Irish Whale and Dolphin Group

Examining Standards of Baseline Data Acquisition for EIA And Mitigation for Offshore Construction under the EU Habitats Directive

European Cetacean Society Workshop Proceedings 2025

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Introduction

Construction of offshore wind farms is a regulated process in European waters, with the EU Habitats Directive legally underpinning all activities which have the potential to impact the environment. However, regulations are not consistent across jurisdictions, with a variety of approaches taken to solve the problems of minimising environmental impacts. Some European countries (i.e. Germany, Denmark, Belgium, the Netherlands) and the UK, with more mature offshore wind industries, are in a position to inform countries which are only now embarking on offshore wind development (i.e. Ireland, France, Spain, Sweden, Portugal, Baltic and Mediterranean States) of the successes and failures of their established regulatory frameworks. This workshop seeks to capitalise on that experience to inform other countries in Europe, and to consider any potential advantages of a more homogenous approach in European waters. The consenting process is new in many countries and currently operating in a guidance vacuum in two key areas: the standards for baseline data acquisition, and standards for underwater noise mitigation. Outputs from this workshop will give regulators in all jurisdictions an opportunity to include up-to-date evidence-based European expertise into upcoming assessment and review in these areas.

Mitigation For Underwater Noise During Windfarm Construction – The Irish Case

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To introduce the organisers of the workshop and to provide context: the Irish Whale and Dolphin Group (IWDG) was established in 1990 and is now an internationally recognized all-Ireland eNGO "dedicated to the conservation and better understanding of cetaceans (whales, dolphins and porpoises) in Irish waters through study, education and interpretation". They are an evidence-based organisation operating unique national sightings and strandings databases. Irish waters are productive, diverse, and internationally important for cetaceans with 26 species recorded.

Cetaceans are protected under 1992 EC Habitats Directive (Annex II and IV), Favourable Conservation Status must be maintained and deliberate capture, killing or disturbance of these species in the wild is prohibited. They are also protected under the Wildlife Acts 1976-2018 *any person who injures a protected wild animal… shall be guilty of an offense*, and they are also protected from *wilful interference of breeding or resting place.* The Marine Strategy Framework Directive overarches environmental protection and monitoring, of particular relevance for the workshop is the Good Environmental Status (GES) under Descriptor 11 Energy which includes underwater noise.

Ireland has ambitious targets for offshore wind of 5GW installed by 2030 and 20GW by 2040. While the 5GW target is unlikely to be reached there are to date five bottom-fixed projects in the planning system with a sixth recently withdrawn. The planned construction of these projects, all in the Irish Sea, includes up to 255 turbines supported by monopiles or jackets.

These projects are known as "Phase I" projects, whereby site selection was developer-led under the Irish Offshore Renewable Development Plan (OREDP). This has since been replaced by a State-led system of Designated Maritime Area Plans (DMAPs) under OREDP II. The first site designated under the new system,

Tonn Nua off the south coast with a capacity of 900MW, is coming up for auction in late 2025 and will also be bottom-fixed. Current plans are to rapidly expand the DMAP network to facilitate further construction of offshore windfarms.

Of greatest concern to the IWDG is the underwater noise from impact piling during the construction phase of these and future windfarms in Irish waters. Driving piles deep into the substrate using hydraulic hammers generates high levels of impulsive low frequency noise with the potential to injure or disturb cetaceans over great distances. The projected trend in industry is to use bigger piles to support more powerful turbines, with an associated increase in underwater noise. Noise abatement systems (NAS) are available to reduce the noise in the marine environment during piling; however not all jurisdictions require their use.

In Ireland underwater noise is currently managed by the document *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters (DAHG, 2014).* The document is based in turn on Ireland's first underwater noise guidance document published in 2007. The approach largely mirrors that of the Joint Nature Conservation Committee (JNCC) in the UK at that time and is focussed on mitigation for noise during seismic surveys. It is inadequate to deal with the differing scenarios and much greater levels of noise from piling, as the protocols merely attempt to establish that no cetaceans are present in a 1000m radius from the noise source over a 30-minute period prior to start-up. The guidance also incorporates soft starts; does not allow the use of passive acoustic monitoring (PAM) as a mitigation method during night-time or periods of poor visibility; does not allow acoustic deterrent devices (ADDs); and does not require a shut-down if an animal is detected in the mitigation zone following start-up; however, in contrast to guidance in other jurisdictions, temporary threshold shift (TTS) is considered to be an injury. The inadequacy of the guidance is acknowledged by the State and an update is underway at time of writing.

The Phase I windfarm projects were put in the difficult position of having to make their planning applications, including Environmental Impacts Assessment Reports (EIARs), without up-to-date guidance for underwater noise. In this vacuum the developers took a range of approaches which An Bord Pleanála (ABP), the Irish planning authority, found less than satisfactory. ABP to date has made a number

of Further Information Requests (FIRs) which included the following requests and observations:

Marine strategy Framework Directive: Model, map and present the areal and temporal extent of the potential impact of the proposed development (accounting where appropriate for each design option), for the full construction and operation campaign for… modelled impulsive noise (D11C1) with and without abatement; and modelled continuous noise (D11C2).

TTS: The 2014 National Parks and Wildlife Service (NPWS) 'Guidance…' notes that sound sources with the potential to induce TTS in a receiving marine mammal has the potential to cause both disturbance and injury. This guidance has a statutory basis under Regulation 71 of SI No. 477 of 2011, and refers to the "offence to injure" under the Wildlife Act, 1976, noting that TTS "may constitute such an injury".

Noise abatement systems: The review must consider the range of suitable abatement measures available, including consideration of, at a minimum, bubble curtains, casings, resonators, and alternative hammer/piling technologies to reduce noise emissions, and set out in detail the suitability of such measures for the construction of the proposed development at this location, including restrictions in relation to their suitability, where relevant.

Thresholds: The applicant must also consider and draw on the best available technology and thresholds, including as applied in other EU jurisdictions (e.g. Germany; Belgium; Netherlands; Denmark), to identify and provide for suitable noise abatement to reduce the level and extent of potential noise impacts arising from the proposed development (German and Danish thresholds quoted).

The review of the 2014 Guidance was underway at the time of this workshop, the draft document having been considered by the National Parks and Wildlife Service, the Department of Housing, Local Government and Heritage, and the Department of Environment, Climate and Communication, with inputs from MarEI in University College Cork and Bluewise Marine. A completed draft was to open for public consultation later in 2025 giving an opportunity for the IWDG to make appropriate comments guided by the proceedings of this workshop.

Bottlenose dolphins ©Mags Daly

Integrating Marine Mammal Protection Into Offshore Wind Law And Policy: A European Perspective

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INTRODUCTION

Europe has long led the way in offshore wind development. The world's first offshore wind farm was commissioned at Vindeby in Denmark in 1991 – initially a small-scale demonstration, but a signal of what was to come. After a slow start in the 1990s, rapid technological advances and growing political commitment to climate action drove significant expansion from the early 2000s. Today, offshore wind is a cornerstone of Europe's clean energy strategy.

However, as the industry expands into more sensitive and less-studied marine environments, particularly in deeper waters, for example, off Ireland and the south of England, the environmental legal frameworks that govern development have become increasingly important. Marine mammals – such as the harbour porpoise and baleen whales – are particularly vulnerable to impacts like underwater noise and habitat disruption. They are protected under environmental law, including under the EU Habitats Directive.

LEGAL FRAMEWORKS FOR PROTECTION OF MARINE MAMMALS

Cetaceans

All cetaceans are European Protected Species – being listed in Annex IV of the Habitats Directive and receiving 'strict protection'. This is the main legal framework for protecting cetaceans in Europe.

The objectives of the Habitats Directive have been enacted in the UK and each EU Member State through secondary legislation since it came into force in the 1990s.

In addition, the bottlenose dolphin and harbour porpoise are listed in Annex II of the Habitats Directive, which means that Member States must designate Special Areas of Conservation (SACs) to protect important habitats for these species and

achieve / maintain favourable conservation status of the species (as per Article 6).

Pinnipeds

The grey and common seal are not European Protected Species (they are not listed in Annex IV of the Habitats Directive). They are, however, listed in Annex II.

In addition, some jurisdictions also offer protection through other frameworks, for example, the Wildlife and Countryside Act and the Marine (Scotland) Act in the UK.

THE HABITATS DIRECTIVE AND 'STRICT PROTECTION'

Article 12 of the Habitats Directive establishes a system of strict protection for the animal species listed in Annex IV(a), which includes all cetacean species together with the Mediterranean monk seal (but allows for derogations from these provisions under defined conditions set out in Article 16).

Article 12, (with emphasis added for its applicability to cetaceans), reads as follows:

1. *Member States shall take requisite measures to establish a system of strict protection for the animal species listed in Annex IV(a) in their natural range, prohibiting*:
    a. *All forms of deliberate capture or killing of specimens of these species in the wild;*
    b. *Deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;*
    c. *–*
    d. *Deterioration or destruction of breeding sites or resting places.*
2. *–*
3. *The prohibition referred to in paragraph 1(a) and (b) and paragraph 2 shall apply to all stages of life of the animals to which this Article applies.*
4. *Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV(a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and*

killing does not have a significant negative impact on the species concerned.

For Annex IV species, Article 12 is the main provision for achieving the objective of the Habitats Directive and ensuring strict protection throughout the whole territory to which it applies.

In contrast, only two cetacean and three pinniped species are protected under Article 6 and the habitat conservation regime.

HABITATS DIRECTIVE - ARTICLE 12 DISTURBANCE

The legal approach to 'disturbance' of cetaceans under Article 12 of the Habitats Directive remains a complex and evolving area of law. Article 12 makes it an offence to 'deliberately disturb' any cetacean species within European waters, reflecting their status as European Protected Species.

However, neither the Directive, nor its implementing legislation provides a specific legal definition of what constitutes 'disturbance' in the context of cetaceans. Instead, Member States rely on EU guidance, national guidance, case law and case-by-case assessments to interpret and apply the law.

In October 2021, the European Commission adopted a guidance document[1] providing legal interpretation and clarifications on Article 12 of the Habitats Directive.

The European Commission's Guidance document states in paragraph 2.3.2.a:

"Any deliberate disturbance that may affect the chances of survival, the breeding success or the reproductive ability of a protected species, or that leads to a reduction in the occupied area or to relocation or displacement of the species, should be regarded as a 'disturbance' in line with the terms of Article 12."

The Guidance goes on to provide a little clarity with respect to marine mammals, stating that:

[1] https://op.europa.eu/en/publication-detail/-/publication/a17dbc76-2b51-11ec-bd8e-01aa75ed71a1/language-en

"Considering their specific life histories (in particular their reproductive strategy or mobility) and the often complex social interactions of some animals, disturbance of individuals can often have impacts on population levels. For example, this would be the case if disturbing a pregnant female or separating a mother from a calf of large, long-living and highly mobile animals with low fecundity, such as marine mammals."

