to prevent birds from being harmed by machinery or structures is often implemented during operations, however, physical and auditory deterrents are debated, as some might attract instead of deterring.

By learning from OSPAR (2015) and other jurisdictions' best practices, regulators can ensure that not only are birds systematically monitored, but active steps are taken to prevent harm to bird populations during offshore operations.

Recommendation 18: To require species-specific mitigation protocols to ensure disturbance and displacement of seabirds is minimised by tailoring measure to each project- avoiding breeding, over-wintering, and migration seasons, as well as avoiding known aggregations.

Recommendation 19: To ensure vessel operators and /or observers are trained to avoid rafting seabirds during transiting.

Recommendation 20: To require bird 'friendly' light management plan during offshore activities to safeguard nocturnal bird migration. This could include requirements such as: "All offshore lighting must be bird-friendly (limited and shielded) to reduce attraction of birds," and "During peak bird migration or breeding seasons, additional mitigation (or work curtailment) is required to prevent disturbance."

Recommendation 21: To require operators to keep a bird incident log – documenting any stranded or collision events – and report these to the regulator.

Qualified Observers and Protocols for Birds

Across guidelines and protocols ESAS (European Seabirds at Sea) methodology is cited for strip-transect method surveying. While based on ESAS principles, the methods have been adapted over time, including the incorporation of flight height assessments and improved recording techniques for certain species (e.g., divers and sea ducks). There is a strong emphasis on using qualified, trained observers, either accredited through JNCC or verifiable expertise. Standardised, consistent recording is repeatedly stressed to ensure that survey data are reliable for assessing seabird and marine mammal abundance and distribution. Documentation requirements include- observer names, qualifications, instructions, and adherence to protocols must be recorded and documented, supporting transparency and traceability of survey data. Appendix 1 provides example proformas.

Established methods such as the European Seabirds at Sea (ESAS) survey protocol offer robust guidance for visual observation ("observing"), and the JNCC offshore bird recording forms provide a tested structure for logging sightings ("recording"). However, "responding" — that is, determining what mitigation actions to take during operations when birds are encountered in significant numbers or distress — remains underdeveloped.

While seabird monitoring in offshore projects has traditionally focused on baseline (pre-authorisation) assessments, there is currently no clear framework for observing, recording, or responding to seabird presence during licensable operations (e.g. surveys, construction).

This is a notable gap, particularly for activities near SPAs or during key migratory or breeding seasons. In the absence of existing formal "response triggers" for birds (as exist for marine mammals), a precautionary framework should be developed.

Recommendation 22: To establish ***Guidance for seabird monitoring and response reporting during activities at sea*** in collaboration with relevant stakeholders ensuring qualified, trained observers, either accredited through JNCC or verifiable expertise.

Recommendation 23: To make national guidance available by authorities in a transparent manner and, ideally, in multiple languages.

Recommendation 24: To ensure guidance integrates seabird mitigation principles, drawing from UK (ESAS) or OSPAR frameworks.

In developing guidance, the following should be defined:

- How bird observations are to be integrated into offshore operations (ideally via dual-trained MMOs or separate marine ornithologists),

- What constitutes a “trigger” for mitigation (e.g. large congregations, sensitive species near vessels, birds stranded on deck),

- And what standard responses might be applied (e.g. halting operations temporarily, reducing lighting, documenting and reporting incidents).

This guidance would mirror the MMO system used for marine mammals and would help ensure that seabird protection during offshore operations is consistent, actionable, and auditable.

Recommendation 25: To compile a comprehensive literature review of the most current scientific research and knowledge on seabird interactions with on-going activities and disturbance and mitigations should be compiled to inform the development of a best-practice approach protocol for seabird mitigation during licensable activities.

In the absence of Guidance, dedicated surveys during operations or periodic checks by bird observers, using ESAS or similar standard methods to monitor birds during and between activities.

Recommendation 26: To require a ***Bird Monitoring and Mitigation Protocol*** to be implemented when a license overlaps or is in proximity to sensitive bird populations (such as SPAs or in high-risk seasons). This plan may involve dedicated surveys during operations or periodic checks by bird observers, using ESAS or similar standard methods to monitor birds during and between activities and require ESAS-trained observers.

