WP **4**	Deliverable **4.2**

Report on the analysis of commonalities and differences in approaches to pre-consent surveys

Deliverable 4.2

PROJECT COORDINATOR

David Gray

TASK LEADER

WavEC – Offshore Renewables

AUTHORS

Teresa Simas (WavEC – Offshore Renewables), Julia Heinrichs (WavEC – Offshore Renewables), Juan Bald (AZTI – Tecnalia), Iratxe Mentxaca (AZTI – Technalia), Ross Culloch (University College Cork), Finlay Bennet (Marine Scotland)

SUBMISSION DATE

30 | June| 2015

Citation

Simas T, Heinrichs, J, Bald, J, Mentxaca, I, Culloch, R, Bennet, F. (2015) Report on the analysis of commonalities and differences in approaches to pre-consent surveys, Deliverable 4.2, RICORE Project. 22 pp.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646436.

BOX 1. DEFINITION OF TERMS

ADCP – *Acoustic Doppler Current Profiler*;

AGDS – *Acoustic Ground Definition System*;

AMETS – *Atlantic Marine Energy test Site, one of the Irish wave energy test sites;*

AUV – *Autonomous Underwater Vehicle*;

Bimep – Biscay Marine Energy Platform;

BSH – *German Federal Maritime and Hydrographic Agency*;

CPUE – *Catch Per Unit Effort*;

CTD – *Conductivity, Temperature and Depth profilers*;

EIA – *Environmental Impact Assessment*;

EMF – *Electro-Magnetic Fields*;

EU – *European Union*;

EUNIS – *European Nature Information System*;

HF – *High Frequency*;

LIDAR – *Light Detection And Ranging*;

MRE – *Marine Renewable Energy*;

MS – *Member States*;

ROV – *Remotely Operated Vehicle*;

SAC – *Special Areas of Conservation*;

SDM – *Survey, Deploy and Monitor*;

SPA – *Special Protected Area*;

WP – *Work Package*.

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1. INTRODUCTION

In order to ensure the timely exploitation of our oceans and future sustainable development of marine renewable energy, the way must be paved for efficient streamlined cost-reducing Environmental Impact Assessment (EIA) procedures in all Member States (MS). The main aim of the RiCORE project is to ensure the successful development of the sector in EU MS by reducing the cost and time taken to consent projects of low environmental risk, through the development of a risk-based approach during projects' consenting. This type of approach has already been developed by the Scottish Government in its Survey, Deploy and Monitor Approach (SDM) policy, and its application across Europe (with appropriate adaptations to each MS) may be a way of standardising the assessment of key components of environmental risk from Marine Renewable Energy (MRE) developments.

In order to implement a risk based approach through utilising the SDM approach, the existing requirements for pre-consent surveys in the EU countries must first be assessed. Generally such pre-consent survey may be part of a preliminary site characterisation exercise or scoping as part of the EIA process. Different approaches are followed by EU MS during this licensing phase and a review is needed to assess how well existing methods can be optimised across EU, taking into account the consequent potential positive implications for project timescales and costs. A key outcome of the work to be developed under WP4 of the RiCORE project will be to develop guidance for pre-consent surveys considering the spectrum of survey requirements for projects under SDM and existing project experience. The guidance will encompass the transferability of methods and technologies.

1.1 Objectives

The overall objective of the present deliverable is to identify commonalities and transferability of pre-consent surveying (issues and/or methodologies) among renewable energy technology types. In this report a list of methodologies used across

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technologies is presented as well as their applicability to pre-consent surveys of the different technologies (wave, tidal and offshore wind, which includes fixed and floating devices).

