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Evaluating the Transferability of Marine Mammal Data Between Tidal Stream Energy Developments (2025)

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Notice

This document establishes a framework for evaluating strategic data requirements related to tidal stream projects, with a focus on marine mammal impact monitoring data. This document is intended to support discussions on environmental monitoring assessment needs; however, site-specific variations must be considered for each location. While this document serves as a guiding resource, final decisions should be determined through mutual agreement between the regulator and the developer.

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We also acknowledge the valuable contributions to our recent publication, the Tidal Stream Energy Project: Collision Risk Data and Evidence Summary, 2025 (The Crown Estate, ABPmer, 2025) which have played a pivotal role in shaping this report.

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Foreword

“The opportunity to learn from other consented projects is essential for progression of the marine renewable energy industry. This project provides guiding principles to help inform consideration of data transferability for tidal stream projects, focussing on marine mammal impact monitoring data. NRW has advised TCE on the development of the project outputs which we will look to use as tools to support discussions with stakeholders in the early pre-application stage of project development. This will help to provide greater transparency on this matter between all parties involved.”

Jasmine Sharp
Sustainable Places, Land & Sea Manager, Natural Resources Wales

“Nova has been using subsea cameras to monitor our Shetland Tidal Array in Bluemull Sound for more than 9 years, during which no collisions between wildlife and the turbines have been observed. The Crown Estate’s work is crucial for helping to use this growing body of evidence to derisk consenting and unlock the full potential of tidal stream energy”.

Dr Kate Smith
Head of Environmental Management, Nova Innovation Ltd

“The UK has tremendous tidal stream and wave energy potential, which will only be realised through cooperation and collaboration. Initiatives like these are critical in improving our understanding of the impact of project deployment, and where appropriate, expediate the time it takes to get technology in the water.”

Richard Arnold
Policy Director, Marine Energy Council

“I’m proud to support this important step forward for the tidal stream energy sector. The Crown Estate’s development of the data transferability matrix and guidance framework, focused on marine mammal environmental data and collision risk, marks a significant milestone in enabling smarter, more efficient use of existing evidence. This work directly supports tidal energy schemes like Morlais by reducing potential uncertainty, streamlining the consenting process, and improving baseline ecological understanding. By enhancing access to high-quality data and fostering collaboration between developers and regulators, we’re strengthening our ability to deliver sustainable, low-carbon energy solutions while safeguarding our marine environment.”

Andy Billcliff
Chief Executive Officer, Menter Môn Morlais

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Introduction

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Project aims

The Crown Estate identified a need to ensure that data and evidence from already consented tidal stream projects are readily available, and where possible transferable, to tidal stream projects subject to consenting or to those that have already been consented. This work aims to pinpoint areas where scientific uncertainty can be minimised, allowing research and monitoring efforts to focus on critical evidence gaps.

ABP Marine Environmental Research Ltd. ("ABPmer") and The Crown Estate have developed a data transferability matrix that can be used by regulators/advisors and industry developers to provide an indication of the extent to which existing tidal stream energy datasets are transferable to another project. In addition, an accompanying guidance framework has been developed to provide direction and key principles when considering data transferability. This document outlines the purpose of both the matrix and guidance framework and how using them in conjunction with each other can assist in the effective use and reuse of existing data.

The scope for this matrix was based on the project focal points of the Tidal Stream Energy Project: Collision Risk Data and Evidence Summary, 2025 (The Crown Estate, ABPmer, 2025). The focus for the transferability matrix and framework is on tidal stream energy marine mammal environmental data, particularly in relation to collision risk. If displacement is an interaction of concern for a project under consideration, then the matrix may also assist with data transferability. Seabirds and fish monitoring data are not the focus, however, some of the factors included in the matrix could be applied to these data.

The monitoring techniques used to collect marine mammal data to which the matrix could apply are inclusive of, but not limited to, hydrophones, sonar, Passive Acoustic Monitoring, underwater cameras, land-based Vantage Point surveys, boat-based surveys, photography, drones, and GPS/GSM tagging.

The development of the transferability matrix aims to provide a systematic approach to discussions on the necessary monitoring required for a project. These discussions will not only facilitate the identification of transferable data but also determine which data may require enhancement through additional monitoring. Using expert judgement, the matrix should provide clarity where existing data and evidence can be applied. The matrix does not use a dichotomous approach: it does not aim to divide data into opposite classifications but instead aims to highlight where new scientific evidence can enhance a tidal stream project's evidence base. The matrix is designed to facilitate discussions between developers and regulators. Therefore, even if certain factors score lower on transferability, they can still be evaluated collaboratively to determine how the available data may be utilised.

Scenarios for the use of the matrix include assessing the likely risk of nearfield encounters between animals and turbines, enabling a more detailed assessment of collision risk between animals and operational turbines, and informing the design of post-installation monitoring programmes. Some aspects of the matrix can also be applied to baseline data. Applying key findings from baseline surveys at one tidal site to another could de-risk consenting by improving baseline ecological knowledge about how the species might use the site at the proposed project in question and therefore how they might interact with tidal devices. This may reduce the amount of monitoring required and/or increase confidence in the impact assessment. If applying the matrix to baseline data, it should be recognised that some factors will not be relevant to the assessment: installation size, tidal stream technology type, spatial scale, operating conditions, and mitigation measures.

This work marks a significant advancement for the industry, in terms of establishing a well-structured foundation for guided conversations. While the framework and matrix will naturally evolve and undergo refinement over time, The Crown Estate remains dedicated to driving progress within the sector. Through the development of a comprehensive and adaptive framework and matrix, The Crown Estate aims to enhance data transferability and foster meaningful dialogue, ensuring sustained innovation and continuous improvement to the consenting process. This commitment highlights The Crown Estate's role in shaping a dynamic and progressive industry landscape.

Transferability framework

Review of existing data from other projects to build an evidence base ahead of site-specific monitoring for proposed new project or project extension

OR

Monitoring for new project or project extension has been conducted, however data gaps have been identified

Transferability

Determine how transferable existing data are from other projects to the project in question

Decision on the transferability of existing data to form part of the evidence base for the project in question

Review applicable transferability factors in the transferability matrix

Quality Assurance (QA) measures

Key:

- Installation size
- Receptor species or group
  Sub-factor: Receptor species population
- Tidal stream technology type
- Seasonality coverage
- Site conditions

Desirable:

- Spatial scale
- Functional use
- Operating condition & project phase
- Population densities

Conditional:

- Age
- Methodological limitations
- Mitigation measures

Discussion between regulators and developers on whether the existing available data can be used to inform the environmental assessments required to support the licence application for a new project or project extension

Provides basis to determine what additional data needs to be collected to support licence application

If data gaps are identified, conduct required monitoring

OR

Provides basis to determine where original data gaps have now been resolved

If all data gaps have been resolved, there may be no requirement for additional monitoring

Comparability

Review the comparability of existing data to the data you have collected to determine if they can be integrated, and more detailed analyses can be conducted where appropriate

The transferability framework provides a process flow diagram to systematically consider the factors influencing the transferability of existing data to a project, and a way to identify key data gaps and survey requirements for that project. The framework also shows the user how to implement the matrix to assess the usefulness of the data applied when evaluating transferability or comparability (see: Definitions).

