Ocean Energy Pathway

In partnership with

The Biodiversity Consultancy

Biodiversity Survey Concept Note for Offshore Wind in South Korea



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This report outlines priority survey approaches to support offshore wind industry development in South Korea across early industry and project stages.

Contents

1. Context 3
1.1 Objectives 3
1.2 Offshore Wind in South Korea 3
1.3 Legal and Policy Basis for Biodiversity Integration 4
1.4 A Window of Opportunity in the Siting Process 4
2. Approach 6
2.1 Extent 6
2.2 Prioritisations 6
2.3 Stages of Development 9
3. Planning Stage Survey Concepts 11
3.1 High Priority Features 11
3.2 Medium Priority Features 11
3.3 Low Priority Features 12
3.4 Survey Options 12
4. Project Stage Survey Concepts 19
4.1 High Priority 19
4.2 Medium Priority 19
4.3 Low Priority 20
4.4 Survey Options 20
5. Strategic Approach Recommendations 30
5.1 Collaborative approach 30
5.2 Strategic sequencing 30
6. Summary 33

Context



1. Context

1.1 Objectives

Ocean Energy Pathway (OEP) requested The Biodiversity Consultancy (TBC) to produce a Survey Concept Note of recommendations in relation to potential offshore wind developments in South Korea. TBC has also prepared a Biodiversity Scoping Study to screen priority biodiversity values in an indicative South Korean Exclusive Economic Zone (EEZ), which provides the basis for recommendations made in this report.

The primary purpose of this Survey Concept Note is to present possible approaches to additional data collection to support early-stage and sustainable offshore wind development in South Korea. The recommendations in this report intend to focus efforts to ensure spending is targeted and effective. Recommendations will help to facilitate sustainable development by closing knowledge gaps for identified priority biodiversity features in both sector-wide planning and project-specific stages.

1.2 Offshore Wind in South Korea

South Korea is actively pursuing offshore wind development as a driver of green energy growth and decarbonisation, national energy security, and economic development from job creation and exports. As a key pillar of its carbon neutrality goal, the South Korean government has a target of 10.5 GW in offshore wind to be either operational or under construction by 2030; of this, there is a target for 3.1 GW of installed capacity by 2030. There is an additional target of 25 GW installed capacity by 2035. Note, the current 2030 target is revised from the previous target of 13.5GW installed capacity, set by previous administrations. This reflects a revised realistic approach that considers policy frameworks, market conditions, and infrastructure constraints, and allows development of these foundational factors to ensure sustained offshore wind development. These revised targets and adoption of a more systemic approach have also facilitated the opportunity to consider and plan for enhanced biodiversity outcomes in early stages of development, and creates opportunity to integrate biodiversity considerations at the earliest stage of spatial planning and project development. To implement these targets, the government published a ten year auction roadmap in June 2026, under which a total of 55 GW of offshore wind capacity will be put to tender between 2026 and 2035, with more than 4 GW to be announced annually.

The Ministry of Climate, Energy and Environment (MCEE) is responsible for matters of both energy and environment, which were previously considered by the separate departments of Ministry of Trade, Industry and Energy (MOTIE) and Ministry of Environment (MOE), respectively. This

arrangement provides opportunities for climate and biodiversity issues to be considered directly alongside energy infrastructure development. The Ministry of Oceans and Fisheries (MOF) retains responsibility for marine spatial planning and marine environmental management, and acts jointly with MCEE in the offshore wind siting process described in Section 1.4.