2. METHODOLOGY

A literature review, based on standards available for the EIA process of MRE across Europe[1] and on EIA report results, was carried out on the pre-consenting requirements for wave, tidal and offshore wind (fixed and floating) projects. The pre-consent requirements and monitoring methods used have been identified for some EU countries (Denmark, France, Germany, Ireland, Portugal, Spain, the Netherlands and UK). In order to synthesize this information with the information collected in previous project activities, namely, workshop 1 discussions, the following main receptors were considered: physical environment (which includes the acoustic environment), marine mammals, fish and shellfish, benthos and seabed habitats, seabirds, bats, and socio-economic receptors. After a general discussion on the requirements per receptor and per country presented, a table was developed to summarise these findings, including considered parameters and methodologies to assess them against with regard to each MRE technology type. The monitoring approaches correspond to the pre-consent information that is needed to define the scope of the EIA process. It should be noted that, for each receptor, the monitoring approaches listed in the tables as well as their suitability does not denote that they are always required during the pre-consenting phase. Actually, the use or application of these methodologies will be dependent on what information is requested on a case-by-case basis by the MS licensing authorities. The information presented in these tables intends to provide information on the wide range of techniques available and what are the most relevant for some types of MRE in order to prepare the work for further reports under this WP on pre-consent surveying.

[1] In countries where no guidance on environmental impact assessment was available, existing EIA for MRE have been analysed as examples of the level and detail of the monitoring approaches that are requested.

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3. Commonalities and transferability of pre-consent surveying

3.1 Physical environment

The analysis of the existing information from MRE EIAs indicates that, in general, the physical environment refers to data on wave climate and hydrodynamics as well as on seabed composition (sediments) and weather data. Most countries including Denmark, France, the Netherlands, Spain, Ireland, Northern Ireland, England, Wales, and Scotland examine water, air and climatic factors. Many of them (France, Portugal, Spain, Northern Ireland, England, Wales and Scotland) also include geomorphology as a parameter for the characterisation of the physical environment. In Denmark preliminary geophysical investigations need to be carried out before starting the EIA process. In Ireland, additional investigations are carried out concerning electro-magnetic fields as a parameter of the physical environment. In France, a detailed analysis of the physical environment needs to be performed, including analysis of sediment quality. In Portugal, the physical environment description focuses exclusively on geology and geomorphology. In Germany, mandatory ground investigations are established to be implemented in order to grant the license before starting the EIA process. The parameters considered to characterise the physical environment in different MS do not vary significantly, although the methodologies to assess them are varied. Technologies that are currently used include acoustic surveys such as Acoustic Doppler Current Profiler (ADCP), Acoustic Ground Definition System (AGDS), side-scan sonar and multibeam and echo-sounder (single line bathymetry), satellite imagery, drop-down video and photography, ROV, diver quadrats, intertidal surveys, numerical modelling analysis, wave scan buoy, samples analysis collected with grabs and corers, optical sensors or backscatter sensors, surface mounted wave buoys or seabed mounted devices, sediment traps, conductivity, temperature and pressure (CTD) profilers, digital image scanning sonar and swath bathymetry (multibeam), geophysical and geotechnical surveys and walkover surveys. The methodologies and equipment

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chosen vary depending on the parameters that are under examination, on the area to be covered and on the project characteristics. In most of the MS only the parameters are defined; the method used to investigate them seems to be left to the developers or the contracted teams that carry out the surveys.

Table 1 – Parameters with established and potential approaches that could be used to address pre-consent surveys for the physical environment for MRE types; a green cell (✓) indicates the approach is suitable; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Geomorphology	Grab and core sampling analysis	✓	✓	✓	✓
	Acoustic methods	✓	✓	✓	✓
	Optical methods	✓	✓	✓	✓
	Numerical modelling	✓	✓	✓	✓
	Sediment trap analysis	✓	✓	✓	✓
Weather data	Desk based study	✓	✓	✓	✓
	Meteorological station	✓	✓	✓	✓
	LIDAR[2]	-	-	✓	✓
Hydrodynamics	Modelling	✓	✓	✓	✓
	Moored wave buoys	✓	✓	✓	✓
	ADCP[3]	✓	✓	✓	✓
	HF[4] radar	✓	✓	✓	✓
Water quality[5]	CTD[6]	✓	✓	✓	✓
	ADCP[3]	✓	✓	✓	✓
	Water samples collection and analysis	✓	✓	✓	✓
Sediments quality[7]	Grab and core sampling analysis	✓	✓	✓	✓
Underwater acoustics[8]	Desk based study on local noise sources	✓	✓	✓	✓
	Boat based surveys	✓	✓	✓	✓
	Static systems[9]	✓	✓	✓	✓
	Drifting systems[10]	✓	✓	✓	✓