The matrix can be used to determine how transferable existing data are from other projects to the project in question by reviewing the applicable transferability factors in the transferability matrix. The framework incorporates a feedback loop which recognises the iterative process involved in reaching a consensus between regulators/advisors and developers on whether the existing available data can be used to inform the environmental assessments required to support the licence application for a new project or project extension. The decision on the transferability of existing data will form part of the evidence base used to support the licence application for the project in question.

After monitoring has been conducted, selected factors in the matrix (see section: Joining two existing datasets for quantitative analyses) can also be used to assess the comparability of existing data to the data that have been collected. This is to determine if they can be integrated, and more detailed quantitative analyses conducted where appropriate.

The application of the framework will encourage the use of existing data where possible and potentially accelerate the consenting process by identifying the greatest risks and uncertainties, and help to ensure pre-application data collection is proportionate. It will also provide the opportunity to identify where limited funding resources for both developer and/or research programmes can be more usefully directed toward environmental issues that remain most uncertain and/or receptors that are most sensitive.

Data Transferability Matrix: Evaluating the transferability of marine mammal impact data from tidal stream energy projects

Transferability Factors		Applicable to Post-installation Data	Applicable to Baseline Data	Factor description	Level of Transferability		
					H	M	L
Quality Assurance (QA) Measures		Y	Y	Data that is more consistent and has undergone quality checking will have a greater transferability and will be more useful for applying to future projects. If data has not undergone QA, the data may have the potential to be relevant, however QA would need to be undertaken to enable its consideration. This factor is needed for successful transfer of data between projects to take place.	Data is consistent with QA measures stated		Data is inconsistent, and QA not conducted or QA information unavailable
Key	Installation size	Y		Data for the same or similar installation size class will have a greater transferability. Size classes are a single device, a small array (2 to 6 devices), a medium array (7 to 9 devices) and an larger array (10 to 30 devices).	Installation size is the same e.g. both projects small arrays	Installation size is one size class different e.g. a small array and a medium array	Installation size is more than two size classes apart e.g. a single device and a large array
Key	Receptor species or group	Y	Y	Data for the same receptor species or group will have a greater transferability. The three marine mammal groups considered within the transferability matrix are seals, toothed cetaceans, and baleen cetaceans. The same receptor group is important when comparing data between the two projects, but the species might differ. Examples of different species include harbour seal and grey seal. Examples of different groups include baleen cetaceans and seals.	Receptor species is the same	Receptor group is the same	Both receptor species and group are not the same
Key	*Sub-factor: Receptor species population*	Y	Y	*It is important to consider the specific population when comparing the same species, as they could be a resident population which occupy a given geographic area over a long period of time, or a population that use the area while in transit.*	*Species is the same population*	*Species is a different population*	
Key	Tidal stream technology type	Y		Data for a device with same or similar technological specifications will have a greater transferability.	Device specification is the same	Same group of tidal stream generators	Different group of tidal stream generators
Key	Seasonality coverage	Y	Y	Data fully covering seasonality will have a greater transferability. Seasonal species may need longer monitoring timeframes to collect sufficient data for assessment.	Data covers all seasonal cycles	Data has partial seasonal coverage	Data covers only one seasonal/ behavioural period
Key	Site conditions	Y	Y	Data that is from sites with similar geography, hydrodynamics, and oceanographic conditions will have a greater transferability. Considerations include seabed type, seabed depth (bathymetry), and current speeds. Channels between islands and more open areas of water may be used differently by marine animals. It should also be considered that evidence from similar geographic regional areas are likely to be more transferable than evidence from distinctly different regions.	Site conditions are the same	Site conditions are similar	Site conditions are dissimilar
Desirable	Spatial scale	Y		Data that covers all three spatial scales will have a greater transferability than data that only covers one spatial scale. Near field monitoring around the tidal device will provide data on device interactions whereas larger scale data collection can provide wider disturbance or barrier effects. Levels of spatial coverage for monitoring can be defined as macro, meso, and micro.	Data covers all three spatial levels (macro, meso, micro)	Data covers two spatial levels	Data covers one spatial level
Desirable	Functional use	Y	Y	Data is likely to be more transferable between areas with more similar functional use by the receptor species rather than one area being a low use area and the other of important functional value. This factor should be assessed for each receptor species considered.	Functional use of the habitat is the similar (e.g. both sites are functionally important areas)		Functional use of the habitat is dissimilar (e.g. low use area vs functionally important area)
Desirable	Operating condition & project phase	Y		Data that have been collected across all possible operating conditions and throughout different phases of a project's lifecycle will provide a more comprehensive and valuable dataset and are therefore considered to have a higher transferability. If turbines are not operational at particular times, such as no nighttime operation, this limits the usefulness of data collected.	Data covers all operating conditions	Data covers some operating conditions	Data covers one operating condition
Desirable	Population densities	Y	Y	Data from sites with similar species population densities will have a greater transferability. Marine mammals can be found in high abundances in some sites, and low in others.	Population density is similar		Population density is dissimilar
Conditional	Age	Y	Y	Data that is more recently collected will have a greater transferability, when considering data at the same project site. Age of data may be more or less relevant based on the amount of data available at the site. Data transfer between projects would be suitable for 3 to 5 years as species diversity and ecology at a project area are unlikely to change in the short term. However, it is recognised that this may not always be possible, and should be assessed on a case-by-case basis.	Data is < 5 years old	Data is 5 to 10 years old	Data is > 10 years old
Conditional	Mitigation measures	Y		Data collected where less mitigation measures are in place will have a greater transferability. For example, if the turbine is switched off when marine animals are detected, data on collision risk is less valuable. It is important to note that data that includes knowledge and/or clarity around any mitigation employed and how that impacts the findings will be more useful. The impact of this factor on transferability is dependent on the spatial scale of data (e.g. micro scale collision risk data is most impacted by the shutdown procedure).	No mitigation measures are employed to deter animals from the turbine	Mitigation measures are employed to deter animals during construction/ operation of turbine	Mitigation measure of switching the turbine off when marine animals are detected
Conditional	Methodological limitations	Y	Y	Data that has fewer methodological limitations associated with its collection will have a greater transferability. Techniques to reduce limitations of the data collection method could make the data more transferable (e.g. measures to reduce biofouling).	A limited number of methodological limitations	Some methodological limitations	A lot of methodological limitations

TRANSFERABILITY FACTOR TYPES

- **Key:** These factors are key in the transferability process, and should be considered of high importance when applying the matrix.
- **Desirable:** These factors are important and should be considered, however may be of less importance depending on the project location and/or receptor species.
- **Conditional:** These factors only need to be considered if applicable to the project and/or data in question.

The purpose of the transferability matrix is to provide a tabular method for determining an indication of the extent to which existing datasets may be transferable to another project. The main aim of the matrix is to determine how applicable or transferable past available data are to inform a new proposed development, or an extension or amendment to an existing development. The factors in the matrix could also be used to help determine the comparability of joining two datasets for quantitative analysis as explained earlier.