1.3 Legal and Policy Basis for Biodiversity Integration

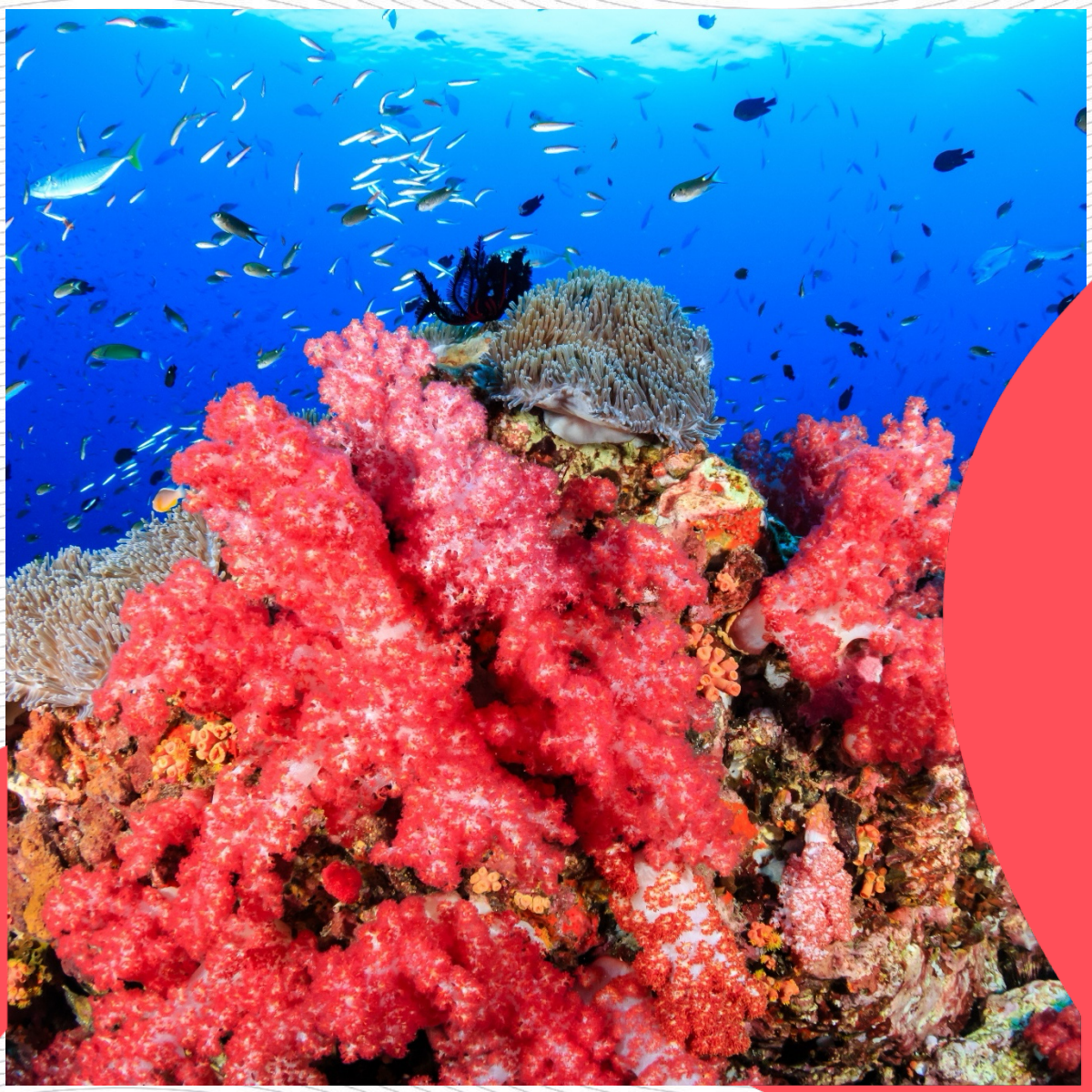
Biodiversity considerations in offshore wind development are not discretionary in South Korea. The country is a Party to the Convention on Biological Diversity, and its Fifth National Biodiversity Strategy (2024–2028) is aligned with the Kunming–Montreal Global Biodiversity Framework adopted under the Convention. Target 8 of the Framework concerns the relationship between climate change and biodiversity, and requires that climate mitigation and adaptation actions themselves minimise negative impacts on biodiversity and foster positive ones. Offshore wind, as a climate mitigation measure, falls squarely within this requirement: its contribution to decarbonisation does not exempt it from biodiversity obligations, but rather makes the manner of its deployment a matter of international commitment.

Domestically, the Act on the Conservation and Use of Biological Diversity requires government plans and projects to be consistent with the National Biodiversity Strategy. The Special Act on the Promotion of Offshore Wind Power Deployment and the Development of the Offshore Wind Industry (the Offshore Wind Act) also places responsibility on both the State and offshore wind operators to conserve the marine environment when planning and implementing offshore wind development. Awareness of these obligations within the South Korean offshore wind sector remains limited, and the survey work described in this report offers a practical means of meeting them.

1.4 A Window of Opportunity in the Siting Process

The Offshore Wind Act, (March 2026) establishes a government-led siting regime under which the MCEE and the MOF jointly designate preliminary zones, subject to committee deliberation, before areas proceed to full designation and competitive tender. Among the requirements a candidate area must satisfy under Article 14 of the Act is that its impact on the marine environment and ecosystem be limited. The approach and evidence base to assess this requirement has not yet been publicly discussed. With the first preliminary zone designations being progressed during 2026, the data collection approaches presented in this report are directly relevant to that discussion.

Approach



2. Approach

2.1 Extent

The extent selected for the Study Area is shown in Figure 1. The Indicative EEZ used for the Study Area also contains the Korea-Japan Joint Development Zone (JDZ). It is important to note that maritime boundaries utilised are indicative and for biodiversity scoping purposes only, to ensure coverage of all biodiversity aspects that may be relevant. The results of this screening are therefore relevant to potential offshore wind projects developed in South Korea.

The full screening methodology and source list used to identify biodiversity values in this Indicative EEZ are discussed in the Biodiversity Scoping Study (TBC, 2026).

2.2 Prioritisations

This report draws heavily from the Biodiversity Scoping Study (prepared by TBC, 2026) which screened and prioritised biodiversity features based on the Study Area shown in Figure 1 above. The Biodiversity Scoping Study report identified features of high biodiversity value that could be significantly affected by the development of offshore wind energy and should be considered in the planning and biodiversity management priorities for the sector's future development in South Korea. The features identified in the report are legally protected areas (LPAs) and internationally recognised areas (IRAs), and specific taxonomic groups, habitat types, or species, which are referred to as priority biodiversity values (PBVs).

Following the database screening and literature review in the Biodiversity Scoping Study, the identified PBVs were prioritised in table format. The full methodology and prioritisations table can be found in the Biodiversity Scoping Study; below in Table 1 is an excerpt of columns which show the high-level priority levels and suggestions which will be further discussed throughout this Survey Concept Note.