[2] Light Detection And Ranging; for wind resource measurements.
[3] Acoustic Doppler Current Profilers.
[4] High Frequency.
[5] May include the following parameters: temperature, salinity, dissolved O_2, turbidity, suspended particulate matter, nutrients, heavy metals, hydrocarbons, PCBs.
[6] For measuring salinity, temperature and depth.
[7] May include: organic matter content, heavy metals, hydrocarbons, PCBs and other contaminants according to the project location.
[8] May include the following metrics: spectral densities and levels, narrowband/broadband levels and third octave band spectral levels.
[9] Include moored and bottom-mounted hydrophones (cabled or autonomous recorders).
[10] Drifting systems are being increasingly used in high tidal flow areas to minimize the effects of flow noise; these are typically boat based or use drifting autonomous recorders.

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For characterising the acoustic environment in some countries background noise levels are measured in addition to studying sound propagation into the acoustic environment from the devices. These methodologies have been used in Denmark, Germany, Scotland, Spain, England, Wales, Ireland and Northern Ireland. The synthesis of the collected information is presented in Table 1.

3.2 Marine mammals

Marine mammals encompass seals (pinnipeds), whales, dolphins and porpoises (cetaceans). Generally, information will be required by all MS regulators as to whether the proposed development site is within, or close to, a protected area for marine mammals (e.g. SAC), as this will likely require additional considerations (e.g. Habitat Regulations Appraisal in the UK). Nonetheless, the typical minimum requirement is to document the abundance and distribution of these taxa within and near to the proposed area for development. In some MS (e.g. UK, Ireland) this also involves taking into account the seasonal, temporal and spatial patterns. Information on inter-annual variation is requested by some MS regulators, although this may be on a case-by-case basis. Developments in some MS (e.g. UK, Ireland, France, Germany) routinely require a minimum of 2 years baseline survey data prior to applying for consent. However, it is possible, under the SDM approach used in Scotland, for developers to proceed with consent after just one year of baseline data, whereas other MS, such as Germany and France have shown less flexibility in their requirement for a minimum of two years baseline data. Of the MS included in the review, Spain has required the least amount of baseline data (5 months over summer in one particular case study, in which there was also no consideration given to pinnipeds) with no requirement to identify seasonal trends in distribution or abundance.

Some MS (e.g. France, Germany, Ireland and UK) may request more detailed information such as habitat use, which typically requires behavioural data. Ireland and the UK (and Scotland in particular) often have additional detailed requirements, with information on potential impacts being requested on a case-by-case basis (these could include information on the potential impact and mitigation of Electro-Magnetic Fields (EMF), underwater noise, vibration, collision risks and entanglement, displacement, for

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example). To meet the requirements of the individual MS pre-consent guidelines and/or recommendations, the methodologies (where available) are relatively standardised. In the first instance, desk-based studies are undertaken to ascertain if there is sufficient prior knowledge to fulfil the pre-consent requirement. If this is not the case, then the principal field-based approaches for gathering additional information/data are: land-based vantage point surveys (relative abundance); boat and aerial line transects (single platform: relative abundance; double platform: absolute abundance); and Passive Acoustic Monitoring (static and/or towed array from a vessel). The latter is only suitable for cetacean species and the three former approaches (land-based, boat-based and aerial surveys) are generally regarded as ineffective for pinnipeds. Approaches used in the UK for pinnipeds include counts at haul-out sites, where appropriate (i.e. if a haul-out site is in close proximity to the proposed area for development). The UK and Denmark also use telemetry studies of pinnipeds, where appropriate, to ascertain habitat use and movement/distribution within the area of the proposed development. Where additional information on habitat use is requested, land-based surveys (e.g. where cables make landfall) can be used, as can boat-based photo-identification surveys for cetacean species (typically bottlenose dolphins), which can give information on residency patterns (e.g. to assess the likelihood that individuals are persistently exposed to potential impacts) and provide abundance estimates. In most cases, information on EMF, underwater noise, vibration, collision risks, entanglement and displacement (where requested/deemed necessary) are obtained via a desk-based review of literature. However, telemetry studies (pinnipeds; Denmark, UK) and photo-identification (primarily cetaceans) studies (Denmark, Germany, Ireland and the UK) are approaches that have been used pre-consent to assist in better understanding habitat use and residence patterns of marine mammals. These studies can inform the probability of collision risk, for example, by investigating movement patterns of individuals through the proposed development area; these data can be used to inform quantitative numerical modelling of collision and/or entanglement risk.