The matrix involves reviewing the existing data against a series of factors and determining if the level of potential transferability for those factors is high (H), medium (M) or low (L). A low level of transferability may in some cases encompass the absence of a certain factor, such as the absence of quality assurance of data. These factors expand on the OES-Environmental's framework (guidelines for transferability) that notes five characteristics ranging from necessary to desirable for data transfer. The greater the number of factors that have a high level of potential transferability, the more valuable and/or applicable the existing data are likely to be for the project.

Factors have been grouped into different classes: key, desirable, and conditional. Key factors are considered to be the most important to evaluate in the transferability process. Desirable factors are important and should still be considered, however, may be of less importance depending on the project in question and/or receptor species considered. Conditional factors may be dependent on the project in question and/or data evaluated against the matrix and will not always need to be considered. If a dataset scores highly on the desirable or conditional factors, it may still be useful, even if it scores lower on the key factors. Expert judgement should be used to consider the scoring of each factor in order to determine how valuable the data may be for the project in question.

The matrix could be used to facilitate pre-application discussions between regulators, Statutory Nature Conservation Bodies (SNCBs) and developers on the potential value and limitations of using existing data and evidence to infer assumptions and support the impact assessment for that project. These discussions will help to determine which data can be transferred, if there are any data gaps, and as a result, determine the amount of baseline and/or pre- and post-installation monitoring that will be required to support the consenting process.

When using the matrix, there are important caveats, assumptions or principles to consider:

- The matrix is not a prescriptive tool and does not produce a quantitative output but rather should be used to aid discussions between developers and regulators/advisors, to help provide an indication of potential transferability.
- Even if a dataset appears to have low transferability and does not meet all criteria, it could still hold potential value and can be used with appropriate caveats. The data may guide and focus further discussions on data an evidence requirements for addressing specific evidence gaps.
- Use of the matrix does not preclude the requirement for project-specific monitoring particularly if site- and species-specific characteristics differ.
- Factors are grouped and ranked into relative importance but are not individually weighted. Furthermore, the matrix does not take account of the fact that some factors are interdependent and may be linked, for example functional use and site conditions.
- The matrix does not take account of the confidence, statistical power (significance), or relative merits of each data study. If a project had several datasets that were similar to one another, but the findings from each was very different, this would need to be treated carefully as selecting one dataset could be misleading and distort the evidence base.
- Understanding what is driving displacement (e.g. noise, fear of moving structures, lack of prey as prey species avoid devices etc.) is key to understanding the transferability of data, and it is recognised that the displacement effects of tidal stream developments may be site- and species-specific.

Existing resource

This work builds on the work undertaken by the Pacific Northwest National Laboratory (PNNL) and OES-Environmental as well as ORJIP Ocean Energy, recognising the importance of data transferability in the pathway to risk retirement. Risks can be considered retired when the key stressor and receptor interactions are sufficiently understood to be of low risk, therefore reducing the need to carry out detailed investigations for each proposed project (Copping *et al.*, 2020a). In the context of Environmental Impact Assessments (EIAs) in the UK, risk retirement refers to the process of identifying, assessing, and mitigating potential environmental risks associated with a project to a level where they are considered acceptable or negligible. These existing resources are reviewed below.

OES-Environmental Data Transferability and Collection Consistency in Marine Renewable Energy

PNNL and OES-Environmental through their knowledge base on Tethys allow the exploration of publicly available tidal stream project metadata (Tethys, 2024a). In September 2024 an updated OES-Environmental State of the Science Report was published, prepared by PNNL (as the OES-Environmental Operating Agent) on behalf of the U.S. Department of Energy. The report provides a comprehensive and valuable resource for knowledge and evidence on the environmental effects of marine renewable energy development worldwide.

As a result of communication with US regulatory authorities and the worldwide marine renewable energy community, OES-Environmental (formerly known as Annex IV) created a data transferability process and pathway to risk retirement. Data Transferability and Collection Consistency in Marine Renewable Energy, initially prepared by PNNL in 2018 with an update report published in 2020, details the background and advancement of the data transferability process, and provides an overview of the steps involved to successfully employ and use previous data through the data transferability process (Copping, *et al*., 2018; Copping *et al*., 2020b). During the development of their risk retirement pathway, the importance of data transferability was made clear. The review of previous data is fundamental in understanding potential risk (or absence of risk) to establish if retirement could occur.

The data transferability process developed by Copping *et al*. (2020b) comprises four main elements:

1. Data transferability framework – brings together datasets in an organised fashion, compares the applicability of each dataset for use, and guides the process of data transfer.

2. Data collection consistency table – aims to help assure data consistency by providing preferred data collection methods, measures, and guidance on interpreting data.

3. Monitoring datasets discoverability matrix – allows a practitioner to discover datasets based on the approach presented in the framework.

4. Four best management practices (BMPs).

While OES-Environmental developed the risk retirement and data transferability processes to be internationally applicable, when applying them, it is important to note that environmental regulatory processes vary between countries. EIAs in the US and UK exhibit notable differences in their legislative frameworks, scoping, public participation and decision-making process.

ORJIP Ocean Energy: Information Note – Data Transferability

To support consenting of wave and tidal stream energy projects, Information Notes were co-produced by the Welsh Consenting Strategic Advisory Group's Science and Evidence subgroup (SEAGP). Their primary aim is to provide an overview of possible consenting challenges, and how potential impacts that are considered low risk could be safely retired from further detailed consideration within EIAs. The Information Note on Data Transferability highlights the OES-Environmental data transferability framework and process document as a key resource of evidence. In terms of data transferability, SEAGP's Information Note provides four scenarios of how data and information transfer could occur between projects in Section 2.2. 'Scenarios for Data Transferability'. Finally, it outlines key recommendations on data transferability in a Welsh context:

- The use and application of data and evidence from other marine renewable developments, industries, or geographies is important to inform the development of marine renewables in Wales.
- The use of data across projects must be studied and carefully managed on a case-by-case basis using a risk-based approach in recognition that there are site-specific and species-specific characteristics which will differ between projects and device types.
- The establishment of metadata and data management to ensure consistency, and the common availability of data to support EIA and consenting processes is advised.

Factors to consider when evaluating the transferability of marine mammal impact data from tidal stream energy projects

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Data Standards and Quality Assurance (QA) measures

To evaluate the compatibility of data from already consented projects for future projects, the data consistency should be assessed. QA measures for marine mammal data could include data cleaning, which involves identifying and correcting errors such as misspellings, identifying and removing duplicate records, and standardizing data formats (e.g. dates, numbers, units) to ensure data consistency. QA measures are key to producing accurate and reuseable data, resulting in reliable scientific conclusions and improved transferability. Accurate metadata with detailed methodologies and lineages are also key to transferability, allowing users of the data to quickly understand if data is transferable.