And that:
"Generally, the intensity, duration and frequency of repetition of disturbances are important parameters when assessing their impact on a species. Different species will have different sensitivities or responses to the same type of disturbance, which has to be taken into account. Factors causing disturbance for one species might not create disturbance for another. Also, the sensitivity of a single individual of a certain species might be different depending on the season or on certain periods in its life cycle (e.g., breeding period)."

And therefore:
"A case-by-case approach is therefore required. The competent authorities will have to reflect carefully on the level of disturbance that is to be considered harmful, taking into account the specific characteristics of the species concerned and the situation…. For instance, repeated disturbance of cetaceans by whale-watching boats could have significant impacts on individual specimens, with negative consequences for the local population. On the other hand, sporadic disturbances without any likely negative impact on the individual animal or local population, such as for example scaring away a wolf from entering a sheep enclosure in order to prevent damage, should not be considered as disturbance under Article 12."

Finally, the guidance reiterates that the disturbance also has to be 'deliberate' in order to fall within the scope of Article 12(1)(b). Paragraph 2.3.1, in respect of Article 12(1)(a), states that:

"for the condition as to "deliberate" action in Article 12(1)(a) of the Directive to be met, it must be proven that the author of the act intended the capture or killing

of a specimen belonging to a protected animal species or, at the very least, accepted the possibility of such capture or killing."

The Guidance goes on to provide further advice to Member States on addressing the impacts of underwater anthropogenic noise on cetaceans.

This definition of disturbance has been incorporated into some national implementing legislation. For example, in the UK, the Conservation of Habitats and Species Regulations 2017 (including the offshore regulations, and as amended), implement the Habitats Directive and define disturbance as affecting the ability of animals to survive, breed, rear or nurture their young, or to rest or migrate, or as significantly affecting local population distribution or abundance of the species. In Scotland, the offence also includes 'reckless' disturbance. Notably, these definitions do not refer to individual animals but apply at a species level.

14 - Further guidance: Addressing the impacts of underwater anthropogenic noise on cetaceans

Activities that can cause disturbance of strictly protected marine species, such as cetaceans, include shipping or offshore windfarms through continuous noise and construction, oil and gas exploration, or military activities through impulsive noise. The consequences for cetaceans range from disturbance and masking of the sound used in communication, to short and long-term hearing impairment, physical injuries and even death. Combined with the additional effects of stress, confusion and panic, this can be devastating for individual animals and for whole populations.

As regards shipping, Member States can consider a wide range of preventive measures, including reducing the speed of vessels or rerouting the traffic. Concerning seismic surveys using airguns or offshore construction using pile driving, these activities usually require permits. Therefore, for such plans and projects, the necessary preventive measures can be proposed in the context of environmental impact assessments under the Strategic Environmental Assessment and Environmental Impact Assessment directives.

The challenges in defining appropriate mitigation measures have been recognised on the international level and relevant methodological guidelines have been adopted, for example by ACCOBAMS[62] and ASCOBANS[63] focusing on cetaceans, while the Convention on Migratory Species produced guidelines on environmental impact assessments for marine noise-generating activities. These guidance documents provide a very useful framework for ensuring compliance with the rules under the Habitats Directive. However, their application should always take into account the latest scientific and expert knowledge in the field and should be based on detailed considerations of each particular activity and its effects on particular species.

HABITATS DIRECTIVE – ARTICLE 6

The harbour porpoise, bottlenose dolphin, grey and harbour seals are Annex II species, meaning SACs must be designated for them.

Article 6(2) requires:

"Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive."

The European Commission has provided guidance[2] on what could constitute significant disturbance of a species in a Natura 2000 site. Paragraph 3.5.2 of this guidance states as follows:

"... disturbance does not directly affect the physical conditions of a site; it concerns the species and it may be limited in time (noise, source of light etc). The intensity, duration and frequency of repetition of disturbance are therefore important parameters.

To assess whether disturbance is significant in relation to the objectives of the Directive, reference can be made to the definition of the favourable conservation status of a species given in Article 1(i), on the basis of the following factors:

- *'Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable element of its natural habitats'.*

Any event, activity or process contributing to the long-term decline of the population of the species on the site can be regarded as a significant disturbance.

- *'The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future'.*

Any event, activity or process contributing to the reduction or to the risk of reduction of the range of the species within the site can be regarded as a significant disturbance.

- *'There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis'.*

[2] https://op.europa.eu/en/publication-detail/-/publication/11e4ee91-2a8a-11e9-8d04-01aa75ed71a1

Any event, activity or process contributing to the reduction of the size of the available habitat of the species can be regarded as a significant disturbance.

In that regard effects such as noise, vibrations and isolation of sub-populations of a species are capable of causing significant disturbances for that species. Therefore, failure by a Member State to take appropriate measures to prevent them constitutes a failure to fulfil obligations under Article 6(2) of the Habitats Directive….

Factors such as intensity, frequency and duration of the disturbance may be taken into account to determine its significance, which may vary from one species to another and according to different times and different conditions (e.g. food resources, or through the presence of sufficient undisturbed areas nearby).

Disturbance of a species occurs on a site from events, activities or processes contributing, within the site, to a long-term decline in the population of the species, to a reduction or risk of reduction in its range, and to a reduction in its available habitat. This assessment is done according to the site's conservation objectives and its contribution to the coherence of the network."

ARTICLE 6 IN THE CONTEXT OF MARINE MAMMALS

These definitions still leave considerable room for interpretation, particularly given the highly mobile and acoustically sensitive nature of cetaceans.

Uk Guidance – Harbour Porpoise

In the UK, in June 2020, the Joint Nature Conservation Committee (JNCC) together with Natural England (NE) and the Department of Agriculture, Environment and Rural Affairs in Northern Ireland (DAERA) published advice to competent authorities on what could constitute *Significant Disturbance* within harbour porpoise SACs in England, Wales and Northern Ireland marine areas.[3]

This Guidance reiterated the Conservation Objectives for the harbour porpoise SACs, being:

[3] https://hub.jncc.gov.uk/assets/2e60a9a0-4366-4971-9327-2bc409e09784

To ensure that the integrity of the site is maintained and that it makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters

In the context of natural change, this will be achieved by ensuring that:

1. *Harbour porpoise is a viable component of the site;*
2. *There is no significant disturbance of the species; and*
3. *The condition of supporting habitats and processes, and the availability of prey is maintained.*

The Guidance provides a definition of noise disturbance within a harbour porpoise SAC:

"For the purpose of this guidance, noise disturbance within an SAC from a plan / project, individually or in combination, is considered to be significant if it excludes harbour porpoises from more than:

1. *20% of the relevant area of the site in any given day, or*
2. *An average of 10% of the relevant area of the site over a season."*

The Guidance goes on to provide further detail to help interpret this, noting that because density and abundance of harbour porpoise both within and outside the sites vary considerably by season and year, it is therefore not possible or realistic to aim to maintain a given harbour porpoise abundance in the site.

The guidance therefore recommends that 'significant disturbance' should be interpreted as a reduction of the range of the species within the site or a reduction in the access to available habitat within the site. And that, given that disturbance and therefore access to habitat is usually of a temporary nature, management of noise in the sites should ensure that disturbance does not lead to the deterrence of harbour porpoise from a *significant portion* of the site for a *prescribed period of time* thus ensuring the species has sufficient access to the habitat within the sites.

The guidance further details what 'significant portion of the sites for a prescribed period of time' means before going on to set out how temporary habitat loss is assessed – through the use of Effective Deterrence Ranges, which are fixed disturbance distances for different activities, based on empirical evidence.

The Guidance concludes that:
Implementation of any disturbance management is likely to be challenging given the complexity of marine activities, the relevant regulatory arrangements and the scientific uncertainty surrounding the significance of noise impacts on harbour porpoise. The approach recommended by the SNCBs in this guidance document should encourage best practice mitigation for noise reduction and is intended to be adaptive, i.e., the guidance parameters can change as new evidence is made available.

Danish Guidance
In Denmark and other EU countries, the requirements under Articles 6 and 12 are implemented through national legislation and interpreted through technical guidance.
Underwater noise from the construction of offshore wind in Danish waters has been addressed by guidelines from the Danish Energy Agency. These guidelines were updated in 2023 and specify technical methods for performing numerical prognosis and on-site measurements. Acoustic criteria are stated for compliance, including Permanent Threshold Shift (PTS). Temporary threshold shift and behavioural disturbance.

Summary

Despite these measures, there remains significant scientific and legal uncertainty around what level or type of disturbance constitutes an offence, especially when impacts are temporary, non-lethal or indirect.

Ultimately, defining 'disturbance' in legal terms for cetaceans is a complex task, shaped by uncertainties in ecological science, species-specific sensitivities and differing national approaches.

LEGAL FRAMEWORKS FOR IDENTIFYING AND ASSESSING IMPACTS ON MARINE MAMMALS
Offshore wind projects are subject to two key legal frameworks designed to assess and manage their environmental impacts: the Environmental Impact Assessment (EIA) regime and the Habitats Regulations Assessment (HRA)

process. Both play a central role in evaluating potential effects on marine mammals and mitigating these.

Environmental Impact Assessment (EIA)

The EIA process is governed by the EU EIA Directive (as transposed into national laws) and applies to many large-scale projects likely to have significant environmental effects, including offshore wind farms. The EIA process follows several key stages, throughout which marine mammals are assessed and mitigation measures proposed:

1. *Screening* – is the procedure used to determine whether a proposed project is likely to have significant effects on the environment. It should normally take place at an early stage in the design of the project.
2. *Scoping* – identifies the key environmental issues to be assessed in the EIA, including potential impacts on marine mammals.
3. Baseline data collection – extensive data on marine mammals is collected at this stage, including species presence, abundance, distribution and seasonal patterns, often through vessel surveys, aerial surveys and passive acoustic monitoring.
4. *Environmental Statement* – the developer / applicant prepares and submits a report which includes the information reasonably required to assess the likely significant effects of the development, including predicted impacts on marine mammals (for example, from underwater noise, vessel disturbance and potential barrier effects), and setting out mitigation measures to avoid, reduce or offset those impacts. To ensure the completeness and quality of the Environmental Statement, the developer must ensure that it is prepared by competent experts.
5. *Consultation and decision-making* – statutory bodies (e.g., nature conservation bodies) and the public are consulted before a final decision is made.