Table 1 – Summary of Biodiversity Values and Priorities

PBV/Taxonomic Group	Additional Data Collection	
	Suggestions	**Priority***
Marine mammals	**Planning level:** Improve understanding of key marine mammal populations and habitats to allow for planning of OSW in South Korea	Medium
	Project level: Improve site-	Medium

	specific data through surveys after the delineation of development areas and throughout project stages.	
Birds	**Planning level:** Enhance bird distribution and flight behaviour knowledge through dedicated surveys to inform collision risk modelling	High
	Project level: Expand site-specific data through surveys after delineation of development areas	High
Sea turtles	**Planning level:** Existing data should allow for planning of OSW in South Korea	Low
	Project level: Utilise observational data collection opportunities in later project-specific surveys, after delineation of development areas; on observation of Hawksbill Turtle (CR) or nesting sites, additional dedicated surveys recommended	Medium
Bats	**Planning level:** Expand knowledge base by studying broad bat behaviour and movements offshore, prior to development area delineation; results could provide valuable input into spatial planning	Medium
	Project level: Conduct dedicated bat surveys in areas of potential OSW development (i.e. acoustic monitoring, observation) and expert advice.	Medium
Sharks, rays, and ray-finned fishes	**Planning level:** Conduct broad surveys to identify any breeding or key habitat areas. Improve industry-wide knowledge on EMF impacts to key species in	Medium

	South Korea	
	Project level: Assess proposed offshore wind areas in greater detail for key species, after delineation of development zones	Medium
Corals	**Planning level:** Existing data should allow for planning of OSW in South Korea	Low
	Project level: Conduct habitat and species surveys to help to inform routing and nature-inclusive design, after delineation of development areas	Low
Seagrass and algae	**Planning level:** Existing data should allow for planning of OSW in South Korea	Low
	Project level: Conduct habitat and species surveys to help to inform spatial planning and nature-inclusive design, and avoid routing through restricted-range populations, after delineation of development areas	Medium

The **suggestions for additional data collection** in Table 1 are recommended next steps based on existing data and identified gaps; these suggestions will be expanded throughout this report. **Priority** ratings for additional data collection have been assigned as high, medium, or low for both planning and project levels. Priority ratings reflect a combination of factors including the susceptibility of taxonomic groups to offshore wind development impacts, risk to permitting and likelihood of constraint to planning development, quality and availability of data, extent of data gaps, and value of closing these gaps. Priority is assigned based on the overall benefit and necessity of addressing knowledge gaps and is not a reflection of conservation importance. This prioritisation intends to inform future efforts for biodiversity studies to support the development of the offshore wind industry. Priority levels are given for both the planning stage (before specific sites or projects are identified; Korea-wide), and the project stage (spatially restricted surveys to support a particular

development). Focusing on priority PBVs will help to facilitate development by closing knowledge gaps and will ensure spending is targeted and constructive.

2.3 Stages of Development

Two stages of offshore wind development have been considered in order to accurately reflect the differences required in approach for additional data collection.

At the **planning level**, the suggestions identify data collection methods and/or goals that will support early-stage planning of the offshore wind industry in South Korea, by addressing uncertainties and closing key knowledge gaps.

The **project level** suggestions target data collection at a site-specific level once an offshore wind project has been proposed (or a specified development area), often at a population level or to establish baselines.

Planning Stage Survey Concepts



3. Planning Stage Survey Concepts

This section outlines survey concepts for the planning stage of offshore wind development in South Korea, prior to the delineation of specific zones or projects.

3.1 High Priority Features

Birds have been identified as high priority for the sector-wide planning stage. Risk to permitting from birds is considered high due to multiple factors including public concern of collision risk, presence of threatened bird species, and high exposure of the taxonomic group to offshore wind farms. There is good understanding of wintering species distributions including ducks, geese, swans, and shorebirds from sources like the Asian Waterbird Census. Breeding seabirds, in contrast, are less understood and have a higher exposure to potential offshore wind impacts. Closing the key knowledge gaps of flight heights, local movement pathways, and cumulative impacts will be highly valuable to support offshore wind development and constructive action in the industry. Revision and update of Important Bird Areas (IBAs) is expected to be underway in the near future[1] and will be an important component for closing these knowledge gaps. Suggested survey concepts are outlined in Table 2 (Section 3.4).

3.2 Medium Priority Features

Marine mammals have a high permitting risk; as charismatic megafauna, public interest is inherent and protection measures are established. Key impact pathways to marine mammals from offshore wind development are underwater noise during construction, vessel collision, and disruption of key migratory or breeding areas. There is a good understanding of marine mammal presence and distribution in South Korea, and industry-wide knowledge of possible impacts. Establishment of Important Marine Mammal Areas (IMMAs), a resource commonly used to inform offshore wind planning in emerging markets, has not occurred in South Korea. While gathering additional survey information in planning stages is not considered highest priority to progress offshore wind development, it would be beneficial to review current information available of relevance to IMMAs and close this knowledge gap.

Sharks, rays, and ray-finned fishes are of medium permitting risk and medium priority for additional data collection, reflective of public interest levels, implications for the fishing industry, and expectations for well-established baselines and management efforts. Addressing key

[1] Discussed through engagement with local ornithology experts in South Korea

knowledge gaps in relation to breeding habitat and EMF impacts will be beneficial to planning stages in offshore wind development.

Bats are currently a low risk to permitting; there is little public interest in impacts from offshore wind on bats, which is likely a reflection of limited industry understanding of bat and offshore wind interactions. The opportunity to address this significant knowledge gap is reflected in the medium priority ranking. Being able to understand if and how bats are impacted may reduce later requirements for monitoring and/or mitigation, if impacts are established at offshore wind sites. This is particularly relevant due to growing industry interests in bat collisions, and the possibility of bat passage between marine islands in South Korea.

Table 2 outlines key survey recommendations for these medium-priority features during the planning stage.

3.3 Low Priority Features

Seagrass and algae have both been identified as a low risk to permitting and low priority, on consideration of low public interest, lack of threatened species present (partially driven by lack of assessment), and limited susceptibility to offshore wind impacts. There is limited benefit to undertaking additional surveys at a planning stage, without having specific areas in which to focus efforts.