Ensuring the same protocols and methodologies are used would be highly challenging. However, data collected using consistent processes and units, and that has undergone suitable quality control measures, would be more transferable (PNNL, 2020). It is recommended that national data standards should be used, where they are applicable for the collection methods and data in question. In the UK, the Marine Environmental Data and Information Network publishes marine data guidelines and a Discovery Metadata standard, which are applied by The Crown Estate's Marine Data Exchange to incoming industry data. High quality data are, therefore, more accessible and reusable for the renewables sector (The Crown Estate, 2024). Data consistency also ensures that data remain accurate and uniform across a database, allowing the data to be more easily compared.

Key factors

These factors are key in the transferability process and should be considered of high importance when applying the matrix.

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Installation size

An important factor to consider is whether the data are from a project with a similar installation size to the project in question. Installation size refers to the number of devices rather than the power generation capacity. The four installation size classes that are categorised in the matrix are a single device, a small array (2 to 6 devices), a medium array (7 to 9 devices), and a large array (10 to 30 devices). Illustrated in **Table 1** below, if both projects are or planned to be the same size class, the data are considered to have the highest transferability whereas if projects are more than one size class apart, the data are considered to have a lower transferability.

Table 1. Array size classes and their transferability.
L = low transferability, M = medium transferability, H = high transferability.

	Single device	Small array	Medium array	Large array
Single device	H	M	L	L
Small array	M	H	M	L
Medium array	L	M	H	M
Large array	L	L	M	H

It is acknowledged that the tidal stream industry remains in its early stages of development, with most installations consisting of either single devices or small scale arrays, and as a result, data on the environmental impacts of large arrays are lacking. While continued research and monitoring are essential to build a robust evidence base around small arrays, the existing data from single-device and small-array projects may already offer valuable insights that can inform the planning and assessment of future larger array developments.

As larger arrays are installed, there will be a need to monitor the movement of marine mammals around them to determine if larger arrays are causing the potential displacement or disruption of local populations from reaching ecologically important habitats (Hemery *et al*., 2024). This is predicted to be a key risk associated with the scaling up of tidal arrays.

The impact of larger arrays is likely to be complex, site-specific, and dependent on the configuration of the array itself. Marine animals may have an increased risk of collision when navigating through the array, and cumulative effects could lead to avoidance of the area. Cumulative impacts can occur when multiple stressors combine to cause adverse effects, such as the combination of underwater noise and collision risk. Adverse effects are largely dependent on turbine array configuration (Image 1). If the array is configured 'in series' the migratory corridor may remain largely unobstructed, allowing sufficient space for marine animals to travel around the array (Hasselman *et al*., 2023). If the array is configured 'in parallel' migratory species would need to travel through the array and may have a higher risk of collision as they attempt to access important resources (Hassleman *et al*., 2023).

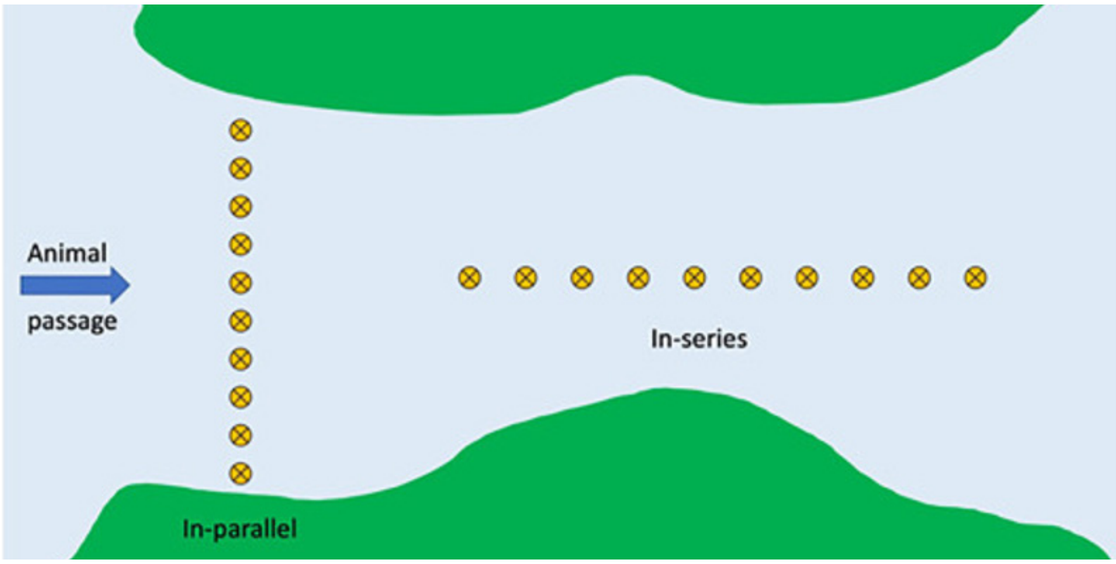

Image 1. Hypothetical 'in-parallel' and 'in-series' tidal turbine array configurations (redrawn by Hasselman *et al*., 2023 from Wilson *et al*., 2006).

Receptor species or group

In ecology, a receptor is the entity or biological resource (i.e., species, population, habitat) subject to the pressure. Data collected on a species are more transferable to another project which needs to consider the same or similar species. For example, data specific to a seal species are more likely to be of value when understanding potential effects on another seal species, e.g. a local grey seal population, rather than data related to a dolphin species. Monitoring methods also target animal groups differently, for example, Passive Acoustic Monitoring (PAM) detects echolocating cetaceans but cannot effectively detect seals which do not echolocate.

The three marine mammal groups considered within the transferability matrix are seals, toothed cetaceans and baleen cetaceans. If the species are different but fall within the same group, transferability of the data will be medium. The varying transferability of marine mammal species and groups is depicted in the species similarity matrix below. Although not exhaustive, the species included in the matrix are representative of the key marine mammal species found in UK waters and are included for illustrative purposes. The matrix below (Table 2) focuses on grouping seals, toothed cetaceans and baleen cetaceans, however there are many aspects, such as hearing ability, that can affect an animal's behaviour around a turbine device.

Table 2. Species similarity matrix. L = low transferability, M = medium transferability, H = high transferability.

	Harbour seal	Grey seal	Harbour porpoise	Bottlenose dolphin	Risso's dolphin	Common dolphin	White-beaked dolphin	Orca	Minke whale	Humpback whale
Harbour seal	H	M	L	L	L	L	L	L	L	L
Grey seal	M	H	L	L	L	L	L	L	L	L
Harbour porpoise	L	L	H	M	M	M	M	M	L	L
Bottlenose dolphin	L	L	M	H	M	M	M	M	L	L
Risso's dolphin	L	L	M	M	H	M	M	M	L	L
Common dolphin	L	L	M	M	M	H	M	M	L	L
White-beaked dolphin	L	L	M	M	M	M	H	M	L	L
Orca	L	L	M	M	M	M	M	H	L	L
Minke whale	L	L	L	L	L	L	L	L	H	M
Humpback whale	L	L	L	L	L	L	L	L	M	H

The most transferable data would be between the same receptor species, as even within a group, such as seals, there are differences in behaviour between species. For example, a key difference between grey seals *(Halichoerus grypus)* and harbour seals *(Phoca vitulina)* is their mating strategies (SCOS, 2022):

- They are different types of breeders: grey seals are capital breeders which rely mostly on stored reserves, whereas harbour seals are income breeders which rely mostly on concurrent intake when factoring in the energy costs of reproduction.
- They breed in different seasons: in the northeast Atlantic, harbour seals have been shown to breed in June and July and moult in August. However, greys seals moult from February to April and breed from September to December (Vincent *et al*., 2017).
- There are differences in seal pup precocity (speed of development): Grey seal females remain ashore for three weeks or so while suckling their pup. In contrast, harbour seal pups will swim with their mothers within hours of birth (SMRU and University of St Andrews, 2016).