Habitats Regulations Assessment (HRA)

The HRA process derives from the EU Habitats Directive and applies to any plan or project that may significantly affect a site designated as a Special Area of Conservation (or Special Protected Area for birds). For offshore wind, this includes

sites designated for harbour porpoise and bottlenose dolphins – as well as the grey and harbour seal (Annex II species). The HRA proceeds in the following stages:

1. *Screening* - assesses whether the project is likely to have a significant effect on a protected site, either alone or in combination with other plans or projects. Where the potential for likely significant effects cannot be excluded, a competent authority must make an appropriate assessment of the implications of the plan or project for that site, in view of the site's conservation objectives. At this stage, as a result of case law, mitigation measures are not considered.
2. *Appropriate Assessment* – if significant effects cannot be ruled out, a more detailed assessment is carried out to determine whether the project will adversely affect the integrity of the site. Marine mammal data from baseline studies and existing literature are critical here, particularly regarding functional use and linkage of the site.
   The scope and content of an appropriate assessment will depend on the nature, location, duration and scale of the proposed plan or project and the interesting features of the relevant site. 'Appropriate' is not a technical term. It indicates that an assessment needs to be proportionate and sufficient to support the task of the competent authority in determining whether the plan or project will adversely affect the integrity of the site.
   An appropriate assessment must contain complete, precise and definitive findings and conclusions to ensure that there is no reasonable scientific doubt as to the effects of the proposed plan or project.
   An appropriate assessment must consider the indirect effects on the designated features and conservation objectives, including identification and examination of the implications of the proposed project for the designated features present on the site, as well as the implications for species present outside the boundaries of the site but functionally linked, insofar as those implications are liable to affect the conservation objectives of the site.
3. *Derogation tests* – if adverse effects on integrity are identified and no mitigation can avoid them; the project can only proceed if:
   a. There are *no alternative solutions*,

b. The project is justified by *Imperative Reasons of Overriding Public Interest* (IROPI), and
c. *Compensatory measures* are secured to *maintain the overall coherence* of the Natura 2000 network.

The HRA is carried out by the competent authority with information provided by the applicant, to determine whether the plan / project will have an adverse effect on site integrity (alone or in combination). The HRA may also conclude whether mitigation / management is needed and can be put in place to prevent adverse effects.

The UK harbour porpoise SAC guidance clarifies that in the case of harbour porpoise, the HRA will need to ascertain that noise disturbance within the site will not displace harbour porpoise from more than 20% of the relevant area of the SAC on any given day or disturb porpoise from an average of more than 10% of the relevant area of the SAC over a season.

However, when the HRA is carried out, there may be considerable uncertainty over project design, schedules and other planned developments. In such cases, a pre-construction condition should be attached to the project approval, requiring an assessment to be undertaken prior to initiating the works to determine if the activities and schedules of this project and of others (relevant for the in-combination assessment) are still within the parameters used to reach the HRA conclusions.

SNCBs will work with Government and regulators to develop this condition, which will be tested, and amended if needed, as projects progress. There should be enough time between the assessment and the start of the construction to allow for the effective implementation of any further mitigation / management considered necessary to satisfy the authorities that the SAC will not be adversely affected.

Summary

Both the EIA and HRA regimes are interconnected and rely heavily on high-quality data and impact predictions. In the context of offshore wind, the growing complexity of projects and ecological sensitivities – particularly regarding

cetaceans – means that these assessments must be rigorous, evidence-based and precautionary in approach.

CONSENTING OFFSHORE WIND DEVELOPMENTS

Denmark – Licence for Preliminary Investigations

In Denmark, the conditions for offshore wind farms are defined in the Promotion of Renewable Energy Act. Under Chapter 3 of this Act, the Danish State holds the exclusive right to exploit energy from wind and water within its territorial waters and Exclusive Economic Zone (EEZ), extending up to 200nm.

The Danish Energy Agency (DEA) serves as the central authority responsible for planning, permitting and overseeing the development of offshore wind farms. Operating as a 'one-stop shop', the DEA coordinates input from relevant authorities to streamline the process for developers.

In Denmark, one of the first steps in the offshore wind permitting process is obtaining a Licence for Preliminary Investigations from the DEA. The licence grants the legal right to carry out site-specific surveys and assessments necessary to evaluate the feasibility and environmental impact of a proposed project.

What the licence permits:

- Grants access to a defined offshore area for the purposes of geotechnical, geophysical and environmental surveys, including:
    - Seabed investigations;
    - Underwater noise modelling;
    - Marine ecology studies (including marine mammals, birds and benthic habitats);
    - Surveys for unexploded ordnance (UXO).
- Allows use of certain survey equipment (e.g., sonar, geophysical arrays), subject to restrictions and requirements detailed in the licence.
- May specify timing and scope of activities to avoid sensitive periods for marine species.
- Requires public availability of survey data, often via national marine data portals or submission to the DEA.

The aim is to collect sufficient data to support the EIA and, if applicable, an HRA.

Environmental Assessment Requirements

While the Preliminary Investigation Licence itself does not require a full EIA at the time of application, it marks the initiation of the EIA process. Once the licence is issued, the developer is expected to:

- Prepare an EIA scoping report, in consultation with the DEA and relevant nature agencies.
- Undertake environmental baseline surveys in accordance with the scope agreed with the DEA. These surveys form the evidence base for the eventual EIA and focus on:
    - Marine mammals, e.g., distribution, abundance, sensitivity to noise
    - Underwater noise predictions and modelling
    - Habitats and species within and around the proposed development area.
- Comply with specific licence conditions on noise mitigation, monitoring programmes and reporting obligations – particularly where surveys could disturb protected species.

Importantly, impacts on marine mammals are a central concern. The DEA may require:

- A prognosis for underwater noise to assess the likely exposure of marine mammals during piling or survey activities.
- A verification measurement programme to validate actual noise levels during surveys.
- Consideration of mitigation measures such as soft-start piling, exclusion zones and use of Acoustic Deterrent Devices (ADDs).

These requirements are grounded in the legal framework of the Promotion of Renewable Energy Act and detailed in DEA's guidance on underwater noise and environmental assessment procedures.

Licence to Establish / Construction Permit

The Licence to Establish Offshore Wind is commonly referred to as the construction permit and is the second of three key licences issued by the DEA under the Promotion of Renewable Energy Act.

Overview

- This licence cannot be granted until the EIA process has been completed, consulted on and approved.
- It legally authorises the developer to begin construction of the offshore wind farm, including turbines, foundations, substations and associated infrastructure.
- The EIA must demonstrate that environmental impacts, particularly on protected species such as cetaceans, have been assessed and mitigated to an acceptable level.

Environmental Assessment Focus:

- The developer must:
    - Submit a final EIA report incorporating results of baseline surveys and stakeholder consultation.
    - Address underwater noise impacts through noise modelling, mitigation plans (e.g., soft-start piling, ADDs), and a verification measurement programme.
    - Demonstrate that the project will not have a significant adverse effect on Natura 2000 sites or European Protected Species (e.g., harbour porpoise). If significant effects cannot be ruled out, an HRA must be included.
- The DEA may impose specific conditions in the construction permit related to:
    - Seasonal restrictions on noisy activities
    - Real-time monitoring during construction
    - Submission of environmental monitoring data.

In summary, the Licence to Establish is only granted if the environmental assessment proves the project is compatible with national and EU environmental laws. It is the key legal checkpoint ensuring marine environmental protection before construction begins.

UK

Offshore wind development in the UK is governed by different regulatory frameworks across its four jurisdictions, reflecting devolved powers over marine and energy planning.

In England, offshore wind farms with a generating capacity of 100 MW or more are classed as Nationally Significant Infrastructure Projects (NSIPs) and require a Development Consent Order (DCO) under the Planning Act 2008. These are granted by the Secretary of State for Energy Security and Net Zero following examination by the Planning Inspectorate. Projects below 100 MW are consented under Section 36 of the Electricity Act 1989 and require a separate marine licence issued by the Marine Management Organisation (MMO) under the Marine and Coastal Access Act 2009.

In Wales, the consenting regime depends on both the project's location and capacity. For inshore waters (0–12 nautical miles), projects between 1 MW and 350 MW require Section 36 consent from the Welsh Ministers. In offshore waters (12–200 nautical miles), Welsh Ministers consent projects between 50 MW and 350 MW. Projects over 350 MW, regardless of location, require a DCO under the Planning Act 2008, granted by the Secretary of State.

In Scotland, all offshore wind farms require both a Section 36 consent under the Electricity Act 1989 and a marine licence, issued either under the Marine (Scotland) Act 2010 for inshore waters or the Marine and Coastal Access Act 2009 for offshore waters. This applies regardless of project size and reflects Scotland's devolved control over marine licensing and energy consents.

The DCO process in England and Wales is a "one-stop shop", allowing applicants to secure a full suite of powers to construct both offshore and onshore works. Where required, a marine licence may also be granted alongside the DCO. The final consent takes the form of a statutory instrument and is subject to conditions—such as requirements for adaptive monitoring and mitigation.

Although the UK is no longer part of the EU, it continues to implement the EIA and Habitats Directives through domestic legislation. Therefore, Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) remain mandatory parts of the consenting process for offshore wind.

Recognising the need to accelerate deployment, the UK Government—through the British Energy Security Strategy (BESS)—has identified long consenting timelines as a barrier to progress. In response, it is introducing reforms to streamline the process while maintaining environmental protections.

ENERGY ACT 2023, STRATEGIC COMPENSATION AND THE MARINE RECOVERY FUND

In response, the UK has introduced a range of reforms, including measures under the Energy Act 2023 and the launch of the Offshore Wind Environmental Improvement Package (OWEIP). These initiatives aim to streamline environmental assessments and improve the efficiency of the planning system while maintaining high environmental standards, including those for marine mammals.

Under the OWEIP, the UK Government has introduced new approaches to facilitate offshore wind development. Two notable tools are strategic compensation and the Marine Recovery Fund. Strategic compensation allows for coordinated, government-led or sector-wide compensatory measures, rather than requiring individual project developers to deliver bespoke compensation.

The Marine Recovery Fund provides a mechanism for developers to contribute financially to wider marine environmental improvements, i.e. potentially funding research, habitat restoration or strategic compensation schemes. This is currently under consultation.

These initiatives aim to maintain compliance with the Habitats Regulations while supporting faster and more predictable consenting.

COMPENSATION UNDER THE HRA PROCESS AND IMPLICATIONS FOR MARINE MAMMALS

In recent years, it has become increasingly common for offshore wind projects to trigger the need for compensation under the HRA process, where adverse effects on the integrity of protected sites cannot be ruled out. This has been most evident in relation to seabird species, with compensation measures such as artificial nesting structures now secured within DCOs, including for kittiwake at projects such as Hornsea 3 and Hornsea 4.