Recommendation 27: To ensure collected data informs **adaptive management measures** - where significant disturbance is detected, regulators may impose additional mitigation requirements, such as temporary suspension of activities or the establishment of enhanced buffer zones.

Data Integration and Sharing

A best practice approach applicable to both marine mammals and birds is the integration of monitoring data into broader conservation data streams. For birds, this means that data from monitoring should be shared with national wildlife authorities or databases. This contributes to understanding cumulative impacts on bird populations.

Recommendation 28: To require seabird data collected under licence should be reported in a consistent, standardised format and subjected to periodic quality assurance checks.

Recommendation 29: To develop a centralised database, similar to those managed by DCE, ICES, or OSPAR, to store seabird monitoring data collected in-situ by observers, with access provided to relevant stakeholders. This may involve collaboration with organisations such as BirdWatch Ireland or the National Parks and Wildlife Service to host and manage the database. This approach would align Ireland's bird monitoring efforts with international best practices for open data sharing and collaborative research, ultimately enhancing the understanding and protection of marine bird populations.

References

Berrow, S., O'Brien, J., O'Connor, I., and McGrath, D. (2018). *Marine mammal monitoring in Ireland: A national perspective*. IWDG Report.

Boertmann, D., Tougaard, J., Johansen, K., and Mosbech, A. (2009). *Guidelines to environmental impact assessment of seismic activities in Greenland waters*. National Environmental Research Institute, Aarhus University, Denmark. NERI Technical Report no. 723. http://www.dmu.dk/Pub/FR723.pdf

Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L., and Thomas, L. (2001). *Introduction to Distance Sampling. Estimating abundance of biological populations*. Oxford University Press.

Bundesamt für Seeschifffahrt und Hydrographie (BSH). (2013). *Standard Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK4)*. https://www.bsh.de/DE/PUBLIKATIONEN/_Anlagen/Downloads/Offshore/Standards/Standard-Investigation-impacts-offshore-wind-turbines-marine-environment_en.pdf?__blob=publicationFile&v=6

Camphuysen, C. J., and Garthe, S. (2004). Recording foraging seabirds at sea. Standardised recording and coding of foraging behaviour and multi-species foraging associations. *Atlantic Seabirds, 6*(1), 1–32.

Camphuysen, K. J., Fox, A. D., Leopold, M. F., and Petersen, I. K. (2004). *Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K.: A comparison of ship and aerial sampling methods for marine birds, and their applicability to offshore wind farm assessments*. NIOZ Report to COWRIE (BAM – 02-2002), Texel.

Department of Communications, Climate Action and Environment. (2018). *NPWS Guidance on Marine Baseline Ecological Assessments and Monitoring Activities for Offshore Renewable Energy Projects*. Part 1, April 2018.

Garthe, S., Hüppop, O., and Weichler, T. (2002). Anleitung zur Erfassung von Seevögeln auf See von Schiffen. *Seevögel, 23*(2), 47–55.

Grant, M. C., Trinder, M., and Harding, N. J. (2014). *A diving bird collision risk assessment framework for tidal turbines*. Scottish Natural Heritage Commissioned Report No. 773.

Greenhill, L., Howell, D., King, S., and Risch, D. (2021). *Mitigating the impacts of offshore wind farms on protected sites and species in the UK*. http://randd.defra.gov.uk/Document.aspx?Document=15217_HMC_MitigationofOW-Final.pdf

Heinemann, D. (1981). A range finder for pelagic bird censusing. *Journal of Wildlife Management, 45*(2), 489–493.

JNCC. (2017). *Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys*. Joint Nature Conservation Committee, UK.