Table 2 summarises the parameters with established and potential approaches that could be used to address pre-consent surveys for marine mammals.

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Table 2 – Parameters with established and potential approaches that could be used to address pre-consent surveys for marine mammals (C = cetacean, P = pinniped) for MRE types; a green cell (✓) indicates the approach is suitable; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Broad scale Occurrence, (relative/absolute) abundance and habitat preferences	Desk-based study (C, P)	✓	✓	✓	✓
	Fixed-point (typically land-based) surveys (C, P)[11]	✓	✓	✓	✓
	Boat-based surveys (line transects) (C)	✓	✓	✓	✓
	Boat-based platform of opportunity (C)	✓	✓	✓	✓
	Aerial surveys (line transects) (C)	✓	✓	✓	✓
	Aerial platform of opportunity (C)	✓	✓	✓	✓
	Towed hydrophones (add-on to boat-based surveys) (C)[12]	✓	✓	✓	✓
	Ecological/habitat modeling (C, P)[13]	✓	✓	✓	✓
	Photo-identification (add-on to boat-based surveys) (C)[14]	✓	✓	✓	✓
	Autonomous acoustic monitoring (C)[12]	✓	✓	✓	✓
	Haul out counts (P)[15]	✓	✓	✓	✓
Fine scale behaviour, movement, habitat use and connectivity	Desk-based study (C, P)	✓	✓	✓	✓
	Telemetry[16]	✓	✓	✓	✓
	Theodolite tracking from fixed-point (typically land-based) platform (C)[11]	✓	✓	✓	✓
	Cetacean photo-identification (add-on to boat-based surveys)[14]	✓	✓	✓	✓
	Pinniped photo-identification (add-on to haul out counts)[15]	✓	✓	✓	✓
	Ecological/habitat modelling (C,P)[13]	✓	✓	✓	✓

[11] If the device is located at an inshore location with a suitable vantage point. It is possible to undertake fixed-point surveys from stationary platforms at sea (e.g. oil rigs), although in practice this is rarely possible.

[12] It is not always possible to identify the species of cetacean using these approaches, and it cannot be used for species that do not echo-locate (mysticetes and pinnipeds).

[13] Can be applied to archived data and/or data collected pre-consent.

[14] Species dependent (bottlenose dolphins are commonly subject to this approach).

[15] Depending on the proximity of the nearest haul-out site to the development and whether there is likely any spatial overlap.

[16] In some EU MS licences for telemetry studies of harbour porpoise are attainable, but this approach has not been employed in the context of pre-consent data collection for MRE devices. With respect to pinnipeds: they are typically caught and tagged at haul-out sites; therefore, the likelihood of seals remaining in the area to assess habitat use, movement patterns, potential collision/entanglement risk is an important consideration. In addition, telemetry data can assist in our understanding of the connectivity between seal haul-outs and the animals' habitat preferences whilst foraging.

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3.3 Fish and shellfish

In Germany, the standard document developed by the German Federal Maritime and Hydrographic Agency (BSH) for offshore wind suggests that the minimum length of monitoring for baseline conditions should be 24 months, which includes beam trawl/otter trawl surveys once a year in autumn.

In Scotland, the SDM approach suggests a minimum of one year monitoring. Where understanding of inter-annual variation is required the minimum length of monitoring is two years. Monthly surveys are used to characterise seasonality. Moreover, Marine Scotland and Scottish Natural Heritage recommendations suggest that additional years would be required to more fully characterise inter-annual variation. An initial year of baseline data should be collected prior to consent application with the possibility of a further year of data collection. In a similar manner, in France, according to MEDDE (2012), three years of monitoring are required.

In Spain, the monitoring is decided on a case-by-case analysis. For example in the case of the *bimep* platform (Biscay Marine Energy Platform) (Basque Country, Spain), only one summer campaign (three months) was carried out. In the Netherlands, for Egmond aan Zee wind farm, pelagic fish were sampled twice per year. In Portugal there are no specific requirements for the minimum length of monitoring.