With multiple SACs designated for harbour porpoise in UK waters, similar requirements could arise for marine mammals. Potential compensation for harbour porpoise could include measures such as spatial and temporal restrictions on high-noise activities, investment in bycatch reduction programmes, vessel speed restrictions in sensitive areas, or funding for broader conservation research. However, defining ecologically robust and legally acceptable compensation for mobile marine mammal species remains complex and is likely to require a strategic, evidence-based approach, thus reiterating the importance of sufficient baseline data collection.

UK POLICY ON REDUCING MARINE NOISE

In January 2025, the UK Government published its policy on reducing marine noise.[4] This reiterated the UK's ambitions to meet its nature targets and achieve good environmental status and that marine noise reduction would be a key part of this.

With regards to reducing noise from offshore wind, the Government announced that it intends to consult on an offshore wind piling noise limit, following which, it will work with offshore wind developers to gather data during piling activities.

The policy also set out that, given the current evidence gaps regarding harbour porpoise disturbance, developers can propose alternative Effective Deterrent Range values in their licence applications and / or post consent requirement discharge requests, provided they are supported by robust evidence appropriate to the case in question.

In addition, Defra and the devolved administrations will be considering noise threshold values for introduction across all UK waters for both impulsive and continuous noise sources. These threshold values would be levels below which Good Environmental Status on underwater noise is expected to be achieved and would be in addition to what currently exists in some harbour porpoise SACs.

[4] https://www.gov.uk/government/publications/reducing-marine-noise/reducing-marine-noise#:~:text=From%20January%202025%2C%20given%20the,to%20deliver%20noise%20reductions%20through

IRELAND: EARLY-STAGE DEVELOPMENT WITH UNIQUE ENVIRONMENTAL CONSIDERATIONS

Ireland is at the beginning of its offshore wind journey. As an EU Member State, Ireland is required to implement the EIA Directive and Habitats Directive, meaning offshore wind proposals must undergo both Environmental Impact Assessment and, where relevant, Appropriate Assessment of impacts on protected sites and species. This includes strict protections for marine mammals under Annex II and IV of the Habitats Directive.

While species such as harbour porpoise have been a focal point of North Sea assessments, Ireland's Atlantic waters host a different set of species, including baleen whales, requiring tailored baseline studies and mitigation.

As Ireland moves forward, it must ensure that the ecological sensitivities of its unique marine environment are fully integrated into the offshore wind planning process.

Ireland's 2014 Guidance to manage the risk to marine mammals from man-made sound sources in Irish Waters requires updating. Updating this guidance will ensure that Ireland's marine environmental protections align with current scientific knowledge, technological advancements, and international conservation obligations.

CONCLUSIONS - BALANCING CLEAN ENERGY AND MARINE MAMMAL PROTECTION

Europe is leading the way in both offshore wind development and marine mammal protection, demonstrating that these two goals can coexist. It is crucial for law and policy to remain dynamic and science-informed, adapting to new knowledge and emerging industries. Specifically, robust baseline data collection and targeted mitigation measures are key to ensuring that offshore wind projects minimize their impact on marine life. As new offshore wind industries develop, it's valuable to look to jurisdictions like Denmark and the UK for guidance. However, we must also consider the unique characteristics of the local environment—such as Ireland's deeper waters, larger EEZ, and increased presence of baleen whales—which require tailored legal and environmental frameworks. The future of both offshore wind and marine mammal protection hinges on our ability to balance innovation with careful, science-driven decision-making.

Interpretation Of Underwater Noise Modelling To Inform Impact Assessment And Mitigation Measures

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The presentation provided a high-level overview of impact assessments and their purpose, with a particular focus on aspects of underwater noise relevant to the offshore wind industry in relation to marine mammals (e.g. Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) in hearing). This was put into context with an example using Hornsea 4 in the Southern North Sea. Followed by mitigation measures that may be used during the construction of an offshore wind farm, and a brief outline of threshold approaches to mitigation, which are used by some countries in mainland Europe and are being considered / assessed for implementation in other countries, including England, Wales, and Ireland.

All aspects required of a project should be proportionate to the risk, this includes the impact assessment, the requirement for baseline data and site characterisation, the site-specific surveys (if needed) and any mitigation measures required. In the case of offshore wind these are larger scale projects, with several impact pathways typically needing assessed, including underwater noise (UWN), vessel disturbance, barrier effects and impacts on prey.

Understanding and assessment of UWN was presented in detail, giving an outline of what impulsive (e.g. pile driving) and non-impulsive (e.g. boat traffic) noise is, and what this means relative to the ecology and physiology of marine mammals. A key conclusion when assessing UWN relates to whether animals are predicted (through UWN modelling) to experience TTS or PTS. The latter, irrespective of jurisdiction, is considered injury, and is defined as a permanent loss of hearing sensitivity at a particular frequency, caused by high sound exposure. Whereas TTS is temporary but recoverable loss of hearing sensitivity at a particular frequency. In the case of TTS, for some jurisdictions such as Ireland, this is considered injury, whereas in the UK, it is not (and is more likely to be considered a proxy for behavioural disturbance in population-level assessments). Furthermore, both PTS and TTS are assessed in terms of instantaneous, meaning the impact occurs

instantly (i.e. a loud noise instantly resulting in a loss of hearing sensitivity) or cumulatively, where the animal develops the loss of hearing sensitivity over time with persistent exposure to the sound source (typically modelled as 24 hours of exposure).

As the above outlines, assessment of UWN is complex and has many steps. The assessment will consider different metrics depending on the type of noise assessed (i.e. impulsive or non-impulsive) and thresholds depending on the species of marine mammal (which are defined by broad species groups) and whether the assessment is for instantaneous or cumulative sound exposure. To help explain this process, the presentation provided an example using Hornsea 4 (https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-000734-A4.4.5 ES Volume A4 Annex 4.5 Subsea Noise Technical Report Part 2.pdf). An overview of the key findings of the UWN modelling, and how to undertake and interpret the assessment of predicted impacts on commonly occurring species in European waters (bottlenose dolphins, harbour porpoise and harbour and grey seals) was provided. For harbour porpoise, the modelling predicted that the maximum range from a monopile installation for instantaneous PTS was 2.9 km, and for instantaneous TTS was 6.6 km (noting that TTS is not considered injury in UK waters). In this case, the example concluded that the impact was 'slight', "with very little chance of disturbance from pile driving resulting in any effect on vital rates or population level changes.....and is not significant in EIA (Environmental Impact Assessment) terms" (https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-000706-A2.4 ES Volume A2 Chapter 4 Marine Mammals.pdf).

Consequently, in relation to mitigation "the pilling MMMP (Marine Mammal Mitigation Plan) will include measures to ensure the risk of instantaneous PTS to marine mammals is negligible and will be in line with the latest relevant available guidance." At the time of assessment, a draft MMMP is provided with the submission, noting that time between submission and, if approved, construction, is typically a number of years. Therefore, the final MMMP used at the time of construction (given changes to guidance over this time period) can look very

different (as compared to the draft MMMP). Mitigation measures are likely to include Marine Mammal Observers (MMOs), and potentially Passive Acoustic Monitoring Operators (PAMOs). Other commonly used approaches include deploying Acoustic Deterrent Devices (ADDs) prior to starting pile driving to deter animals away from the predicted (based on the UWN modelling results) instantaneous PTS zone of impact. Whilst in some countries such as Germany, The Netherlands and Belgium have noise thresholds, whereby the noise, at 750 m (an industry standard) cannot be greater than a country-specific dB level. Other jurisdictions, including England, Wales and Ireland are exploring / considering implementation of a threshold approach to underwater noise.

In addition, there are primary noise mitigation systems (NMS) and secondary noise abatement systems (NAS) that can be employed. Often, to reach a threshold (as required in Germany, The Netherlands and Belgium), NMS and/or NAS is required. NMS includes approaches such as optimising piling components, a pile cushion, and/or a vibratory hammer. However, there are limitations to these and other NMS, including only small reductions in noise can be achieved, uncertainty in effectiveness of some options, and some being constrained to shallow water and/or particular substrate types. NAS options include bubble curtains, hydro sound dampers and cofferdams which, depending on environmental conditions, each of these could decrease Sound Exposure Levels (SELs) from between 8 -23 dB. Although bubble curtains are used regularly in the waters of mainland Europe (meaning we know more about their effectiveness and constraints), other techniques such as cofferdams are still in the conceptual stage.

The presentation considered the initial findings of employing a threshold approach in English and Welsh waters (A noise limit for offshore wind piling driving: feasibility assessment and pilot programme design - ME5618). This desk-based study concluded that it would not be possible to achieve the German threshold in these waters, even with combined NAS. This is largely down to a combination of a larger range of depths and water currents (which in turn have impacts on how sound travels and the effectiveness of NAS itself) in English and Welsh waters. Based on over 60 realistic scenarios modelled, the desk-based study found that double NAS deployment would be needed to reduce PTS injury to

below 1 km for all species groups, which is mitigatable. Therefore, it is likely that, if thresholds were applied in England and/or Wales (and likely Ireland too, given the similar bathymetry and environmental conditions), the dB limit would need to be country and perhaps location (within country) specific, considering these bathymetric and environmental factors.

There are a number of points to consider when assessing the impact of UWN on marine mammals, and when interpretating modelling results. For example:

- a recent study (*ORJIP: Range dependent nature of impulsive noise (RaDIN) | The Carbon Trust) has demonstrated that assumptions in UWN impact assessments may result in an overestimate of auditory injury impacts.
- More work needs to be done on understanding the effectiveness of NMS and NAS under varying conditions.
- Understanding when impulsive noise becomes non-impulsive is particularly important, as the former has a much greater impact on marine mammals with respect to loss of hearing sensitivity.
- Whether TTS should be considered as injury or not continues to be a contentious point, that is not agreed upon across jurisdictions and is not a minor issue, as mitigating out to predicted TTS impact zones, particularly if out to cumulative impact zones (rather than just instantaneous), would certainly require a combination of NMS and/or NAS.

Lastly, it is important to remember that excessive precaution and uncertainty may negatively impact the transition to renewable energy. To address this issue, regulators and their statutory advisors need to provide clear guidance on assessment of impacts on marine mammals, and engage with key stakeholders (e.g. eNGOs, environmental consultants, offshore wind developers) to work together to reduce key knowledge gaps, and to ultimately aid an ecologically responsible transition to renewable energy.

Humpback whale ©Simon Berrow

Informing National Noise Guidance Through GOMOREUS: An Irish Perspective on Evidence-Based Underwater Noise Management and Mitigation

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Ireland has ambitious plans for the near-term roll-out of offshore renewable energy at scale, with targets of 5GW of energy to be delivered by offshore wind by 2030, on route to net zero by 2050, which will mark a clear shift in the use and management of the Irish marine space. This will result in an increasing number of sources of both impulsive and continuous underwater noise within the national maritime territory.