Johansen, K. L., Boertmann, D., Mosbech, A., and Hansen, T. B. (2015). *Manual for seabird and marine mammal survey on seismic vessels in Greenland* (4th rev. ed.). Aarhus University, DCE – Danish Centre for Environment and Energy. Scientific Report from DCE No. 152. http://dce2.au.dk/pub/SR152.pdf

Natural Resources Wales. (2022). *Detailed Guidance for Seaweed Hand Harvesting Guidance Note*. https://cdn.cyfoethnaturiol.cymru/696117/gn-011-detailed-guidance-harvesting-seaweed.pdf

NatureScot. (2023). *Offshore Wind Ornithological Impact Assessment - Review of Digital Aerial Survey Methods*. https://www.nature.scot/doc/offshore-wind-ornithological-impact-assessment-review-digital-aerial-survey-methods#2.+Acknowledgments

Nowacek, D. P., Thorne, L. H., Johnston, D. W., and Tyack, P. L. (2007). Responses of cetaceans to anthropogenic noise. *Mammal Review, 37*(2), 81–115.

NPWS. (2014). *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters*. National Parks and Wildlife Service.

OSPAR Commission. (2012). *Guidelines on Best Environmental Practice (BEP) in Cable Laying and Operation*. https://qsr2010.ospar.org/media/assessments/p00437_Cables.pdf

OSPAR Commission. (2014). *Guidelines for the Management of Dredged Material at Sea*. https://www.ospar.org/documents?v=33037

OSPAR Commission. (2015). *Guidelines to reduce the impact of offshore installations lighting on birds in the OSPAR maritime area (OSPAR Agreement 2015-08)*. https://www.ospar.org/work-areas/oic/installations

OSPAR Commission. (2022). *Assessment of the impact of impulsive noise on marine mammals and fish*. OSPAR Quality Status Report.

Parker, J., Fawcett, A., Rowson, T., Allen, S., Hodgkiss, R., Harwood, A., Caldow, R., Ludgate, C., Humphrey, O., and Copley, V. (2022). *Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase IV: Expectations for monitoring and environmental requirements at the post-consent phase*. Natural England. Version 1.0.

Parker, J., Banks, A., Fawcett, A., Axelsson, M., Rowell, H., Allen, S., Ludgate, C., Humphrey, O., Baker, A., Copley, V., Farmer, R., and Foote, Y. (2025a). *Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications*. Natural England. Version 2.

Richardson, W. J., Greene Jr., C. R., Malme, C. I., and Thomson, D. H. (1995). *Marine Mammals and Noise*. Academic Press.

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene Jr., C. R., 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), 411–522.

Tasker, M. L., Jones, P. H., Dixon, T. J., and Blake, B. F. (1984). Counting seabirds at sea from ships: A review of methods employed and a suggestion for a standardised approach. *Auk, 101*, 567–577.

Webb, A., and Durinck, J. (1992). Counting birds from ships. In J. Komdeur, J. Berelsen, and G. Cracknell (Eds.), *Manual for aeroplane and ship surveys of waterfowl and seabirds* (pp. 24–37). International Wildfowl Research Bureau Special Publication No. 19.

Weilgart, L. S. (2007). The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology, 85*(11), 1091–1116.

Zeidler, U., Nehls, G., Bräger, S., Kosarev, V., and Flamme, J. (2022). *How to manage light emissions to avoid migratory songbird collisions at an offshore construction site*.

Appendix 1

Joint Nature Conservation Committee

SEABIRDS AT SEA TRIP DATA

Date ..... Base Name ..... Sheet ..... of .....

TRIP KEY	TIME	BASE ACTIVITY	SCAN ANGLE	TRANS WIDTH	SPECIES COUNTED	DURATION (mins)	OBSERVER(S)	NO. OBS	NOTES

SEABIRDS AT SEA ENVIRONMENTAL SHEET

TIME (GMT)	WIND DIRN	WIND FORCE (B'fort)	SEA STATE	SWELL HEIGHT	VISIBILITY	CLOUD (Oktas)	RAIN	SUN STRENGTH	SUN DIRN	NOTES

Figure 1: ESAS Trip Sheet

Joint Nature Conservation Committee

SEABIRDS AT SEA OBSERVATION SHEET

SHIP ..... OBSERVER .....

DATE ..... PAGE ..... OF .....

For office use

Coded:

Checked:

	TIME	SPECIES	AGE	PLU	NUM	DIST	DIRN	FLY	SEA	PREY	TR	NOTES
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

Figure 2: ESAS Observation Sheet

Joint Nature Conservation Committee

SEABIRDS AT SEA NAVIGATION SHEET

;HIP ..... OBSERVER (s) .....