Both **turtles** and **corals** pose a low risk to permitting. For corals, this risk is a reflection of geographic distribution being restricted to Jeju Island, rather than a measure of general sensitivity of the PBV. Additional data collection is not essential for facilitation of offshore wind development, and as such these PBVs are a low priority.

3.4 Survey Options

3.4.1 Overview

Table 2 – Survey Concept Options for Planning Stage Offshore Wind Development

Survey Type	Target Data	Details	Indicative Costs (USD)*
High Priority Features			
Birds			
Review/ collation of data	Key seabird breeding areas	Collate and review of existing database records (i.e. eBird, Movebank, others) in	$20,000-$40,000 (estimated cost range for desktop

		combination with stakeholder engagement with local seabird experts	project)
Radar surveys	Continuous flight height distribution data, movement pathways, directionality, nocturnal movements. Contribute to understanding cumulative impacts.	Conduct surveys from onshore at key migratory pathways at the planning stage. Deploy radar unit at strategic points along coast targeting migratory hotspot locations (mid-west, north-west coasts). Three-month duration, at two locations, dual radar (horizontal and vertical).	Costs can range depending on equipment, accessibility and other factors. Approximately $250,000 (one unit), does not include mobilisation or analysis costs. Approximately $500,000 to cover two hotspot sites. These estimates are based on supplier quotations and previous project experience.
Tagging	Continuous flight height distribution data, movement pathways, contribute to understanding cumulative impacts.	Conduct surveys to target key threatened species that are susceptible to impacts (such as Curlew Sandpiper, Spoon-billed Sandpiper, and seabirds like the Black-legged Kittiwake).	Tag and field prices range from approximately $250 for radio tags to several thousand for GPS tags (Smithsonian, 2024; MTI, n.d). Mobilisation costs range depending on project-specific constraints, estimated up to $100,000. Permitting and analysis are additional costs.
Medium Priority Features			

Marine mammals			
Review/ collation of data	Key habitats, important areas for breeding and feeding, seasonal distribution patterns	Undertake desktop study to collate and review existing data to support the identification of possible important marine mammal areas (IMMAs).	$30,000 - $50,000 (estimated cost range for desktop project).
Sharks, rays, and ray-finned fishes			
Database review and industry surveys	Movement and key habitat identification of key species (i.e. Korean Skate)	Undertake desktop collation and review of existing databases (i.e. iNaturalist) for species presence, movement, and habitat use. Support with stakeholder engagement surveys of local fishers.	$30,000-$50,000 (estimated cost range for desktop project).
Review/ collation of EMF impacts research	EMF impacts on key elasmobranch species (or comparable species)	Undertake desktop collation and review of existing research into EMF impacts (lab and field-based) and synthesis of results into a paper expressing current position, and application to relevant species in area (i.e. Korean Skate).	$20,000-$30,000 (estimated cost range for desktop project).
Bats			
Acoustic monitoring	Presence, movements between islands	Deploy acoustic sensors on existing offshore structures (buoys, fish farms, ferries) across summer and autumn seasons to confirm extent of presence and relevant movements of bats. If identified as relevant,	$30,000-$50,000 for a small number of structures; costs increase significantly with number of sites (BOEM, 2022).

	further project-level studies could be conducted.

* Costs are indicative only and are high-level estimates intended to give a general idea of pricing

3.4.2 Review and Collation of Data (Birds)

Existing data needs to be understood in order to draw accurate conclusions and support meaningful recommendations for bird species management. Existing databases including eBird and Movebank should be comprehensively searched for tracking data to identify important breeding areas for key species. This data should be analysed and supplemented through engagement with bird experts from South Korea. Stakeholder input will help identify additional data sources, fill knowledge gaps, and ensure that the assessment reflects the most current understanding of bird populations and their potential sensitivities within South Korea.

3.4.3 Radar Surveys

Bird radar surveys are used in offshore wind projects to monitor bird movement, flight heights, direction, and migration patterns, particularly during day and night conditions when visual surveys are limited. Radar systems can track large numbers of birds over wide areas. This data can then be used during later site-specific stages to inform and assess collision risk around proposed wind farm sites.

Advantages include effectiveness in poor visibility and at night, providing continuous monitoring over large areas, capturing flight height and movement data, and supporting migration and collision risk assessments. Limitations of radar surveys include that they are limited in ability to identify birds to species level, specialist analysis and calibration is required to account for interference from weather or sea clutter, and surveys can be costly to operate and interpret. Radar data is often most effective when combined with additional survey methods (e.g. the use of visual observers to link known birds to radar tracks).

3.4.4 Tagging (Birds)

Bird telemetry and tracking surveys use devices such as GPS or satellite tags to monitor bird movements, foraging areas, migration routes, and breeding behaviour. These methods provide highly accurate spatial and temporal data and can generate near real-time movement maps showing key habitat use and activity areas. Tracking is particularly valuable for offshore wind studies because it provides a detailed understanding of species behaviour rather than a single survey snapshot.

Smaller and cheaper light-level geolocators can also be used, although they provide lower accuracy and require birds to be recaptured to retrieve

data. Tracking studies typically involve tens of individuals per species and can be expensive due to equipment, fieldwork, and analysis costs. Costs of satellite tracking birds can vary between $500 to $7,000 for traditional devices (not including fieldwork and analysis costs), which can last up to five years. One study for Lesser Black-backed Gulls (*Larus fuscus*) estimated between 13 to 41 individuals would be required to describe 95% of the estimated area use of the population, depending on deployment duration. The costs could be in the range of $300,000 to $450,000 for a tracking study accounting for approximately 15 birds tracked from three or four key species, fieldwork and analysis.