Obligations for the regulation and management of underwater noise arise from EU legislation including both the Habitats Directive and from the Marine Strategy Framework Directive (MSFD). There has been considerable experience at the European scale in the practical roll-out of Offshore Renewable Energies (ORE). The existing guidance in Ireland for the management of underwater noise developed by the National Parks and Wildlife Service (NPWS) in 2014, are underdeveloped for the context of the forthcoming ORE expansion and do not reflect recent advancements in scientific knowledge. This regulatory gap is creating uncertainty for developers and challenges for regulators on how to ensure compliance with EU legislation and how to execute accurate environmental impact assessment and marine mammal mitigation plans.

In order to ensure that Ireland has a practical framework for the management of noise compliant with obligations under European Directives, the GOMOREUS project (*Guidance on Managing Offshore Renewable Energy Underwater Sound*) was funded under the Marine Institute's Research for Policy Call 2023. This is a collaborative project with University College Cork, Aarhus University and NIRAS. The project was established to develop harmonised guidelines on the

management of underwater noise including based on European best practices developed through experiences in North Sea countries including Denmark, Germany and the Netherlands.

The GOMOREUS project has compiled and synthesised data, reviewed international regulations and thresholds, and undertook scenario based acoustic impact modelling to help support the update of Ireland's national underwater noise guidance. Technical modelling scenarios were chosen to demonstrate the outcome of applying different legislation to a hypothetical, yet realistic pile driving scenario in Irish waters. A pile driving scenario typical of planned ORE developments was selected for modelling. This included a 15 m diameter steel monopile (larger than current monopiles but in line with projected future plans) at two separate locations within the Irish and Celtic Sea, respectively, representative of similar sites targeted for ORE development in Irish waters. Methodology for the noise modelling was adapted from Tougaard and Mikelsen (2023). The purpose of the modelling was not to provide accurate predictions of noise exposure at each site, but to allow the illustration of different regulatory approaches to the same piling scenario and demonstrate what mitigation measures may be necessary to ensure environmental compliance. Modelling outputs demonstrated that noise propagation was similar at the two locations. Results indicated that the key species of concern were harbour porpoise, and even more so, minke whales. The Danish approach was found to demonstrate more mitigatable approaches for all marine mammal species compared to the German threshold. For harbour porpoise, Permanent Threshold Shift (PTS) risk can be limited to 200 m with 10 dB (Very High Frequency-weighted) noise abatement. For minke whales, greater attention is needed with uncertainty in Temporary Threshold Shift (TTS) thresholds; 25 dB (Low Frequency-weighted) noise abatement needed to limit PTS risk to 200 m. Current noise abatement systems (e.g. bubble curtain systems) would be just about effective to mitigate the noise impacts demonstrated, and systems are only expected to improve with ORE advancement.

Research outputs from GOMOREUS, including the literature synthesis and modelling scenarios have directly informed the drafting of updated national guidance. Several key scientific developments were considered in the revision of the 2014 guidance. This includes the use of M-weighting by Southhall et al. (2007)

has been overridden by a review of more contemporary research by Southall et al. (2019) and NMFS (2018). The 2014 legislation also considers TTS as an injury and the level of strict protection applied to all marine mammals under Annex IV of the Habitats Directive. However, TTS is, by definition, considered temporary and not generally considered to have population level impacts for marine mammals. PTS may directly affect the long-term fitness of animals, their ability to reproduce and thereby maintain populations, and therefore is more widely adopted as the appropriate threshold of strict protection under the Habitats Directive and MSFD. This distinction is currently discussed in the development of the updated guidance. Updated knowledge on noise sources in the marine environment were provided, as well as the inclusion of modelling as a risk minimisation approach. In addition, technical modelling scenarios from GOMOREUS were used to illustrate that large scale piling projects in Irish waters will require additional risk minimisation measures, including noise abatement (e.g. bubble curtains) and that species specific approaches may need to be considered.

This work is being conducted in close collaboration with the Department of Housing, Local Government and Heritage and National Parks and Wildlife Service. The draft guidance is now undergoing internal and external review before it will be released for public consultation. Ireland has a timely opportunity to build smart flexible guidance grounded in international best practices to avoid early mishaps in the regulation of ORE expansion in Ireland. Insights from this current workshop are also expected to be essential knowledge which will further contribute to the development of updated national noise guidance in Ireland.

Pilot whale ©Conor Ryan

Lessons Learned From Offshore Developments In Germany, Current Perspectives And Research Needs

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The European Union and European Commission have agreed on several directives that outline the scope for how a conformant expansion of offshore wind energy shall be conducted. Among them the most important are:

- *the Habitats Directive*
    - prohibits deliberate killing or capture of animal species which need high protection (Injury)
    - prohibits to harass or disturb animals with population level consequences (Disturbance)
    - System of strict protection (§12-16) (Natura 2000 network)
- *the EIA-Directive* (Environmental Impact Assessment Directive)
    - "Member States shall adopt all measures necessary to ensure that, before consent is given, projects likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location are made subject to a requirement for development consent and an assessment with regard to their effects."
- *and the MSFD* (Marine Strategy Framework Directive)
    - Descriptor 11 (underwater noise and energy): Good environmental status must be reached
    - LOBEs (Level of onset of biologically adverse effects)
        - One target: Maximum of < 20 % of the area may be "disturbed" per day or < 10 % per year
        - No thresholds or levels agreed yet and reporting on "Good environmental status" or rather a good overall state of natural environs must be achieved and reported,

All of these directives have been used to assess the impact of the expansion of offshore wind energy to some extent. It must be said that while both the habitats directive as well as the EIA-directive are directly applicable, this is not true for the MSFD and therefore extreme caution must be applied, when using any of the preliminary values proposed by OSPAR ICG Noise, HELCOMs EG Noise or the EUs TG NOISE within an application context by EU member states.

Germany has always used the precautionary principle in combination with an indicator species (the harbour porpoise, *Phocoena phocoena*) since introducing a then called precautionary threshold in 2008 in a combined approach by the Federal Agency for Nature Conservation, the Federal Environment Agency and the offshore windfarm permitting agency the Federal Maritime and Hydrographic Agency (Juretzek et al. 2021). The porpoise as indicator species shall ensure that all species covered as protected species shall be protected based on the existing knowledge at the start of 2007, when the indicator species and thresholds were determined. The results of some studies that later appeared in the peer-reviewed literature, were already available then. They gave concerns about the effect on the auditory system (Lucke et al. 2009) and the effect on behavioural reactions measured as displacement (Carstensen et al. 2006, Tougaard et al. 2009) ranging up to 20 km from pile-driving. Own measurements were first conducted from 2008 – 2011 at the first offshore wind farm in Germany, *alpha ventus* (Dähne et al. 2013). Even though at that time only initial measurements were available that showed that noise mitigation using bubble curtains would be possible (Würsig et al. 2000, Lucke et al. 2011), it was decided to promote the decided threshold value for injury fixed at a single strike SEL_{SS} of 160 dB re 1 µPa²s in 750 m distance and L_{P-P} of 190 dB re 1 µPa both in 750 m distance to a guidance document agreed by the German Bundestag the so-called “Noise Mitigation Concept” (NMC, BMU 2013). In the noise mitigation concept it was assumed that porpoises would be displaced to roughly 8 km when the noise would be attenuated to levels below an SEL_{SS} of 160 dB re 1 µPa²s in 750 m corresponding to an SEL_{SS} of 140 dB re 1 µPa²s using simple propagation models in 8 km. This assumption was basically confirmed afterwards to hold true in most cases (e.g. Dähne et al. 2017, Brandt et al. 2018). Also the assumption that porpoises are the most sensitive species has to date not been disproved.

The NMC provided several aspects that were viewed both as positively and negatively from the NGOs and the industry, showing that it was in general a good compromise:

- It provided a basis to allow offshore pile-driving under agreed conditions creating legal certainty both for applicants and authorities vs. the issue of permitting on a case-by-case basis. It was clear that noise mitigation had to be applied to achieve the threshold values.
- It provided a basis for mitigating the risk of injury by providing a single strike metric that was easy to monitor and abide by, by using real time monitoring and fast reporting for each pile.
- It provided a basis for mitigating population level consequences of disturbance by limiting the duration of pile driving to ~3 hours and including guidance when and where sensitive time periods and areas would lead to stricter measures based on a 10 % area criterion for non-sensitive time periods/areas and 1 % area criterion for sensitive time periods/areas.
- It created a common understanding about necessary development of mitigation measures that still needed to be developed and sparked this development with overall great success (Dähne et al. 2016, 2017).
- It provided solutions to abide by the thresholds using real time monitoring combined with instrumentation at the pile driving ship to control for emitted sound levels and adjust hammer energy in real-time.
- It works in close overlap with the monitoring and baseline data guidance the StUK (Standard investigations of effects of offshore wind energy on the marine environment, BSH 2013).
- It provided an easy to understand approach.
- It was questioned by both applicants as well as nature conservation NGOs and discussed to a level that made both sides nowadays be at ease with the regulation (Dähne et al. 2016).

There could be arguments made that a more species centred focus is necessary in other areas of Europe where more sensitive species occur, like potentially minke whales, but our knowledge on those species is still scarce and even though first

data on audiograms are available now (Houser et al. 2024), the uncertainties are still huge. So even after 12 years the NMC provides a good and applicable basis for regulation and is to my knowledge the only concept that has been tested for its efficacy (Brandt et al. 2018, Juretzek et al. 2021) to actually protect animals from harm.

Some short words are also necessary to describe the StUK a bit better, it defines:

- The legal requirement before consenting as an assurance for wind farm builders as well as nature conservation authorities and permitting bodies.
- Aims:
    - Determination of the spatial distribution and temporal variations of the protected goods before construction (baseline survey/baseline study).
    - Monitoring the effects of the construction, operation and dismantling phases.
    - Creation of a basis for evaluating the results of the monitoring.

- The baseline is (as an example) defined as follows:
    - 2 years
    - One additional year if there is a pause between last year and building start >2 years
    - Complete new baseline if > 5 years
    - Aerial surveys, PAM, underwater noise…etc.

This can be combined into a list of do's and don'ts when creating EIA thresholds for the future:

The do's:

- EIA thresholds should have a direct impact on project level
- Have to fulfill:
    - Sufficiently reasoned scientific background
    - Practicability – ease of use and understanding
    - Applicability – must be applicable to standard situations with minor differences to reality („universal")

    - Durability – cannot change very often
    - Reliability and planning certainty – On project level and across projects
    - Measurability – Must be easy to monitor and report
    - Good thresholds provide legal certainty
    - Must support protected areas
- Users of thresholds need to have guidance – they are not experts in the field of acoustics

The don'ts:

- Cannot be overly complicated.
- Cannot be difficult to report or measure.
- Cannot be „Paper values" only.
- Cannot be diverse like the multiverse since then they are not "easy to understand and follow by".