)ATE ..... SHEET ..... OF .....

TIME	St/ Mid/	Latitude	N/S	Longitude	E/W	Course	Speed

Figure 3: ESAS Navigation Sheet

Template: SAS cover page
(according to FTZ Büsum, BSH version, Status: July 2013)

SHIP: ..... BEOBACHTER/ IN: .....

DATE: .....

Number of SAS positions forms: ..... PORT/STARBOARD SIDE: .....

METHODE:

All species: ..... Transect width: ..... m

Flight directions (absolut/relative): .....

SHIP TYPE: ..... SPEED: ..... Knoten

POSITION OF OBSERVER: Top deck .....
Navigation bridge wing.....

OBSERVATION CONDITIONS:
SEA STATE: ..... VISIBILTY: ..... km

EXTRAS (yes/no):

Ruller for transect distinction: .....

Opeation WEA (on/off): .....

Registration of vessels: .....

Registration of fronts/foam line: .....

Behavioural observations (complete/no): .....

WEATHER:

.....

.....

.....

SHIP POSITIONS:

.....

.....

.....

REMARKS:

.....

Figure 4: BSH Ornithological Recording Form

Template: SAS Bird Count Form
(according to FTZ Büsum, BSH version, Status: July 2013)

SHIP: ..... *OBSERVER:* ..... *DATE:* ..... *SHEET NO:* ..... *OF:* .....

Distance:
F = flying
A = sw., 0-50m
B = sw., 50-100m
C = sw., 100-200m
D = sw., 200-300m
0 = sw., A-D
E = sw., >300m
W = sw., false site

Transekt:
1 = outside
2 = inside

Flight directions:
1 = undirected
otherwise: all flight directions acc. to compass rose (10° - 360°)

Associated with:
12 = front
13 = foam line
14/ 1 / 16 = wood/ garbage/ oil
17 = Macroalgae, seaweed
18/ 21 = own / other ship
19 = ON own ship
26 = fishing vessel
22 = buoy; 27 = ice; 28 = land
29 = sand bar (102 = on/ over; 103 = next to)
50 = participating at feeding flock
100/ 101 = set net/ bow net

Behaviour:
30/ 31 = +fish/ -fish (e.g. alcid)
33 = feeding, no details
36 = pursuit flying (e.g. skua)
40 = scavenging
41 = feeding fishery waste
42 = dipping
43 = surface seizing
44 = surface pecking
45/ 46 = deep/ shallow plunging
48 = diving for food
49 = active foraging
60 = resting, sleeping
61/ 65 = courtship/ with hatchling
66 = preening
68 = cleptoparasitism during swiming
69 = (high) circling (gulls)
90 = attackted by cleptoparasit
93 = escape dive
94 = flying up (escape)
97/ 98/ 99 = oil-fouled/ sick/ dead
111 = NOT foraging
116 = embarassement reaction (disturbed)
113 = targeted flight

Time	Species	Age	Pumage/ Cal.years	Numer	Grp.	Dis-tance	Tran-sect	Flight dir.	Flight alt.	Assoc.	Behav.	Notes
➡		SS:			Visibility:							

Prey: 10 = fish, 11 = small fish (beak length), 12 = medium fish (2-5x beak length), 13 = big fish, 21 = herring or sprat, 22 = sandeel, 24 = flatfish, 29 = pipefish, 30 = unident. small particle, 31 = unident. big object, 32 = jellyfish, 34 = worm (e.g. Nereis), 40 = unident. crustacean, 41 = swimming crab, 45 = unident. mussle, 50 = unident. carcass, 52 = dead whale, 53 = dead bird, 54 = garbage, 60 = unident. fishery waste
Flight alt.: 1 = 0-5 m, 2 = 5-10 m, 3 = 10-20 m, 4 = 20-50 m, 5 = 50-100 m, 6 = 100-200 m, 7 = >200 m

Figure 5: BSH Bird Count Form

MARA

An tÚdarás Rialála Limistéir Mhuirí
Maritime Area Regulatory Authority

www.maritimeregulator.ie

NOVEMBER 2025