Furthermore, different species of marine mammal have different hearing abilities and can be impacted differently by underwater noise:

Table 3. Marine mammal hearing groups and a generalised hearing range (National Marine Fisheries Service, 2024).

Hearing Group	Species	Generalised Hearing Range
Low-frequency cetaceans	Humpback whale	7 Hz to 36+ kHz
	Minke whale	7 Hz to 36+ kHz
High-frequency cetaceans	Bottlenose dolphin	150 Hz to 160 kHz
	Risso's dolphin	150 Hz to 160 kHz
	Common dolphin	150 Hz to 160 kHz
	White-beaked dolphin	150 Hz to 160 kHz
	Orca	150 Hz to 160 kHz
Very High-frequency cetaceans	Harbour porpoise	200 Hz to 165 kHz
Phocid pinnipeds	Grey seal	40 Hz to 90 kHz
	Harbour seal	40 Hz to 90 kHz

In the UK, harbour porpoises are considered to be one of the most sensitive cetacean species to anthropogenic underwater noise (Williams *et al*., 2022). Their behaviour around tidal devices could differ in response to the underwater noise generated, and therefore data on species with different hearing ranges could potentially be less transferable.

While populations which live in noisier environments may exhibit reduced displacement compared to populations which live in less noisy areas, the receptor species factor does not consider any potential habituation of species.

Receptor species population

Receptor species population is a sub-factor to the receptor species or group factor. If the available data are for the same species that needs to be considered by the project in question, it is important to take account of the species' population structure. Some marine mammal species form distinct ecotypes and discrete regional populations which can show little connection to other overlapping or nearby populations. For example, Cardigan Bay is home to a semi-resident population of coastal bottlenose dolphins *(Tursiops truncatus)*, with approximately 200-300 individuals found in the area (Wales Biodiversity Partnership, 2024). This sub-population is the primary feature of the Cardigan Bay Special Area of Conservation (SAC), and a qualifying feature of the Pen Llŷn a'r Sarnau SAC in northern Cardigan Bay, designated under the EC Habitats Directive (Lohrengel *et al*., 2018). An offshore form of bottlenose dolphin occurs in their thousands in offshore UK waters (IAMMWG, 2023) and are generally geographically separate from the coastal form, although overlap does occur. Risk profiles of these two sub-populations of the same species therefore differ markedly. The two distinct sub-populations can be distinguished by their physical appearance (morphology) and physiological differences (Sea Watch Foundation, 2015):

Table 4. Key physical differences between inshore and offshore bottlenose dolphin.

	Inshore	**Offshore**
Size	Smaller (males up to 2.5m in length)	Bigger (males up to 4.1m in length)
Layer of blubber	Thinner	Thicker
Flippers	Proportionally bigger	Proportionally smaller
Colouration	Lighter grey	Darker grey

Marine mammals across different marine regions can have different characteristics. For example, bottlenose dolphins in the UK are typically larger compared to bottlenose dolphins seen in Florida in the United States. Furthermore, humpback whale populations in the North Pacific, North Atlantic and Southern Hemisphere *(Megaptera novaeangliae)* are much more distinct than previously thought and are considered three different subspecies (Jackson *et al*., 2014). Three killer whale ecotypes have been described in the North Pacific: transient (also known as Bigg's), resident (further divided into different populations in the Salish Sea: the Southern Residents and Northern Residents), and offshore (Morin *et al*., 2024). The key differences are outlined below:

Table 5. Differences between killer whale ecotypes.

	Transient/Bigg's	Resident	Offshore
Geographic distribution	Continental shelf: Southern California up to the temperate Arctic waters	Coastal: Eastern and Western sides of the North Pacific	Outer continental shelf: Southern California to the Bering Sea
Prey	Marine mammals and occasionally squid	Fish	Fish, particularly elasmobranchs (sharks)
Family groups	Small groups	Large communities	Large groups with more than 50 individuals

Tidal stream technology type

The technological specifications of tidal stream turbine devices can vary between projects. Technical parameters to consider include tidal device type, size, volume of rotor swept area, number of rotors, and blade tip speed. There are different types of tidal stream generators, including axial flow turbines, crossflow turbines, flow augmented turbines, oscillating devices, and tidal kites. Turbines can be fixed to the seabed by monopiles or gravity-based foundations, or surface mounted/floating devices which are attached to the seabed using tethers.

Data collected during installation and operation for a device with the same technical specification or the same type of tidal stream generator as the project in question are more transferable than data that have been collected from devices with completely different technical parameters, in a different group of tidal stream generators, and/or occupying a different part or proportion of the water column. Data from devices where the specification is the same will have the highest transferability, data from the same group of tidal stream generators will have a medium level of transferability, and data from a device within a different group of tidal stream generators will have the lowest transferability.

Examples of tidal stream devices with different technical parameters are detailed in the Collision Risk Data and Evidence Summary, 2025. These include:

- SeaGen Unit: Four-footed pin-pile foundation supporting a monopile structure. The turbine is a twin blade system with a radius of eight metres. At maximum speed, the blade tips moved at approximately 12m/s.
- Andritz Hydro Hammerfest HS1500 and Atlantis Resources Limited AR1500 turbine (MeyGen Tidal Energy Project): Bottom-mounted, with a rotor diameter of 18m, and a gravity foundation. Blade tip speed operates between 5.6 and 13.2 m/s (Montabaranom *et al.*, 2025).
- Dragon 4 Minesto kite: Turbine with a diameter of 1.3m is attached to a hydrofoil wing, which is tethered to the seabed.
- Magallanes Renovables ATIR at EMEC: Floating energy generation platform that is fitted with two open-bladed counter-rotating rotors, and tethered to the seabed (Tethys, 2024b; Magallanes Renovables, 2025).

It is important to clarify that data from tidal range projects such as barrages, lagoons, or dams are not considered to be at all transferable to future tidal stream energy projects. Tidal range schemes differ considerably from tidal stream energy devices in that they involve turbines encased in a wall-like structure built across a body of water and work by using the rise and fall of the tides.

Seasonality coverage

Particularly for marine mammal and seabird data, seasonality is a key factor in species abundance and distribution. This can be due to different breeding patterns, migratory routes, or life stages (e.g. adult or juvenile). Data that cover a full seasonal cycle and all species life-stages is considered to be of greatest value for assessing impacts and therefore have the highest transferability. Monitoring that has partial seasonal coverage is limited as species can be more sensitive to disturbance at certain life stages and may use different key habitats during migration. For non-species-specific surveys, seasonal species may need longer monitoring timeframes to be of sufficient value for assessment purposes. However, if the survey is species-specific, survey design intention should ensure surveys take place when the species is present in the area. Therefore, the most useful data would be collected despite potential annual gaps.