In principle it can be said that strict conservation measures must provide a basis for guidance on the construction processes, for calculating necessary finances for mitigation measures, but must also provide for legal certainty for wind farm builders. LOBE and MSFD thresholds are not adequate to regulate EIAs, since they are not easy to use metrics, they do not concern population consequences across borders if applied in one country and are not usable for the injury criterion. Not to the least there simply is no agreed threshold yet, since the process takes very long. It is necessary to implement real time monitoring and fast reporting schemes to be able to adjust during the piling process and metrics must therefore be easy to use providing for monitoring checks during the construction.

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Effects Of Seismic Surveys On Harbour Porpoises

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Carbon Capture and Storage (CCS) is a suggested technology to counteract climate change by pressing technically produced or separated carbon dioxide under high pressure into suitable geological sediments, usually at least 2.000 m deep. Often those solutions are searched for in marine offshore areas rather than in terrestrial regions, due to public concern about the consequences. To explore and monitor storage capacities under the ocean floor, surveys using seismic airguns need to be conducted repeatedly over multiple years in the same area, first to explore the so-called “reservoirs” and later to monitor for potential leakages and connecting pathways as a tool to manage the reservoirs. Airguns emit loud sound impulses, similar and but often exceeding broadband sound levels during pile driving for offshore windfarms using noise mitigation systems. The source levels emitted increase with the volume of the airguns used and usually depend on the water depth and the necessary penetration depth to reach the reservoir. Different from pile driving, the sound impulses are usually less intense for small sized seismic airgun arrays, and the array is moving with the ship, but the airgun is operated constantly over multiple days or weeks, creating~3-12 impulses per minute depending on repetition rate.

As part of a test exploration of storage capacities under the German North Sea, the Ocean Museum Germany investigated the effect of airgun noise on harbour porpoises in the area. To examine the effect on porpoise acoustic behaviour and distribution, a field study was conducted, acquiring additional data during a research survey close to the Doggerbank Natura 2000 site. To assess porpoise activity and distribution through passive acoustic monitoring (PAM), 11 CPODs were placed in different distances to the survey track. Additionally, four Soundtraps were deployed together with representative CPOD-stations, to record raw data of the sound impulses of the airgun. Porpoise activity and soundscape were recorded in and around the survey area before, during and after the survey, in up to 20km distances. The survey happened from 16th of May to 5th of June using

an array of two GI-guns with 45 in³ each. The activity of porpoises was modelled in relation to the ship tracks as a proxy to sound source and the effect of different variables using GAM models.

The analysis of the data showed that during CCS surveys the porpoise activity significantly decreased in relation to the distance of the airgun within a range of up to at least 10 km. This compares well to studies on effects of seismic surveys on porpoise echolocation activity (Thompson et al. 2013, Pirotta et al. 2014, Sarnocińska et al. 2020). Furthermore, porpoise activity increased after the survey, indicating a return of animals to the exposed area. The measurement of the sound impulse from the airgun yielded an SEL of slightly below 160dB re 1 µPa²s in a distance of 750 m. That means that the SEL is below the German threshold value for underwater noise regulations concerning the injury criteria of the Habitats directive as well as the German Bundesnaturschutzgesetz. Unfortunately, the survey area was redefined and expanded during the survey, caused by weather changes. In result, the survey reached even the stations planned in higher distances towards the track, affecting our original assumption of unaffected stations for a comparative BACI-design. However, the results of the models seem to be robust. Our results also indicate a significant habitat loss during the survey, while we are not able to quantify the number of affected animals due to the moving vessel and movements of animals. This indicates that behavioural reactions distances to seismic surveys have to be reconsidered, since lowering of the source level does not lead to a less concerning reaction distance. This study provides the first evidence that even small seismic surveys need to be considered as stressors in porpoise habitats.

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Thompson PM, Brookes KL, Graham IM, Barton TR, Needham K, Bradbury G, Merchant ND (2013) Short-term disturbance by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises. Proceedings of the Royal Society B 280:20132001–20132001.

Netherlands Framework For Assessing Ecological And Cumulative Effects Of Offshore Wind

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This talk gave an overview of the marine mammal part of the current Framework for Assessing Ecological and Cumulative Effects of Offshore Wind in the Netherlands, referred to by the Dutch abbreviation “KEC”. KEC provides the approach that underlies the permitting for offshore windfarms. It is regularly updated to the latest state of knowledge, supported by a government-funded research programme (WOZEP). The current version is KEC 5.0.
KEC focusses on mitigating the effects of piling noise on porpoises and seals. The Dutch government has set the ecological standard that the effects of disturbance by piling sound should not lead to a population reduction greater than 5%, with 95% confidence. KEC uses modelling of cumulative effects of wind farm development on the North Sea to derive piling noise standards - maximum allowed unweighted broadband single strike sound exposure level – (SELss) at 750 m from the pile - for offshore wind projects.

In summary, the KEC approach includes modelling of the SELss distribution around the pile (depending on environment, pile, hammer and noise abatement measures), estimating the probability of disturbance (using dose-response curves for porpoises and seals), and then calculating the number of animals potentially disturbed per piling event. Summing these numbers over multiple piling days results in so-called ‘animal disturbance days’. These are used as input for population effect modelling, using the interim Population Consequences of Disturbance (PCoD) model developed at the University of St. Andrews.

KEC offers a structured approach for linking the ecological standard to noise standards for offshore wind permits. KEC 5.0 calculations indicate that the latest scenario for international offshore wind development on the North Sea up to 2030 poses no realistic risk of exceeding the NL ecological limit for porpoises when maintaining the proposed 164 dB noise limit for future NL projects. Risk of piling

noise induced PTS in porpoises or seals is negligible with this noise limit. Because not all model assumptions underlying the KEC approach could be validated, monitoring of underwater sound and animal behaviour remains necessary.

Underwater Baseline Noise Monitoring In Italian Waters And ACCOBAMS Area

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Underwater noise monitoring in Italian waters and the ACCOBAMS area in general (Mediterranean and Black Seas, contiguous Atlantic waters) is a standard requirement for major projects involving the marine environment.

Most current projects requiring noise assessment, in Italy, relate to energy activities, such as natural gas extraction, offshore wind farming (which, due to deep waters, will primarily involve floating structures in Italian waters and the Mediterranean in general), and electricity grids. Other projects include cable-laying, breakwater construction, port pile driving, and dismantling of old platforms.

The main acoustic impacts from floating offshore wind farms are expected during construction (due to additional shipping noise and mooring preparation) and operations (from structure and long mooring line vibrations).

Current noise baseline requirements in Italy are inconsistent, ranging from no monitoring to short-term or long-term monitoring (24 hours to permanent during operations), and vary depending on the permitting public administration (local Authorities, Regional, or Ministries).

We currently suggest and push towards the adoption of standardized protocols, with calibrated programmable bottom recorders for data collection, using quick temporary moorings (up to -50m depth), acoustic releases (-50m to -250m depth), or free-drifting acoustic recorders offshore.

Recording periods are typically 24-48 continuous hours per station per session, with recordings up to 48kHz or 96kHz in band. The acquisition of more than a single station is always suggested.

Final reports consider both single strike levels and sound exposure levels (24 hours). Analysis of data from five sample stations across various Italian locations (Genoa, Ravenna, Brindisi, Bari, and Montecristo Island) indicates that shipping noise is the primary and widespread impact, except in the pristine reference station at Montecristo Island. An average increase of +15dB from pristine to trafficked areas has been recorded. The presentation discusses how to manage these findings when delivering baselines and anticipates changes in noise scenarios with the operation of new wind farms and altered traffic routes.

Predicting And Monitoring Impact Of Underwater Noise – The Problematic Case Of The Minke Whale

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The common objective of the Danish and German underwater noise regulations is the protection of marine mammals against injury (from acoustic trauma) and behavioural disturbance during piling operations. The methodologies differ in that the German regulations have one general threshold for noise, while in Denmark thresholds are species-specific and frequency weighted.

In Germany during piling operations sound levels are measured at 750m from a monopile and are required to be < 160dB re 1 µPa^2 s (L_E single strike). This threshold is broadband and unweighted, and is based on behavioural disturbance for harbour porpoise. In Denmark acoustic trauma is regulated through species group-specific thresholds, where cumulative exposure to noise of an animal swimming away from the sound source is modelled. The thresholds are frequency weighted by species group, for instance the limit for minke whales is LE,LF,entire piling < 183 dB re 1 µPa^{2}s. It is notable however that thresholds for behavioural disturbance have not been established for minke whales.

Most sound energy from pile driving is at low frequencies, and this is presumably where baleen whales have their best hearing. Consequently, these frequencies are likely to be where they are most sensitive to injury. Noise abatements systems (NAS) are very effective at reducing noise levels during piling. Current systems essentially remove all energy above a few kHz, however they are less effective at low frequencies. There is a technical limit to how much sound can be reduced. Floating wind farms, deeper waters, and larger piles introduce new acoustic challenges that will test these limits further.

To model cumulative exposure, an animal is at distance R_{start} when piling begins, it is assumed the animal swims directly away from the noise with speed V_{flee}. The source level gradually increases throughout the soft start, and the received level

is estimated for each pulse. This is then summed over the entire pile driving event and compared with the PTS onset threshold for that species group.

As part of the GOMOREUS project a generic unabated piling scenario was modelled for both the Irish Sea and the Celtic Sea. The results indicated that the PTS zone for baleen whales in the Irish Sea under Danish guidance was by far the largest. For instance up to 10471km^2, greater than under the German guidance when the zone was 3181km^2 under identical circumstances. For harbour porpoise and phocids the PTS zones were much smaller in the same locations and seasons, for instance 38km^2 and 77km^2 respectively.

The level of attenuation required to meet Danish regulations for minke whales in the Irish Sea as modelled would be 24.1dB, and for harbour porpoise 10.6dB. Under the German regulations 29dB reduction in noise would be required for all species. The noise reduction required to meet Danish requirements for harbour porpoise is easily achievable using currently available NAS technology in Irish waters. However the requirement for minke whales is more challenging but possibly achievable with best available technology (BAT) gving a 22dB reduction currently. Given the higher frequency weighting for harbour porpoise, 44dB reduction using BAT has been achieved meaning Danish regulatory thresholds can easily be met for this species. The further noise reduction required to satisfy German regulatory standards in the Irish context currently looks unachievable.