Advantages include capture of high-resolution movement and behavioural data, strong understanding of foraging and migration patterns, near real-time monitoring, and useful flight height and speed information. Tagging studies are limited, however, by the requirement to capture and handle birds, relatively small sample sizes, potential tag failure, high costs, and possible impacts on bird behaviour or survival, particularly for threatened species.

3.4.5 Review and Collation of Data (Marine Mammals)

Existing data needs to be understood to draw accurate conclusions and support meaningful recommendations for marine mammal management. Literature published should be reviewed (including literature from Korean journals, written in Korean) regarding key species. A greater understanding of presence, movements, and behaviours identified through literature and databases will help to identify habitats, important areas for breeding and feeding, and seasonal distribution patterns. This may then help to inform delineation of IMMAs which are a key tool in marine spatial planning and management.

3.4.6 Database Review and Industry Survey (Elasmobranchs)

Existing data and literature around shark and ray populations needs to be understood in order to draw accurate conclusions and support meaningful action. Existing data (sightings, tracking) should be collated and reviewed from sources such as iNaturalist, alongside published and grey literature, to build baseline knowledge of key species (such as the Korean Skate). Additional data should be collected from local fishers active within the fishing industry, which may provide insight into elasmobranch movements, abundance, bycatch, and key areas.

3.4.7 EMF Impacts Research (Elasmobranchs)

Review and collation of research on electromagnetic fields (EMF) associated with offshore wind infrastructure is important to understanding their possible impacts on elasmobranchs. Lack of industry-wide position on this potential impact increases difficulty of assessing risk and appropriate management actions. Elasmobranchs are known to use electroreception for navigation, prey detection, and environmental

sensing. Review of research should be completed with a focus around subsea cables and wind farm infrastructure attraction, avoidance, or behavioural changes in response to EMF exposure. Review of EMF studies related to offshore wind impacts would help map current scientific uncertainties, support evidence-based mitigation measures, and improve understanding of species-specific sensitivities, particularly for migratory and threatened elasmobranch species.

3.4.8 Acoustic Monitoring (Bats)

Offshore acoustic monitoring for bats is increasingly used to assess bat activity and movement in marine environments, and can be applied around offshore wind areas. Using affordable ultrasonic detectors mounted on platforms, buoys, or vessels, researchers can record bat echolocation calls and identify species presence, activity patterns, and migration behaviour. This data helps improve understanding of how bats use offshore habitats and could contribute to later stage evaluations of potential collision risks with wind turbines, and inform mitigation measures.

Project Stage Survey Concepts



4. Project Stage Survey Concepts

This section outlines survey concepts for project-specific offshore wind development in South Korea, once specific zones or projects have been identified.

4.1 High Priority

Birds have been identified as high priority for additional survey efforts in project stage development. Risk to permitting from birds is considered high due to multiple factors including public concern of collision risk, presence of threatened bird species, and high exposure of the taxonomic group to wind farms. Closing the key knowledge gaps of flight heights, local movement pathways, and cumulative impacts will be highly valuable to support offshore wind development and a constructive action in the industry.

Table 3 (Section 4.4) below outlines project and site-specific survey recommendations to build essential knowledge regarding birds.

4.2 Medium Priority

Marine mammals have a high permitting risk. As charismatic megafauna, public interest is inherent and protection measures are established. However, there is a good understanding of marine mammal presence and distribution in South Korea, and industry-wide knowledge of possible impacts. At the project stage, a medium priority reflects industry and public expectations of establishing site-specific baselines, monitoring and management efforts.

Seagrass and algae have both been identified as a low risk to permitting, on consideration of low public interest, lack of threatened species present (partially driven by lack of assessment), and limited susceptibility to offshore wind impacts. It is, however, important to consider these key marine habitats in the project stage. Location of offshore wind could greatly increase risk to these habitats, particularly through siting of cabling or associated onshore infrastructure, and there is potential for significant impact to range-restricted species despite lack of threatened status, resulting in a medium priority.

Sharks, rays, and ray-finned fishes are of medium permitting risk and medium priority for additional data collection, reflective of public interest levels, implications for the fishing industry, and expectations for well-established baselines and management efforts. Closing key knowledge gaps of breeding habitat and EMF impacts will be beneficial to both project stages in offshore wind development.

Bats are currently a low risk to permitting; there is little public interest in impacts from offshore wind on bats, which is likely a reflection of limited industry understanding of bat and offshore wind interactions. The opportunity to address this significant knowledge gap is reflected in the medium priority ranking. Being able to understand if and how bats are impacted may reduce later requirements for monitoring and/or mitigation, if impacts are established at offshore wind sites. This is particularly relevant due to growing industry interests in bat collisions, and the possibility of bat passage between marine islands in South Korea.

Turtles are of low risk to permitting but have significant public interest. Impacts to turtles from offshore wind are restricted primarily to habitat disturbance of important breeding areas by onshore coastal infrastructure like cabling, and possibly construction noise impacts. Given this, it is important that turtles are considered during the project stage as there is limited available information regarding key movements and habitats of species that have been identified in South Korean waters. It will be important to avoid any key breeding habitats if they are identified during any project-level surveys.

Table 3 below outlines key recommended survey approaches for medium-priority biodiversity features in project-specific offshore wind development.