When considering the comparability rather than transferability (see section: Definitions) of seasonal data, the most comparable datasets would be collected in the same season/seasons. This would allow for the integration of existing datasets (see section: Joining two existing datasets for qualitative analyses).

Site conditions

Environmental conditions are likely to vary greatly between sites, impacting data transferability. These site conditions include seabed type (hard/soft bottom), ambient noise levels (loud/quiet), seabed depth (shallow/deep), shape of sea area (narrow/open), tidal amplitude (small/large), and tidal flow speeds (high/low). For example, data from project areas with high flow speeds (>3 m/s) would have a higher transferability, with a project area with high flow speeds (>3 m/s) versus a project area with low flow speeds (<1.5 m/s). In addition, the shape of the area will influence the nature and scale of impacts; for example, barrier effects may be more likely if a project is situated in a restricted channel, compared to a project in the open ocean. All site conditions should be considered individually using expert judgement, and a transferability score of high, medium, or low score assessed. It is recognised that the distinction between "same", "similar", and "not similar" can be subjective and will involve discussion with relevant regulators and advisors to develop consensus.

Site conditions can influence usage of an area by marine mammals; Tidal devices that are situated in a relatively constrained area, such as a tidal race between a headland and island, could invoke a different set of effects on marine animals compared to a more open area of water. Whales are known to use channels between islands, as they can provide important feeding habitats (Benjamins *et al.*, 2015). Ocean topographies that are preferentially foraged by marine mammals and diving seabirds include shelf-edge fronts, upwelling and tidal-mixing fronts, offshore banks and internal waves, regions of stratification, and topographically complex coastal areas exposed to strong tidal flow (Cox *et al.*, 2018). Harbour porpoises, for example, use a high-energy habitat in South Ramsey Sound at certain states of the tide to feed, where seabed topography and tidal currents interact to create a foraging resource utilised by the species at regular and predictable intervals (Pierpoint, 2008). These behavioural observations are likely to differ markedly from those found at more open sea sites.

Within this factor, geographic region should be taken into consideration to an extent. Data from similar geographic regional areas are likely to be considered more transferable than data from distinctly different marine regions.

Desirable factors

These factors are important and should be considered, however may be of less importance depending on the project location and/or receptor species.

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Spatial scale

Data can be collected at different spatial scales. This will provide information about animal behavioural responses and exposure risk to operating turbines, to inform collision risk modelling and also changes in habitat use to monitor potential displacement. The concept of spatial scales provides a framework for analysing environmental patterns and processes as different phenomena may manifest differently depending on the scale of observation. Broadly, spatial scales are broken down into three main types (Turner *et al*. 2001):

- Micro Scale: This involves fine-scale patterns and processes, typically within a few meters. It focuses on small, localised areas. Nearfield monitoring immediately around the tidal device will provide data on the interactions between marine animals and the device and aims to identify close encounters/collisions and evasions.
- Meso Scale: This intermediate scale covers tens to hundreds of meters. It examines broader patterns and processes that occur over larger areas than the micro scale. Medium-field data collection provides information about animal interactions and avoidance further away from the swept area of the device.
- Macro Scale: This large-scale perspective spans hundreds to thousands of meters or more. It addresses extensive patterns and processes that influence entire habitats or regions. Larger scale/far-field data collection will cover the entire project area and the surrounding key habitats to record any wider disturbance/displacement or barrier effects.

The definitions of spatial scales such as micro, meso, and macro are broadly similar across various development projects, but the specific ranges of values are often determined on a case-by-case basis. For instance, in the context of offshore wind farms, micro-avoidance might refer to last-second actions taken to avoid collision, typically occurring within 10 meters of the turbine rotor blades. Meso-responses could encompass all responses to individual turbines, ranging from the base of each turbine to the windfarm perimeter, which might be defined as 500 meters from the base of the outermost turbines. Macro-responses would then include all behavioural responses to the presence of the wind farm that occur at distances greater than 500 meters from the base of the outermost turbines (Cook *et al*. 2014). When considering available data to transfer to the project in question, datasets that cover all three spatial scales are considered to have the highest transferability, whereas datasets that cover one spatial scale are considered to have the lowest transferability.

If only considering nearfield responses to turbines (rather than displacement), micro scale data would be the main spatial scale of interest. Therefore, the need for macro scale data could be less relevant. However, consideration of more than one spatial scale is more likely to be required by regulators/SNCBs. When considering the comparability (rather than transferability) of the spatial scales of data, the most comparable datasets would be collected at the same scale. This should only be considered when integrating existing datasets or comparing like-for-like surveys (see section: Joining two existing datasets for quantitative analyses).

Survey design, including spatial area monitored, is key to determining significance and confidence in the results because it directly influences the quality and reliability of the data collected. Adequate spatial coverage ensures that the monitored area is representative of the entire project, capturing all relevant interactions and behaviours. Balancing different spatial scales (micro, meso, and macro) provides a comprehensive understanding, with nearfield monitoring offering high-resolution data on immediate interactions and far-field monitoring capturing broader patterns. Sufficient sample size and appropriate statistical methods are essential for detecting significant effects and drawing reliable conclusions. By carefully considering these factors, one can ensure that the data collected is meaningful and reliable, leading to more accurate models and better-informed decisions regarding collision risks and habitat use changes.

Functional use of the site by receptor species

As well as considering the receptor species, it is important to consider how the habitat is being used by the species in question. For example, data are likely to be more transferable between areas with broadly similar functional use by the receptor species rather than one area being a low use area and the other of important functional value. Critical areas which may be highly functionally important include feeding areas which often have high site fidelity, calving/pupping areas used annually by the same returning population, areas in proximity to seal haul out sites, and migratory routes between key areas. This factor differs from the site condition factor as it aims to capture differences in how important the habitat is for species at key life stages.

For example, if a previous project where data were collected was based in proximity to a whale feeding site, those data will be more applicable if the proposed project is also located near to a whale feeding site. The data would have a high transferability for this factor, as both areas are of high functional importance. However, if the previous project was a low use area for whales, but the proposed project area was a key whale breeding site, the data would have a low transferability for this factor.

Operating condition & project phase

Data collected can be across all, some, or one operating condition and can cover different phases or the complete lifetime of a project.

Project phase: Pre-installation, installation, post-installation

Operating condition: Daytime, night-time, operational, stationary/idle

Data collected throughout all phases of a project (i.e., pre-, during and post-installation) allow for baseline data to be compared against post-installation data to determine whether there have been any changes in abundance or distribution of animals. This can provide valuable insight into any potential disturbance/displacement effects. Inadequate survey periods can result in data gaps, reducing the confidence in the results and limiting their applicability to other contexts. Therefore, a well-designed survey plan that includes all project phases is key to ensuring a greater value and confidence in the results.