Key knowledge gaps have been identified, in particular a better understanding is needed for the hearing of low-frequency baleen whales, their TTS onset threshold, and their behavioural reaction thresholds. In general more information is needed on general minke whale biology, their population structure, movement and migration patterns and their sensitivity to disturbance.

Current regulations, particularly Germany's, are in some sense arbitrary but precautionary, they are designed to limit harm. There is growing political and public demand for quick answers and simple thresholds, which outpaces the speed of research. Regulations must balance achievability with biological protection. It is incorrect to assume that thresholds like TTS are sufficient proxies for disturbance, especially in small or vulnerable populations.

This presentation was based on the report GOMOREUS – Guidance on managing offshore renewable energy underwater sound. Modelling of impact ranges for pile driving in Irish waters Technical Report from Danish Centre for Environment and Energy Aarhus University No. 351 202.

Risso's dolphin © Richard Creagh

Workshop Discussion – Morning Session

FOCUS: NOISE MITIGATION REQUIREMENTS

Moderator Stephen Comerford

WORKSHOP TOPIC 1: IS THE USE OF NOISE MITIGATION (E.G., NOISE ABATEMENT SYSTEMS) EFFECTIVELY A LEGAL REQUIREMENT UNDER EU LAW, PARTICULARLY THE HABITATS DIRECTIVE?

Key Points from Discussion:

- General agreement: If noise reduction methods are available and practical, they should be used to reduce environmental impact.
- It's not just about marine mammals — all species can benefit from reduced noise.
- The Habitats Directive implies that if thresholds are exceeded, mitigation becomes a legal requirement.
- Some disagreement exists around how practical certain techniques are in deeper waters or with floating wind installations.
- There was a comparison to early German regulations, where no one initially knew how to meet them — but innovation followed the regulation.
- Argument: If you set a clear threshold, industry will find a way to meet it. Engineers will develop solutions if the regulatory requirement is firm.
- Economic and certification barriers are still an issue (e.g., insurers won't certify alternatives to driven piles).
- There's concern that focusing only on cost or certification may limit adoption of more environmentally friendly technologies.

WORKSHOP TOPIC 2: HOW SHOULD THE APPROPRIATE NOISE THRESHOLD LEVEL BE CALCULATED TO ENSURE MINIMUM DISTURBANCE? WHAT APPROACHES ARE BEST, GERMAN, UK, DANISH?

Key Points from Discussion:

- German approach: Seen as strict and precautionary, but is based on older data.

- New research suggests lower thresholds for disturbance e.g., 130–135 dB rather than 160+ dB, may be more appropriate.
- Concerns about using data from outdated studies to set thresholds, particularly as species sensitivity and energy propagation in water are better understood now.
- Discussion on the distance and impact radius — some studies show disturbances from unabated piling well beyond estimates.
- The issue of cumulative effects of multiple projects was raised — current thresholds might not reflect combined impacts.
- Ambient noise levels should also be considered — background noise from ships or industry could mean thresholds need local adjustment.
- Some argued that baseline noise levels and ecological importance of the area should influence the threshold decision.

WORKSHOP TOPIC 3: IS IT NECESSARY TO CONDUCT VISUAL OR ACOUSTIC MONITORING BEFORE STARTING PILING, AND SHOULD THERE BE A MANDATORY SHUTDOWN IF SPECIES ARE DETECTED?

Key Points from Discussion:

- Strong support for pre-activity monitoring but scepticism about effectiveness.
- MMOs and PAM operators vary greatly in quality and training across Europe.
- Some felt that mitigation measures (e.g., soft start, ADDs) were used more to "tick boxes" than to truly prevent harm.
- Precautionary principle: assume animals are present, especially in high-value conservation areas.
- Soft starts: There is uncertainty about their effectiveness, and in some cases the sound starts loud right away depending on seabed type.
- Debate about Habitat Directive protection thresholds — TTS (Temporary Threshold Shift) vs. PTS (Permanent Threshold Shift).
- Argument: knowingly causing PTS is a direct violation of the Directive, and shutdown should be mandatory if animals are present.
- Concerns that marine species are treated less rigorously than terrestrial protected species like bats.

- Example from France: a court mandated a shutdown zone during cable laying operations, reinforcing legal accountability.
- Conclusion: need stronger enforcement of shutdown protocols and better integration of new technology in mitigation planning.

WORKSHOP TOPIC 4: WHAT CONSTITUTES AN INJURY TO A CETACEAN? PTS, TTS, DISTURBANCE, DISPLACEMENT? PORPOISE POPULATION LEVEL EFFECTS? DO ALL JURISDICTIONS HAVE GUIDELINES TO DETER DISTURBANCE IN THE CONTEXT OF CONSENTING?

Key Discussion Points:

- PTS is broadly accepted as "injury," while TTS is considered a weaker proxy and not necessarily equivalent to disturbance.
- Disturbance and displacement are often subtle and context-dependent but can result in significant effects—especially with repeated or chronic exposure, or in small, localised populations.
- There is no universal agreement or threshold across jurisdictions. The lack of consistent definitions for disturbance leads to varying mitigation standards.
- TTS is used operationally as a precautionary indicator in some contexts, but it was emphasised that it should not be equated directly with behavioural disturbance or population-level impact.
- Porpoise responses were noted as highly variable; while some individuals may remain, others are displaced, suggesting nuanced behavioural responses.
- The consensus was that better science is needed to link acoustic exposure to biological consequence, but decisions must often rely on imperfect proxies in the meantime.

WORKSHOP TOPIC 5: WHAT EFFECTIVE NOISE ABATEMENT TECHNOLOGY IS AVAILABLE IN ADDITION TO BUBBLE CURTAINS, AND WHAT WILL WORK IN DEEPER WATERS? HOW TO DEAL WITH EVER BIGGER PILES? "BLUE" PILING, FLOATING WINDFARM OR FIXED BOTTOM?

Key Discussion Points:

- Bubble curtains are widely used but lose effectiveness in deeper water or with mobile sound sources (seismic surveys).
- Alternatives mentioned include:
    - Double bubble curtains,
    - Blue piling (low-noise pile driving),
    - Hydro sound dampers,
    - Acoustic deterrent systems (ADDs),
    - Pin piles: considered quieter and more stable
- Floating windfarms present new acoustic challenges due to anchor systems, cables, and motion. Some experts suggested they may be noisier during operation and mooring installation than fixed-bottom turbines.
- Cost concerns for floating were highlighted — floating wind may be up to three times more expensive. Its deployment in deeper waters is likely to expand, but needs tailored mitigation strategies.
- Engineering input suggested that firm regulatory thresholds drive innovation in abatement, "if you set the limit, engineers will meet it."

WORKSHOP TOPIC 6: TRUE QUALITY OF NOISE MODELLING CAN VARY FOR ENVIRONMENTAL ASSESSMENT. ACCORDING TO BEST PRACTICE, WHAT SHOULD LEGISLATION REQUIRE AS MINIMAL STANDARDS FOR EFFECTIVE NOISE IMPACT MODELLING TO INFORM MITIGATION PLANS?

Key Discussion Points:

- Concern was raised that environmental regulators and consultants often lack the technical expertise to critically assess noise models.
- Models are frequently accepted at face value in EIAs, even when based on inconsistent or overly conservative assumptions.
- Best practice should include:
    - Transparent documentation of inputs, assumptions, and propagation conditions.
    - Validation with real-world acoustic measurements where feasible.
    - Inclusion of cumulative noise sources (USBLs, operational vessels).
    - Modelling uncertainty clearly communicated.

- Debate over how precautionary assumptions should be — overly conservative worst-case scenarios can delay or derail projects unnecessarily.
- Real-time acoustic monitoring and dynamic modelling were presented as gold-standard approaches but are rarely implemented due to resource constraints.
- There is a strong call for standardised guidance and minimum legal requirements for noise modelling across jurisdictions to improve consistency and accountability.

OVERALL CONCLUSIONS MORNING SESSION

There is a requirement for noise abatement technology where thresholds can't be achieved, though thresholds under the German system, or for baleen whales under the Danish system, will be challenging to meet as projects use bigger piles and develop deeper waters.

There was skepticism about the effectiveness of mitigation methods such as MMOs, PAM, ADDs and soft starts, but agreement that they have their place. Shutdowns in the event of a detection in the mitigation zone were seen as necessary, requiring observers during operations.

Better evidence is needed linking exposure to injury and disturbance, particularly for baleen whales.

Standardised guidance and minimum requirements for noise modelling are needed across jurisdictions.

Sperm whale ©Siún Ní Cheallaigh

Workshop Discussion- Afternoon Session

FOCUS: ENVIRONMENTAL IMPACT ASSESSMENT REQUIREMENTS

Moderator Patrick Lyne

WORKSHOP TOPIC 7: MONITORING NOISE LEVELS

Noise monitoring is typically required prior to the construction of windfarms. This allows pre-existing noise levels to be established and allows the measurement and quantification of noise increases during windfarm operation. Noise levels around ports was highlighted as a particular problem as noise levels can already exceed that associated with disturbance of marine mammals, how then should port development projects deal with construction noise and deal with thresholds being exceeded when normal port operation already exceeds required thresholds. In such environments, with existing noise threshold levels already exceeded, no amount of construction mitigation can reduce noise to "acceptable" levels.

Case Study Discussed: Port Of Vancouver Initiative

The Port of Vancouver provides an exemplary model for addressing shipping noise through economic incentives:

- Vancouver Fraser Port Authority offers up to 47% discount on docking fees for ships meeting new engine noise reduction standards
- Initiative specifically targets protection of at-risk marine life, particularly whales
- Part of broader EcoAction program and Enhancing Cetacean Habitat and Observation (ECHO) program
- Demonstrates successful integration of economic incentives with environmental protection

Reference Materials:

- IMO-WMU Workshop Presentation https://wwwcdn.imo.org/localresources/en/About/Events/Documents/Presentations%20-%20IMO-WMU%20Workshop%20on%20Underwater%20Radiated%20Noise%202024/Se

ssion%203/Port%20of%20Vancouver%20presentation%20for%20GloNoise%20October%2016,%202024.pdf
- ECHO Program Summary https://tc.canada.ca/sites/default/files/migrated/echo_program_summary_may_2017.pdf

WORKSHOP TOPIC 8: BASELINE SURVEY REQUIREMENTS

Comprehensive baseline studies are seen as a feature of responsible development and allow the determination of impacts post construction and during operation, as well as impacts after the windfarm or offshore construction is removed.

Key Questions:

- How many years of data collection (acoustic/visual) are required pre-construction?
- What is the purpose of baseline data: distribution, abundance, presence/absence, or density trends?
- Should there be consistent methods (e.g., aerial, shipboard, acoustic) across jurisdictions and species?