4.3 Low Priority

Corals pose a low risk to permitting due to geographic restriction of distribution. Additional data collection is not essential for facilitation of offshore wind development, and as such this PBVs is a low priority. As such, survey options for corals have not been included in the following section.

4.4 Survey Options

4.4.1 Overview

Table 3 – Survey Concepts for Project Stage Offshore Wind Development

Survey Type	Target Data	Details	Indicative Costs (USD)*
High Priority Features			
Birds			
Vessel-based transect surveys	Building long-term datasets that can support knowledge of flight heights, movement	Conduct site-specific survey for assumed two-years, four surveys per year (eight total), four days per survey.	Approximately $480,000+, or up to $2 million for greater survey coverage

	pathways, cumulative impacts, and species identification. Vessel-based surveys are good opportunities for multi-taxa approaches (marine mammals, sharks, rays and ray-finned fishes)	Coverage of 150 km^2 per day (600 km^2 per four-day survey). More frequent surveys are recommended if there is available budget, particularly due to possibility of multi-taxa focus (i.e. monthly surveys (total 24 mobilisations) for two years).	(24 surveys over two years)
Digital aerial surveys (DAS)	Data useful for large areas and contributes to modelling for flight height, movement pathways, cumulative impacts. Species identification. Digital Aerial Surveys are good opportunities for multi-taxa approaches (marine mammals, sharks, rays and ray-finned fishes)	Conduct DAS limited to assumed six surveys over two years (three per year), low coverage and 10% analysis with 4 km buffer. This represents minimum recommended survey effort; more frequent surveys are recommended if there is available budget, particularly due to possibility of multi-taxa focus (i.e. monthly surveys (total 24 mobilisations) for two years).	Approximately $750,000+, or up to $3-4 million for greater survey coverage (24 surveys over two years)

Medium Priority Features

Marine mammals			
Vessel-based transect surveys	Species presence and distribution, identification of key habitat areas. Contributes to understanding of cumulative impacts.	Conduct site-specific survey for assumed two-years, four surveys per year (for additional survey design details see 'Bird' taxa above). More frequent surveys are	Approximately $480,000+, or up to $2 million for greater survey coverage (24 surveys over two years)[2]. A multi-taxa approach (marine mammal, bird, turtle surveys

[2] Costing based on discussion with key providers for offshore wind projects in 2024. May vary due to location differences, size of target area, and other factors.

		recommended if there is available budget, particularly due to possibility of multi-taxa focus (i.e. monthly surveys (total 24 mobilisations) for two years).	occurring together) reduces number of mobilisations needed across taxa and reduces costs.
Digital aerial surveys	Species presence and distribution, identification of key habitat areas. Contributes to understanding of cumulative impacts.	Conduct DAS limited to six surveys over two years (for further survey design details see 'Birds' above). More frequent surveys are recommended if there is available budget, particularly due to possibility of multi-taxa focus (i.e. monthly surveys (total 24 mobilisations) for two years).	Approximately $750,000+, or up to $3-4 million for greater survey coverage (24 surveys over two years)[3]. A multi-taxa approach (marine mammal, bird, turtle surveys occurring together) reduces number of mobilisations needed across taxa and reduces costs.
Passive acoustic monitoring	Presence, distribution, seasonal activity	Conduct survey with informed arrangement of 10 to 20 mooring hydrophone stations around site. Equipment should be utilized long-term (ideally two years).	$500,000+ for multi-station array
Seagrass and algae			
Benthic AUV/MBES Surveys	Species presence, identification and distribution at possible disturbance areas	Conduct surveys in target areas; these can be restricted by depth of occurrence for target range-restricted habitat-building species	Costs dependent on equipment and vessel availability in country.

[3] Costing based on discussion with key providers for offshore wind projects in 2024. May vary due to location differences, size of target area, and other factors.

		(*Acrochaetium inkyui, Codium spinulosum, and Elachista falcata*). Reduction in target area will greatly reduce costs. Grid patterns of 2.5 km to 1 km/500 m/100 m spaced transects depending on survey design and granularity requirements.	Supporting survey design, data processing, logistics fees generally at least $65,000, not including equipment and vessel costs.
Sharks, rays, and ray-finned fishes			
eDNA	Metabarcode analysis to determine the species present across seasons. Good opportunity for multi-taxa targeting (marine mammals)	Conduct survey with design of four samples (take concurrently with BRUVs surveys for cost effectiveness). Four sampling events (across two years), total 16 deployments.	$674 per sample (Clark et al. 2024). Prices may underestimate lab costs for additional taxa groups. Includes equipment, fieldwork, and analysis.
Baited remote underwater video (BRUVs)	Site-specific to determine presence of key species and behaviour	Conduct BRUVs surveys within a defined project area. Survey design of approximately 12 BRUV deployments (3 replicates at close distances, at 4 locations). Four sampling events (across two years), total 48 deployments. 75 minutes footage per replicate, dependent on equipment. Up to two weeks per sampling event (four events).	$356 per BRUVs site (Clark et al. 2024), includes equipment, fieldwork, and analysis.Total approximately $17,000.
Tagging	Movement and key habitat identification of key	Conduct long-term surveys for tagging/tracking data	Acoustic tags most suitable tag choice; up