Once the turbine has been installed, it is important to consider whether data were collected across all possible operating conditions. During a study by SMRU highlighted in the Collision Risk Data and Evidence Summary, 2025, there was no night-time operation of the SeaGen turbine during the survey (Hastie *et al*., 2010). Comparisons in marine mammal activity between day and night could therefore not be made, limiting the effectiveness of these data and their potential transferability.

Data that have been collected across all possible operating conditions and throughout different phases of a project's lifecycle will provide a more comprehensive and valuable dataset and are therefore considered to have a higher transferability. Data that have been collected across some but not all operating conditions are considered to have a medium transferability, and data that have been collected across one operating condition are considered to have a low transferability.

Population densities

In addition to considering the receptor species and functional usage of the project area, the density of the receptor population should be taken into account. If the proposed project area is known for a particularly high density of animals, the transferability is considered high for a dataset where the population density is similar. This is particularly important when considering collision risk, given that a low usage of the area by marine mammals may indicate that collision is less likely to occur. Where the population density of a species in an area is of a similar level, the transferability is high, and where the population density is dissimilar, the transferability is low.

Conditional factors

These factors only need to be considered if applicable to the project and/or data in question.

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Age of the dataset

Data that have been more recently collected have the potential to be more representative although not necessarily more transferable. For example, this factor can be used to assess the transferability of species abundance data but not species behavioural data, which is independent of how recently it was collected.

The age of the dataset may also be more or less relevant as a factor for transferability based on the amount of data available for the project area. For example, if the only available dataset that is potentially transferable to the project in question is considered 'old', and there are significant data gaps or a lack of available dataset for the project area, the age of the data may be less relevant as a factor for transferability.

In the ORJIP Ocean Energy Data Transferability note (2022), NRW advises that when using data and evidence to support the conclusions or assumptions in an EIA of a project in another area rather than to supplement data for an EIA, the timeframes for knowledge transfer would likely be considered less relevant. In terms of marine mammal ecology data, data transfer between projects would be suitable for 3 to 5 years as species diversity and ecology at a project area are unlikely to change over these timescales. However, it is recognised that this may not always be possible and should be assessed on a case-by-case basis.

Mitigation measures

Mitigation measures are practices that are put in place to prevent, reduce or minimise impacts. For example, to move marine mammals out of a high-risk area, aversive sounds can be produced by an acoustic mitigation device (Gordon *et al.*, 2007). It is important to consider how mitigation measures may impact monitoring observations. Knowledge regarding any mitigation employed during previous data collection and how that might influence the findings will be important in judging how transferable that dataset will be to other projects.

Detailed in the Collision Risk Data and Evidence Summary, 2025, SeaGen operated a precautionary approach of a shutdown procedure when a target (animal) travelled towards the turbine, identified through active sonar monitoring. This meant that the turbine turned off before a potential collision, interaction, or evasion would take place. The shutdown operating procedure for this turbine restricted the conclusions that could be drawn from the Environmental Monitoring Programme (EMP) and associated analysis. In other words, such mitigation measures have the potential to limit the ability to detect collision and behavioural responses, and restrict the potential transferability of data.

The influence of mitigation measures on transferability depends on the type of data that are being considered. For example, the shutdown mitigation most strongly influences micro scale collision risk data and will likely have less of an influence on macro scale abundance data. Therefore, micro scale data that was subject to shutdown mitigation would have a low transferability. However, macro scale data that was subject to shutdown mitigation would have a medium transferability.

Data collected when no mitigation measures are employed to deter animals from the turbine are considered to have a high transferability, whereas data collected when measures are employed to deter animals during the construction/operation of turbine are considered to have a medium transferability. Finally, data collected when a shutdown mitigation measure was applied are considered to have a low transferability.

Methodological limitations

The limitations in the survey methodologies that have been applied and how they may impact the findings should be considered. Survey design is important in determining significance and confidence in the results because it can influence the reliability and validity of the collected data. Limitations associated with monitoring equipment and techniques are detailed in the Collision Risk Data and Evidence Summary, 2025, and the Environmental Monitoring Guidance page. The Environmental Monitoring Guidance page signposts and summarises key resources and projects which have either conducted their own review of key literature, developed their own standards, or provided best practice recommendations/guidelines for a particular monitoring method. The resources selected are for marine mammal and seabird characterisation surveys and collision risk monitoring techniques in the context of Tidal Stream Energy projects.

This factor may or may not necessarily be relevant to the data. The methodology may inherently be uncertain with known limitations, but those data might be transferable (e.g. active sonar). Although active sonar is arguably the most important monitoring technique for recording collision risk and undertaking consent monitoring, it may not be able to distinguish between certain fish species or seal species and is limited in the very near field due to entrained air and blade rotation (Cotter and Staines, 2023). Despite this, active sonar data are still likely to be transferable to another project.

For example, an underwater video survey which has the limitation of high amounts of biofouling on the camera lens, and only captures 20% of the rotor swept area, will be less transferable and useful compared to a survey using the same methodology, but with measures to reduce biofouling, and footage covering 80% of the swept area.

Joining two existing datasets for quantitative analyses

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The aim of the transferability matrix is to help determine the potential transferability (i.e., applicability) of existing datasets to a proposed project in order to streamline the consenting process. However, it is also important to be able to compare two existing datasets and allow for their integration in analyses to fill existing data gaps. For example, a previous dataset could be used to supplement an existing survey conducted under the same parameters. This process would come after monitoring for a project has been conducted and previous transferable data has been used to build an evidence base (see: Transferability framework).

To be able to integrate additional data into an existing dataset, the factors included in the matrix could be considered as follows. It is important to note that the weighting in terms of value of each factor for determining comparability will vary depending on specific regulator/consenting concerns, and the country of usage.

Factors listed below must be the same in order to be able to integrate two datasets:

Receptor species: The data must be collected on the same receptor species for it to be comparable. For example, an existing dataset on harbour porpoises has the potential to be supplemented using a previous harbour porpoise dataset.

Tidal Stream technology type: Both datasets must be related to the same device specification, for the data to be comparable.

Seasonality: Both datasets must cover the same season in order to be comparable. This is particularly important when considering migratory species.

Spatial scale: Both datasets must cover the same spatial scale. If both datasets cover micro scales, then the data are highly comparable for this factor. If one dataset is micro scale only and the other covers all spatial scales, then the micro scale component is still highly comparable. Issues arise when very different spatial scales are used for comparison. For example, a project that has only collected micro scale data can be used to inform nearfield collision risk but cannot be used to infer assumptions about wider displacement, and wide scale data collection should not be used to inform nearfield collision risk.

Mitigation measures: If mitigation measures have been applied, they must be the same for both datasets. The degree of comparability relates to whether data are collected using similar or the same mitigation measures. For example, nearfield observations with Acoustic Deterrent Devices (ADDs) versus nearfield observations with no ADDs will have limited comparability in contrast to two datasets of nearfield observations with ADDs.

Factors listed below should be evaluated as follows to determine whether two datasets can be integrated:

Operating conditions: Datasets that have similar turbine device operating conditions and cover the same stage of the project are likely to be more comparable than datasets that cover different operating conditions and project stages.