The fish and shellfish baseline site characterisation varies among countries, but basically includes a wide scale description of fish and shellfish diversity (identification of all species), distribution, abundance (number, biomass) and population structure.

Specifically, in Denmark, according to DAE (2013), the fish and shellfish assessment includes the Catch Per Unit Effort (CPUE). In Portugal, the identification and the cartography of the areas of protected species are also included. In Spain, for the specific case of *bimep*, only the presence of shoals was necessary. In Denmark, Ireland and the UK, the identification of the importance of an area as foraging area, as spawning ground for important fish species, as nursery ground for important fish species, the migration routes, the importance of commercial fisheries, the sensitive habitats/conservation interests were also included in pre-consent reports.

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Methodologies and equipment currently used by MS for the baseline monitoring of fish and shellfish includes desk-based literature review (including commercial fishing or scientific research), commercial gears (pots, trawls, fixed nets, lines, etc.), hydro-acoustic equipment (Acoustic Ground Definition System – AGDS, 'Scientific' Echo-Sounder), underwater video, still photography and side-scan sonar.

The spatial coverage of monitoring used by MS is normally within and around the expected zone of influence. In Scotland, taking into account mobile species (i.e. basking sharks) larger spatial scales are also required.

According to BSH (2013) from Germany and the baseline study report for Egmond aan Zee wind farm in the Netherlands, reference areas may be used and they should be located outside project areas. Table 3 summarises the parameters with established and potential approaches that could be used to address pre-consent surveys for fish and shellfish.

3.4 Benthos and seabed habitats

In general, parameters regarding benthos and seabed habitats assessment include substrate distribution (sediments' grain size analyses), the habitat/biotope community/distribution (using the European Nature Information System-EUNIS) and presence of certain species, species abundance, species richness, diversity indices and community composition.

There is extensive literature on standard methods for benthos sampling and data processing and analysis. However, decisions on the methodology, equipment and analysis will strongly depend on the particular aims of a study, on the nature of the habitat involved, on the staff and facilities available and on historical or personal preferences.

The benthos and seabed habitats baseline characterisation currently carried out by MS includes a desk study review of collected data in the area and field data collected specifically for that purpose.

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Table 3 – Parameters with established and potential approaches that could be used to address pre-consent surveys for fish and shellfish for MRE types; a green cell (✓) indicates the approach is suitable; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Species composition, abundance and population structure	Desk based study[17]	✓	✓	✓	✓
	Commercial gears (pots, trawls, fixed nets, etc.)	✓	✓	✓	✓
	Hydro-acoustic surveys[18]	✓	✓	✓	✓
	Underwater video and photography	✓	✓	✓	✓
	Side-scan sonar	✓	✓	✓	✓
Species distribution and habitat use[19]	Desk based study[20]	✓	✓	✓	✓
	Hydro-acoustic surveys	✓	✓	✓	✓
	Underwater video and photography	✓	✓	✓	✓
	Side-scan sonar	✓	✓	✓	✓

Table 4 – Parameters with established and potential approaches that could be used to address pre-consent surveys for benthos and seabed habitats for MRE types; a green cell (✓) indicates the approach is suitable; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Seabed mapping and sediments' grain size	Desk based study	✓	✓	✓	✓
	Analysis of samples collected with dredges, grabs and corers (soft bottom)[21]	✓	✓	✓	✓
	Imagery acquisition (hard bottom)[22]	✓	✓	✓	✓
	Multibeam sonar	✓	✓	✓	✓
Habitat (biotope) distribution	Desk based study[23]	✓	✓	✓	✓
	Imagery acquisition with vehicles[22]	✓	✓	✓	✓
Species composition and abundance and benthic community conditions	Desk based study	✓	✓	✓	✓
	Analysis of samples collected with dredges, grabs and corers (soft bottom)	✓	✓	✓	✓
	Imagery acquisition with vehicles (hard bottom) [22]	✓	✓	✓	✓
	Calculation of diversity indices[24]	✓	✓	✓	✓

[17] Landings data, importance of species in the food web and species of conservation importance.
[18] Includes Acoustic Ground Definition System (AGDS) and 'Scientific' Echo-Sounder
[19] E.g. foraging areas; spawning and nursery grounds; migration routes; sensitive habitats.
[20] Desk based studies may include distribution of spawning and nursery grounds.
[21] For soft bottom sediments to estimate organic matter content and analyse sediments grain size.
[22] With Remotely operated vehicles (ROV) or Autonomous Underwater Vehicles (AUV).
[23] Including the identification of sensitive habitats and using the European Nature Information System EUNIS.
[24] E.g Shannon–Wiener (Pielou, 1975), AMBI (Borja et al., 2000) and BQI (Rosenberg et al., 2004).