Case Study Discussed: Denmark Substation Project

Energinet Denmark substation project highlighted the critical importance of comprehensive baseline data:

- Baseline studies revealed proposed location was in area of high importance for harbour porpoise (Phocoena phocoena)
- Importance could have been predicted through thorough examination of sandeel distribution maps
- Development ultimately stopped for other reasons before breeding area significance became determining factor
- Lesson: Comprehensive ecological mapping essential before site selection

Survey Duration and Methodology

Some key recommendations were highlighted by those present with regard to baseline studies for marine mammals.

Consensus and Recommendations:

- No consensus on the required duration—estimates ranged from 1 to 3 years a minimum of 2 years was suggested prior to EIA.
- Visual data may miss deep-diving species like minke whales; shipboard or digital aerial surveys may improve coverage. Combined approach: Visual and acoustic studies essential.
- Broader government-led baseline surveys (e.g., Denmark's Energinet programme) were seen as a more efficient approach. Baseline data must also be relevant to long-term population effects, not just permitting timelines.
- There is a lack of standardised survey frequency or spatial resolution across projects.

WORKSHOP TOPIC 9: ACOUSTIC MONITORING TECHNOLOGY

Acoustic studies form a key part of baseline information and the following recommendations were put forward by those attending.

- What is the necessary spatial extent of acoustic monitoring (e.g., 5 km vs. 20 km buffer)?
- How many CPODs/stations are sufficient for statistically meaningful data?
- Are newer platforms (e.g., satellite, aerial drones, towed arrays) feasible replacements or supplements?

Equipment Mix Recommended:

- Combination of FPODs and broadband WAV file recorders
- Trend toward broadband recorders by some attendees over FPODs was stated
- Example deployment: 5 static acoustic stations for 63,000 sq.km windfarm deemed adequate, though there is no fixed rule and more acoustic stations will always be better
- Minimum requirement: At least 2 static recorders should be Soundtraps or similar broadband devices recording raw (wav) data
- Acoustic monitoring may outperform visual surveys, especially for detecting consistent presence (e.g., harbour porpoises).
- Satellite-based tracking is limited for deep-diving or fast-moving species.

WORKSHOP TOPIC 10: VISUAL SURVEY METHODS COMPARISON

Baseline studies adopt a variety of visual surveying approaches:

UAV Aerial Surveys: Higher flight paths avoid turbine blades; repeatable during wind farm operation; lower detection rates than boat surveys, best for operational windfarms

Boat Survey: Higher sighting rates inside windfarms; limited during windfarm operation; best for pre-construction baseline

Land-based/Vantage Point: Cheap and easy to perform; limited range and visibility; best for near-shore developments and cable landfall locations

Fisheries Observer Data: Existing data collection framework; not suitable for site-specific assessment; best for marine spatial planning

WORKSHOP TOPIC 11: BUFFER ZONE REQUIREMENTS

Survey areas typically exceed that of the development site but this varies from one jurisdiction to another with typical buffer zones varying from 5km to >20km. The size of the buffer zone in Denmark is normally double that of the impact area when using required noise abatement and threshold limits. This allows impacts of windfarms to be measured to the full extent and into areas where no change can be demonstrated. The Danish threshold for piling is based on harbour porpoises and is a cumulative Sound Exposure Level (SEL) of 155 dB re 1µPa²s measured at 750m,

Standards:

- Germany: 16-20km buffer for divers (10km for red-throated divers in current guidance - requires verification)
- Denmark: >20km buffer for marine mammal baseline data
    - Rationale: Double the estimated impact area
    - Enables demonstration of impact limits and confirms zero impact beyond expected influence range and demonstrates recovery.

WORKSHOP TOPIC 12: ECOLOGICAL CONSIDERATIONS

The positive impacts of windfarm construction were highlighted by attendees.

Key Questions:

- Do offshore wind farms create new foraging grounds or just concentrate existing resources?
- How do changes in fisheries access around turbines affect predator-prey dynamics?
- Wind farms may lead to increased fish aggregation and biodiversity due to exclusion zones and reef effects.
- These ecological shifts are not necessarily positive—may result in redistribution rather than population gains.
- Inclusion of fisheries effects and food availability in EIA is often missing but critical.

Potential Positive Impacts

Fishing Exclusion Benefits:

- Greater food availability through fishing prohibition
- Elimination of bycatch mortality
- Net gain for marine mammal species within windfarm sites expected

Habitat Enhancement:

- Turbine foundations provide substrate for *Sabellaria* reefs
- Created artificial reef ecosystems

Consensus

Discussion of problems created by windfarms did not highlight significant unknown issues but stated that continued research was needed.

Current Understanding:

- No consensus on whether offshore windfarms constitute barriers to marine mammal movement
- Electromagnetic Fields (EMF) do not appear to create barriers for marine mammals
- Requires continued monitoring and research

WORKSHOP TOPIC 13: COMPENSATORY MEASURES

The requirement in the UK for windfarm companies to undertake compensatory measures to offset impacts was raised and it was not felt these contributed significantly at this time to recovery of protected species.

Key Questions:

- Can compensatory measures be used for mitigation, compensation, or justification of impacts?

Current Approaches:

- UK example: Companies funding seal rescue centers.
- Limitation identified: Sandeel fishery closure in UK not recognized as a compensatory measure as not directly related to windfarm construction.

Consensus:

- Need for clearer guidelines on acceptable compensatory measures directly linked to windfarm impacts.
- Compensation measures must demonstrate additional—not just reduced fishing effort or passive gains.
- Compensation strategies are being explored but are legally and biologically complex.

WORKSHOP TOPIC 14: NATURA 2000 SITE MANAGEMENT

The proximity of some construction sites to SACs (Special Areas of Conservation) was raised as a potential issue, with future sites potentially being in SACs this may be an even bigger issue. There currently is a lack of specific guidance on how to mitigate or determine noise impact limits for SACs. While some guidance does exist it is very broad and not easily applied. The importance of baseline data for adjacent SACs was highlighted.

Key Questions:

- How should noise/displacement effects in Special Areas of Conservation (SACs) be assessed and mitigated?
- What constitutes sufficient compensation for impacts within marine SACs?
- Is temporary displacement into other already-occupied areas acceptable?

Current SAC Deficiencies:

- Denmark: Poor management with no comprehensive management plans
- Germany: Similar management challenges

German SAC Approach:

- Disturbance limits: Maximum 10% of harbour porpoise population in SAC
- Breeding season protection: <1% disturbance during May-August period
- Measurement method: 8km radius from windfarm center, which was raised as not always logical.
- Shipping mitigation: Efforts to reduce/divert shipping from SACs

Key Points Raised:

- Displacement into neighbouring habitat (already occupied) could increase competition and reduce survival.
- 10% disturbance within SACs during sensitive periods (e.g., calving, breeding) may already be too high.
- SAC management plans are often vague or outdated, creating legal uncertainty.

WORKSHOP TOPIC 15: DATA CURRENCY AND CONTINUITY

The question was raised when does baseline data become historic and when is it deemed current and applicable to a development application.

Critical Timeline Issue:

- Baseline data considered historic after 3 years, though this based on a 1 - 2 year baseline data period requirement.
- Recommendation: Continuous baseline data acquisition during assessment and planning phases
- Risk: Project delays may invalidate existing baseline data

WORKSHOP TOPIC 16: SPECIAL ENVIRONMENTS AND EMERGING CHALLENGES

Development of floating wind will see windfarm development in offshore areas which will encounter a different species mix and different development techniques. Some requirements particular to these sites were considered.

Key Questions:

- What is the noise output of floating wind farms during construction and operation?
- How can regulators or researchers assess impact in the absence of reference data?
- Are countries and stakeholders ready for rapid deployment and the need for real-time acoustic benchmarking?

Deep Water Developments

Madeira:

- Floating turbines planned for 600m water depth
- Acoustic data mandatory for such developments
- Recommendation: Scalable monitoring programs that can expand and develop with development requirements

Canary Islands:

- Oil and gas surveys prohibited within 50km of coast
- Naval sonar also restricted
- Question raised: How windfarm surveys permitted under these restrictions
- Status: Windfarm surveys appear to have received permissions

Key Points Raised:

- There is currently no baseline acoustic footprint for floating turbines, especially in deep offshore environments used by large whales (e.g., fin, sperm whales).
- Many proposed sites (e.g., Portugal, Canary Islands) are ecologically sensitive and could see cumulative impacts without proper oversight.
- Calls were made for a standardised, accessible noise measurement framework to establish baseline soundscapes, capture turbine-specific acoustics, and inform future thresholds.
- Participants discussed preventative monitoring programmes that could be activated rapidly, especially for pilot or test installations.

WORKSHOP TOPIC 17: DATA SHARING AND ACCESSIBILITY

The need for better information and information on ambient noise was discussed and the following issues raised:

Regulatory Requirements:

- Ambient noise measurement across full frequency spectrum recommended
- GES Monitoring: Required under Descriptor 11 (Noise) for Good Environmental Status
- Critical need: Enhanced data sharing with research community

Implementation Recommendations and concerns:

1. Establish centralized databases for baseline acoustic data
2. Mandate data sharing requirements in development licenses
3. Coordinate with existing GES monitoring programs
4. Develop standardized data formats and accessibility protocols
5. Concerns were raised about the military's reluctance to share underwater acoustic data, although freedom of information requests had been successful in some jurisdictions (e.g., UK).

A call to action: collaborative environmental coalitions or scientific alliances should push for transparent data sharing, especially under marine directives (e.g., MSFD) already requiring states to monitor deviation from acoustic baselines.

OVERALL CONCLUSIONS AFTERNOON SESSION

The discussion highlighted the complexity of establishing adequate baseline data for marine environmental impact assessments. While consensus emerged on minimum requirements (2-year surveys with mixed visual/acoustic approaches), significant challenges remain in data standardization, management, and application across diverse marine environments.

The workshop emphasized the need for continued innovation in monitoring approaches, particularly for emerging technologies like floating wind turbines in deep water environments, while ensuring robust protection of marine mammal populations through evidence-based regulatory frameworks.

Some key action areas for future work were highlighted:

1. Standardization: Develop consistent baseline data requirements across EU member states
2. Technology integration: Establish best practice guidelines for acoustic monitoring equipment deployment
3. Data management: Create frameworks for data currency, sharing, and accessibility
4. Compensatory measures: Develop clearer guidance on acceptable mitigation and compensation approaches
5. Special environments: Establish protocols for deep water and sensitive area developments
6. Continuous improvement: Implement adaptive management approaches incorporating new scientific findings

ECS Workshop Proceedings

Examining Standards of Baseline Data Acquisition for EIA and Mitigation for Offshore Construction under the EU Habitats Directive

Prepared by:
Irish Whale and Dolphin Group

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