	species	for target species (Korean Skate), if individuals can be captured for tagging	to $4,000 per animal (MTI, n.d(b)), not including mobilisation costs.
Turtles			
DAS or Vessel-based surveys	Presence, movement, key habitats	Conduct vessel-based transect surveys (site-specific survey for assumed two-years, four surveys per year; more frequent if possible) or DAS (six surveys over two years; more frequent if possible). See Vessel-based Transect Surveys or DAS under 'Birds' above for additional survey design details. A multi-taxa approach should be targeted to allow for cost-reduction.	Vessel-based transect surveys (approximately $480,000+, or up to $2 million) or DAS (approximately $750,000+, or up to $3-4 million). Costs can be reduced substantially by adopting a multi-taxa approach (i.e. a single set of surveys covering multiple taxa including birds, marine mammals and turtles).
Bats			
Tagging	Movements between marine islands, flight height and maneuverability	Conduct long-term surveys for tagging/tracking data if individuals can be captured for tagging	Radio tags preferred at a cost of approximately $400 per individual (NHBS, n.d.), not including deployment costs
Acoustic monitoring	Presence, distribution, movement between islands	Conduct longer-term surveys (when compared to planning stage acoustic monitoring in Table 2) in project-relevant	$100,000+ for long-term monitoring, including equipment, deployment and expert analysis, price dependent on size of study area

	study area	(BOEM, 2022).

* Costs are indicative only and are high-level estimates intended to give a general idea of pricing
Note: Many of the survey methods outlined in the above table are continuously developing and have the potential to be improved or streamlined through AI integration. A key example of this is data processing with various kinds of survey imagery or video, which is already established in some methodologies. Integration of AI can help reduce manual labour and innovate technological approaches throughout the sector, and should be considered where relevant.

4.4.2 Vessel-based Transect Surveys

Vessel-based surveys are used for monitoring seabirds, cetaceans, and turtles, although they are significantly slower than digital aerial surveys (DAS; see Section 4.4.3). Studies indicate vessel surveys can cover around 50 to 150 km² per day, compared to 500 to 1,200 km² coverage for aerial surveys depending on survey parameters such as flight height, weather, and intended survey coverage percentage[4].

Advantages to vessel-based transect surveys include high-quality data collection, including behavioural observations such as flight heights, and a wider range of available service providers when compared to DAS. Limitations include slower survey speeds, relatively high costs, larger survey teams, additional health and safety risks, and possible observer effects where animals are attracted to or disturbed by the vessel, potentially biasing results. There is also a greater risk of double-counting birds compared to aerial surveys.

Monthly surveys are generally recommended. Survey methods should follow standard strip-transect and distance-sampling approaches to reduce bias, particularly as seabirds may be attracted to vessels. Additional behavioural data, such as flight heights, can also be collected using flight height categories or laser rangefinders. Surveys should use vessels with clear visibility and travel at a steady speed of approximately 7 to 10 knots.

There is good best practice information published regarding vessel-based observational studies for seabirds, including that from New York State Environmental Technical Working Group[5]; DAS surveys are also covered.

4.4.3 Digital Aerial Surveys

Digital aerial surveys (DAS) can rapidly cover large offshore areas, collecting high-resolution imagery and video for expert analysis. Surveys can cover up to 1,200 km² per day (at low coverage levels around 10%), with data often available in near real time to support stakeholder engagement. Monthly surveys are typically recommended, with additional surveys during key periods such as migration seasons.

Advantages of DAS include fast and efficient coverage, detailed data collection, large data volumes, and minimal disturbance to wildlife.

[4] Survey coverage figures are informed by previous engagement with key industry providers, with additional supporting evidence including: Scottish Government Survey, https://briwildlife.org/digital-aerial-surveys/
[5] https://www.nyetwg.com/specialist-committees/avian-displacement

Limitations include high costs, logistical and mobilisation requirements, limited behavioural data, difficulty distinguishing similar species, and inability to operate at night or in poor weather.

Only a small number of specialist providers currently offer DAS globally. Two major companies have strong international experience and are considered suitable for expansion into new regions, while additional small companies mainly provide post-survey data analysis services. Although providers are interested in expanding geographically, availability for operations in South Korea is not guaranteed.

Survey costs discussed with major suppliers in 2023 ranged from approximately $43/km² in Europe to $77/km² in higher-cost regions such as Australia. Costs depend heavily on survey coverage and regional start-up requirements. Lower costs may be possible where local aircraft and personnel are available. A dedicated cost estimate would be needed for the specific proposed offshore wind development site.

4.4.4 Passive Acoustic Monitoring

Passive acoustic monitoring (PAM) for marine mammals is an effective method for collecting long-term presence, distribution, and seasonal activity data, particularly in offshore environments where visual surveys may be limited by weather or daylight. Costs are variable depending on survey duration, equipment requirements, deployment and recovery logistics, data storage, and specialist analysis of acoustic recordings. While initial investment in hydrophones and mooring systems can be significant, PAM provides continuous monitoring over extended periods, offering valuable information on species occurrence and behaviour that can support the offshore wind approvals and regulatory compliance processes including for impact assessments and mitigation requirements.

4.4.5 Benthic AUV/MBES Surveys

High-resolution seabed surveys can be conducted using multibeam echosounders (MBES) and Autonomous Underwater Vehicles (AUVs). AUVs provide particularly detailed data, including imagery, video, habitat mapping, and species distribution information, making them well suited to targeted project-level surveys alongside methods such as BRUVs.

Advantages of MBES include that it can be installed on various survey vessels, while AUVs offer high-resolution data and broad survey coverage compared to Remote Operated Vehicles or towed cameras. Limitations of these survey methods include that AUV performance can be reduced in turbid waters, and larger systems require specialist vessels, deck space, launch and recovery equipment, and trained operators.