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Field campaigns for benthos and seabed habitats identification include: collection of samples from ships with dredges, grabs and corers, for soft bottom sediments; underwater cameras (video and photograph, with Remotely Operated Vehicles-ROV or divers), for hard-bottom benthic characterisation; and multi-beam sonar for seabed mapping. There is not a consensus of the minimum length of monitoring for baseline conditions among MS, and it is decided on a case-by-case study, depending on the purpose. However, recommended sampling may be at least one sampling pre-installation, extending 24 months in order to complete at least two consecutive seasonal cycles. The spatial coverage of monitoring used by MS is normally within and around the expected zone of influence. BSH report (2013) recommends the use of reference areas, to be located outside the project areas. If possible, BSH report (2013) recommends that the benthos investigations should be carried out at the same time as the fish investigations, but mutual disturbance should be avoided. Table 4 summarises the information on potential approaches that could be used to address this receptor during pre-consent surveys.

3.5 Seabirds

Generally, information will be required by all MS regulators as to whether the proposed development site is within, or close to, a protected area for birds (e.g. SAC, SPA), as this will likely require additional considerations (e.g. Habitat Regulations Appraisal in the UK). The typical minimum requirement for MS is to document the abundance and distribution of seabird species, with some MS (e.g. UK, Ireland) requiring information on seasonal, temporal and spatial patterns in abundance. Information on whether or not their key breeding, moulting and foraging sites and migration routes occur within and/or nearby the proposed development site are often requested by several MS regulators (UK, Denmark, France and Germany). Information on inter-annual variation may be requested by some MS, although this may be a case-by-case basis. As such, it is not uncommon for developments in some MS to need a minimum of 2 years baseline survey data prior to applying for consent (e.g. UK, Ireland, France and Germany). However, it is possible, under the Survey Deploy Monitor approach used in Scotland for developers to proceed with consent after just one year

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of baseline data. Examples of risk-based monitoring approaches of a one year minimum monitoring (with the need for further survey work being reviewed based on the findings from the first year) has been implemented in Ireland (e.g. AMETS) and the UK (e.g. Torr Head). However, other MS, such as Germany and France have shown less flexibility in their requirement for a minimum of two years baseline data.

The UK often has additional detailed requirements, with these tending to be requested on a case-by-case basis. These could include information on the potential impact of underwater and airborne noise, collision risk (particularly for diving birds for wave and tidal) and displacement, for example. Of the other MS included in the review, Denmark and The Netherlands are the only other to consider collision risk.

To meet the requirements of the individual MS' pre-consent guidelines and/or recommendations, the methodologies (where available) are relatively standardised. In the first instance, desk-based studies are undertaken to ascertain if there is sufficient prior knowledge to fulfil the pre-consent requirement. If this is not the case, then the European Seabirds At Sea methods for data collection are typically followed (this is explicitly true for the UK and Ireland). These methods are based upon boat or aerial line transects. Digital photographs and/or video are increasingly likely to be used during surveys in some MS (Denmark, Germany and UK); it should be noted that this is an evolving approach that is improving in its application as technology progresses. Land-based vantage point surveys are also commonly used in several MS (France, UK and Ireland) during breeding and wintering seasons to obtain count data.

Other approaches include the use of radars (Denmark, France, Germany and UK), telemetry (UK) and focal follows (UK). All can give information on habitat use and movement patterns. Telemetry also gives information on distribution, whereas focal follows of individuals can also give detailed information on behaviour.