Receptor species population: The data must be collected on the same type of receptor species population for it to be comparable. For example, an existing dataset on resident bottlenose dolphin has the potential to be supplemented with a previous resident bottlenose dolphin dataset.

Survey technique: Similar survey techniques used across two datasets will be more comparable. For example, aerial survey for surface abundance data versus dive profile data are not considered comparable. Aerial survey abundance data versus acoustic abundance are considered to have a low to medium comparability; and aerial survey abundance versus vessel survey abundance are considered to have a high comparability.

Site conditions: Datasets that have similar site conditions (e.g. high flow speeds) are likely to be more comparable, compared to datasets that have different site conditions.

Abbreviations

ABPmer: ABP Marine Environmental Research

ADDs: Acoustic Deterrent Devices

BMP: Best management practices

EC: European Commission

EIAs: Environmental Impact Assessments

EMEC: European Marine Energy Centre

EMP: Environmental Monitoring Programme

GPS: Global Positioning System

GSM: Global System for Mobile Communication

IAMMWG: Inter-Agency Marine Mammal Working Group

IUCN: International Union for Conservation of Nature

NRW: Natural Resources Wales

OES-E: Offshore Energy Society-Environmental

ORJIP: Offshore Renewables Joint Industry Programme

PAM: Passive Acoustic Monitoring

PNNL: Pacific Northwest National Laboratory

QA: Quality Assurance

SAC: Specific Area of Conservation

SCOS: Special Committee on Seals

SEAGP: Science and Evidence Advisory Subgroup

SMRU: Sea Mammal Research Unit

SNCB: Statutory Nature Conservation Body

UK: United Kingdom

US: United States

Definitions

Acoustic Deterrent Device: A device that transmits sound into the surrounding water to deter marine mammals from approaching.

Array: In this context, a collection of tidal stream turbines at sea, and the cables linking them together.

Avoidance: Behaviour of an animal responding to and moving away from a turbine.

Axial flow turbine: Turbine type which generates energy as water travels through the turbine in a straight line, parallel to the turbine's shaft.

Baseline data: Initial monitoring to establish a reference point against which potential changes can be monitored in the future.

Boat-based survey: Data collection conducted from a vessel which could include visual, acoustic, line transect or digital still surveys.

Biofouling: The accumulation of microorganisms and macroorganisms on wet surfaces.

Cetaceans: Whales, dolphins and porpoises.

Collision risk: The possibility of an animal coming into contact with the moving parts of a turbine.

Comparability: Similarity between two existing datasets to integrate them for quantitative analyses.

Crossflow turbine: Turbine type which generates energy as water passes across the rotor blades, causing the rotor to rotate. This water direction is different to a turbine directing water parallel to its rotor axis.

Cumulative impacts: Can occur when multiple stressors (e.g. human activities or natural processes) combine to cause adverse effects on the environment or receptor species. This can result from multiple actions or events that have occurred over a long period of time, or sequentially.

Data cleaning: Sorting through a dataset to remove false data, incorrectly formatted, duplicate or inconsistent entries.

Data consistency: Standardising data formats (e.g., dates, numbers, text), consistent processes and units, and suitable quality control measures.

Displacement: When a species moves to a new area due to unfavourable conditions.

Disturbance: When an activity causes changes in species composition, abundance or distribution within a particular area.

Drone: An unmanned, remote-controlled aircraft which can be used to collect, for example, visual data.

Ecotype: An ecotype refers to a group of organisms, e.g. a subspecies, that are genotypically suited to a specific environment. This is sometimes referred to as an ecospecies.

Encounter: When an animal is in the proximity of a tidal turbine and has potential to collide with the turbine.

Entrained Air: When microscopic bubbles of air are deliberately incorporated into and stored in concrete.

Environmental Impact Assessment: A tool used to assess the significant effects of a proposed project on the environment.

Evasion: When an animal changes its behaviour to escape contact with a turbine.

Flow augmented turbine: Turbine type which enhances flow through the turbine and therefore has a higher power output.

Functional value: The positive impact a trait, behaviour or environment has on the survival and reproductive success of an organism.

GPS/GSM tagging: A way of using a satellite-based navigation system to track the location of individuals after being attached with a GPS device. GSM tagging also involves the use of the cellular network.

Gravity-based foundation: Large concrete structure that sits on the seabed and rely on their weight to provide stability for marine structures.

Habituation: When an individual gradually decreases its response after it is exposed to repeated, non-threatening stimuli over time.

Haul out: When seals come onto land to rest or breed.

Hearing group: Categories of groups of cetaceans based on the different frequencies they can hear.

Hydrophones: Microphones used for recording or listening to sound waves underwater.

Land-based Vantage Point surveys: Monitoring looking out to sea from a high vantage point on land scanning the survey area at regular intervals.

Large array: 10 to 30 devices.

Marine Mammals: Classified into four different taxonomic groups: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and marine fissipeds (polar bears and sea otters).

Medium array: 7 to 9 devices.

Metadata: Gives information about data, such as the author, date created, date modified, and file size.

Migration: Seasonal movement of species from one region to another.

Mitigation measures: Methods to prevent, reduce or control negative environmental effects of a project.

Monopiles: Offshore wind turbine foundation type made up of a single vertical steel cylinder which is secured into the seabed.

Operating conditions: The status of turbine operation including daytime, nighttime, operating as normal, or stationary during slack tides.

Oscillating devices: Often a hydrofoil, this device is forced up and down due to the force of the current, whereby the resulting lift generates power.

Passive Acoustic Monitoring: Uses mounted hydrophones to detect echolocating marine mammals.

Photography: A method of recording images and visual data.

Pinnipeds: Seals, sea lions and walruses.

Population density: The number of individuals of a particular species in a set area.

Project phase: The stages of a project's lifecycle including pre-installation, construction, and post-installation.

Project in question: Project that is going through the consenting process and is required to undertake some form of environmental assessment work in support of a licence application (i.e. a new project) or licence variation application (i.e. a project extension or amendment).

Receptor: The entity or biological resource (i.e., species, population, habitat) subject to the pressure.

Small cetaceans: Dolphins, porpoises, and small toothed whales.

Small array: 2 to 6 devices.

Sonar: Using sound wave propagation and echo analysis to measure distances or detect objects underwater.

Spatial scales: The resolution of the area being studied.

Stratification: Separate horizontal layers of the ocean due to varying densities as a result of differences in temperature or salinity.

Swept area: The area of water the rotating turbine blade interacts with.

Tidal amplitude: The difference in vertical height between the height of high tide and the height of the subsequent low tide.

Tidal kites: Turbine type consisting of a hydrodynamic wing with a turbine attached. It is tethered to a fixed point, meaning water flow creates lift, forcing the tidal kite to move in a figure of eight pattern which generates energy.

Tidal range: The difference in height between high and low tide.

Transferability: Qualitative assessment of the applicability and relevance of applying existing data to the project in question.

Transferability factor: Factors that may or may not need to be considered in order to determine how applicable or transferable available data may be to the project in question.

Underwater cameras: Device which captures visual subsea data.

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