In most cases, information on noise, collision risks and displacement (where requested/deemed necessary) are obtained via a desk-based review of literature. However, telemetry studies (UK) and radar studies (Denmark, France, Germany and UK) are approaches that could be used pre-consent to assist in better understanding habitat use and movement patterns. These studies can inform the probability of collision risk, for example, by investigating movement patterns of individuals through

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the proposed development area; these data can be used to inform quantitative numerical modelling of collision risk. Table 5 shows the potential approaches that could be used to address the receptor “seabirds” during pre-consent surveys. It is important to note that when planning sea birds surveys the temporal variation need to be considered: in particular, tidal state, diurnal and seasonal (e.g. breeding and/or moulting periods) patterns of occurrence/behavioural state, which will vary between species.

3.6 Bats

Regulation for assessment of bats is established in Germany, France, Denmark and the UK because these MS have specific legislation concerning offshore wind farms, which might endanger bat populations. Comparing these three countries in terms of the criteria and methodologies, they have a lot in common. Denmark and France focus on identifying key species. France further examines abundance and habitat use of bats. Germany stresses research on bat migration, their distribution and call activity. In Scotland, England and Wales it is decided on a case-by-case basis to conduct collision risk studies. Ireland focuses in general on bat activity and Northern Ireland focuses on investigations concerning the identification of known bat roosts, foraging grounds, commuting routes and habitat use.

Concerning the methodology all of them use ultrasound detectors. Additionally in some MS radar, as well as infrared cameras or direct observation is used to detect bats. Furthermore in Ireland and Northern Ireland desk based studies are used and if distribution maps suggest that bats are present in the area it is likely that bat activity studies will be required. Table 6 shows the potential approaches that could be used to address this receptor during pre-consent surveys.

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Table 5 – Parameters with established and potential approaches that could be used to address pre-consent surveys for seabirds for MRE types; a green cell (✓) indicates the approach is suitable for the MRE type; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Broad scale occurrence, (relative/absolute) abundance and habitat preferences	Desk-based study	✓	✓	✓	✓
	Fixed-point (typically land-based) surveys (e.g. snapshot scans, line transects, flying bird watches)[25]	✓	✓	✓	✓
	Boat-based line transects	✓	✓	✓	✓
	Aerial surveys (line transects with/without high resolution digital photography/video[26])	✓	✓	✓	✓
	Ecological/habitat modelling[27]	✓	✓	✓	✓
Fine scale behaviour, movement, habitat use and connectivity	Desk-based study	✓	✓	✓	✓
	Telemetry (e.g. positional information, dive depths, swim speeds, flight altitude)	✓	✓	✓	✓
	Focal-follows/behavioural observations (e.g. diving behaviour, flight paths, identify prey items)[25]	✓	✓	✓	✓
	Ecological/habitat modelling[27]	✓	✓	✓	✓

Table 6 - Parameters with established and potential approaches that could be used to address pre-consent surveys for bats for MRE types; a green cell (✓) indicates the approach is suitable for the MRE type; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Occurrence, abundance and habitat use	Desk based study	-	-	✓	✓
	Acoustic surveys[28]	-	-	✓	✓
	Radar[29]	-	-	✓	✓
	Thermal infrared imaging[30]	-	-	✓	✓

[25] Land-based surveys should be conducted at colonies where birds are suspected to be foraging in/transiting through the MRE proposed site. If the site is an inshore location with a suitable vantage point then land-based surveys can be undertaken. If the site is offshore, it may be possible to undertake fixed-point surveys (stationary platforms at sea, e.g. oil rigs) although in practice this is rarely possible.
[26] High resolution digital photography/video is a relatively new technology; it has proven useful for seabird surveys and is likely to become a standard approach for seabird aerial surveys in the near future.
[27] Can be applied to archived data and/or data collected at pre-consenting.
[28] Cannot determine numbers of bats present but are useful to provide population indices or indications of relative bat abundance.
[29] Several techniques to monitor bats: e.g. Doppler weather stations and marine radar systems or more advanced radar systems. All systems detect bats at greater distances than other techniques and give information on numbers, direction, velocity and altitude.
[30] Particularly useful to survey whispering bat species that are difficult to detect in acoustic surveys.

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3.7 Other users (socio-economy)

Socio-economic receptors include architectural and archaeological heritage, landscape, perceptions like the visual impact of the project, public opinion, potential benefits and negative impacts, maritime related professional activities (e.g. military or commercial activities) and leisure and recreational activities such as tourism and water sports.

Two countries, Germany and the Netherlands, consider only one parameter. In Germany the emphasis of the investigation is on the landscape/seascape and in the Netherlands it is all about the public opinion of stakeholders like residents of the coastal towns, local businesses owners and tourists. In Denmark besides the landscape/seascape, architectural and archaeological heritage are also considered. All other MS take into consideration far more factors. France, Ireland, Scotland, Northern Ireland and Portugal also consider maritime-related professional activities. Furthermore France, Ireland, Northern Ireland, England, Wales and Scotland include recreational activities and tourism. Ireland, Northern Ireland and Scotland add employment as a parameter and other socio-economic benefits. In Ireland additional other impacts on humans are examined.

Methodologies that are currently used by MS to investigate the parameters of socio-economic receptors include photorealistic simulation of the landscape/seascape, landscape/seascape and visual surveys, surveys of natural features and processes and outdoor recreation, maritime traffic and access surveys, radar surveys, field inspections (geophysical, dive and walkover investigations), seascape assessment, historical seascape and landscape assessment, reviews in the context of the existing evidence and desk-based literature reviews.

With regard to methodologies and equipment used, only Germany prescribes requirements concerning the implementation of a photorealistic simulation of the landscape/seascape since the landscape/seascape is the only parameter evaluated regarding socio-economic factors. This visibility range report includes data regarding the visibility of the wind farm over the course of a year and a day.

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Based on the above information and on the findings of Workshop 1 (Simas et al., 2015), Table 7 shows the parameters and approaches that may be used to address this receptor for all MRE types.

Table 7 – Parameters with established and potential approaches that could be used to address pre-consent surveys for other users for MRE types; a green cell (✓) indicates the approach is suitable for the MRE type; a yellow cell (✓) indicates the approach may be suitable; a grey cell (-) indicates that the parameter is not a concern for the MRE type.

Parameters	Approaches	Wave	Tidal	Fixed offshore wind	Floating offshore wind
Archaeological heritage	Registry of archaeological remains	✓	✓	✓	✓
List of commercial and recreational activities in the site	Listing of activities	✓	✓	✓	✓
	AIS data[31]	✓	✓	✓	✓
	Radar surveys[31]	✓	✓	✓	✓
	Maritime traffic routes	✓	✓	✓	✓
Public opinion about MRE and the specific project	Questionnaire surveys	✓	✓	✓	✓
	Public sessions	✓	✓	✓	✓
	Meetings with relevant stakeholders	✓	✓	✓	✓
Landscape and seascape perception	Photorealistic simulation	✓	✓	✓	✓
	Visual surveys	✓	✓	✓	✓
	Historical assessment (desk based studies)	✓	✓	✓	✓
Socio-economic benefits	Number of jobs created	✓	✓	✓	✓

[31] To analyse the navigation use of the area.

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4. CONCLUSIONS

In this report information on pre-consent monitoring practices has been compiled for the assessment of the effects of MRE developments on relevant receptors. In general, methodologies to assess most of the parameters identified for each receptor seemed to be applicable to all MRE types (wave, tidal, fixed offshore wind and floating offshore wind). However, there are some exceptions related to aspects of the specific marine environment where the developments are to be located. One such exception is the site depth, which in the case of floating offshore wind projects may be higher than for the rest of the considered technology types. This may influence the methods selected for the benthos and sediments assessment, which will possibly need to make much use of ROVs to collect images instead of samples. Another exception is related to acoustic assessment of the physical environment. Although all listed approaches are valid for all MRE types considered, drifting systems are recommended in high tidal flow areas to minimize the effects of flow noise.

In some cases, the assessment of some parameters and even receptors may not be a concern for some of the MRE types. Examples of such parameters are the accurate measurement of wind resource conditions using LIDAR techniques for wave and tidal energy developments. Also, the assessment of bats is not considered a concern for wave and tidal developments.

The information provided herein is the first step in the process of understanding how existing methods can be optimised across EU, taking into account the consequent potential positive implications for project timescales and costs. The information contained in this report will support the development of guidance on pre-consent surveys taking into account risk based approaches such as SDM.

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