4.4.6 eDNA

Environmental DNA (eDNA) is an emerging and cost-effective tool for

marine biodiversity monitoring, particularly suited to offshore wind studies. eDNA methods are commonly used to detect invertebrates and fish and other taxonomic groups, and can be used to target elasmobranchs. The approach can be readily expanded for multi-taxa survey targets. eDNA sampling is constantly developing and improving with the biological sequence library and can complement visual survey methods by identifying additional or cryptic species.

Water samples can be collected quickly, non-invasively, and at different depths during vessel surveys, making the method scalable across large offshore areas. Costs mainly depend on the number of samples and species groups analysed, with additional expenses for permits, training, survey design, and laboratory analysis.

Advantages of eDNA sampling include that it is non-invasive, the ability to survey at depth, effective detection of cryptic species, and strong suitability for multi-taxa detection. Limitations include that effectiveness depends on supporting genetic, ecological, and population data. Availability of elasmobranch genetic information relevant to South Korea is a key restrictive factor to this type of survey.

4.4.7 Baited Remote Underwater Video

Baited Remote Underwater Video systems (BRUVs) are widely used to monitor elasmobranchs such as sharks and rays. The method uses underwater cameras with bait to attract animals into the field of view, allowing researchers to record species presence, abundance, and behaviour without capturing or disturbing the animals. BRUVs are particularly useful for reef, coastal, and offshore habitats and can support baseline and impact assessments for offshore developments.

Advantages of BRUVs are that they are non-invasive, effective for detecting mobile or elusive species, provides visual and behavioural data, is relatively cost-effective, and is suitable for deployment in remote or deeper waters. Limitations include that results can be influenced by bait type and environmental conditions, may underestimate non-scavenging species, limited sampling area per deployment, and data processing can be time intensive. Visibility and turbidity can also affect image quality and species identification.

4.4.8 Tagging (Elasmobranchs)

Elasmobranch tagging surveys involve attaching acoustic, satellite, or archival tags to sharks and rays to monitor their movements, habitat use, migration routes, diving behaviour, and interactions with offshore developments. These surveys are widely used to identify critical habitats, movement corridors, and potential overlap with offshore wind farm areas.

Acoustic tags are commonly used for regional movement studies through networks of underwater receivers, while satellite tags provide broader-

scale migration and offshore movement data. Tagging surveys can generate long-term information on species behaviour and population connectivity.

Advantages of elasmobranch tagging techniques include detailed movement and behavioural data, identification of migration routes and critical habitats, long-term monitoring potential, and strong support for impact and collision-risk assessments. Limitations include that it requires capture and handling of animals, relatively high equipment and fieldwork costs, potential tag loss or failure, limited sample sizes, and possible effects of tagging on animal behaviour or health. Detection coverage may also depend on receiver network availability. Tagging studies are also expensive, with a moderate-sized study tracking multiple shark or ray species easily costing tens to hundreds of thousands of dollars, particularly where offshore logistics and long monitoring periods are required.

4.4.9 Tagging (Bats)

Radio tagging surveys are used to study bat movement, migration routes, foraging behaviour, and habitat use by attaching small radio transmitters to individual bats and tracking them using handheld or automated receivers. These surveys can be applied in offshore wind assessments to understand bat activity, migration corridors, and contribute to understanding bat collision risk near turbines.

Advantages of bat radio tagging are that it provides detailed movement and behavioural data, identifies migration routes and roosting areas, is effective for tracking species that are difficult to detect acoustically, and supports collision risk assessments. Limitations include limited tracking range and battery life, labour-intensive fieldwork, small sample sizes, potential stress to bats during capture and tagging, and reduced effectiveness over long offshore distances without extensive receiver networks.

4.4.10 Acoustic Monitoring (Bats)

As described in Section 3.4.8, acoustic monitoring for bats is a cost-effective and useful tool for identification of bats and insight into bat behaviour. At the project stage, ultrasonic detectors can be deployed on turbines for ongoing, long-term monitoring.

Strategic Approach Recommendations



5. Strategic Approach Recommendations

This section outlines a strategic level collaborative approach concept and sequencing approach that may be considered during planning and project level offshore wind development.

5.1 Collaborative Approach

South Korea is in an early stage of the offshore wind industry which allows an opportunity for a considered approach that learns from other regions.

As the industry in other jurisdictions has progressed, regulations and approvals frameworks have been developed and have brought increased requirements for biodiversity data collection and environmental surveys. This applies across project phases but is of particular importance in the permitting and approvals phase. It is becoming increasingly essential and expensive to collect robust data that meets changing requirements. In some jurisdictions like Scotland and France, developers have moved towards a collaborative approach to data collection and sharing[6]. This has occurred where development zones are located closely together and where broad scale data about relevant biological features was relevant across the zones. Developers may reduce costs and effort by using a joint approach to data collection and sharing, while still reaching data requirements and ensuring biodiversity features are appropriately considered.

There are many potential offshore wind projects in early stages of planning from development companies and local governments in South Korea. The number and proximity of these projects creates a good opportunity for a collaborative approach.

As public and private development zones become more established, the survey approaches and costs outlined in this report can be refined to better account for zone size, location, and proximity to specific biodiversity features. Proximity to other zones can also be better understood, and with it the potential for collaborative survey approaches.

5.2 Strategic Sequencing

Considering survey sequencing in a strategic manner will allow for the most cost-effective approach; this is important to consider at an early stage when indicative total budgets cannot be established for reasons

[6] https://stromarwind.co.uk/neeog-wins-environmental-excellence-award-at-global-offshore-wind-awards/

including a lack of defined survey areas, difficulty in assessing local capacities and costs, and differences in the emerging market when compared to established European markets.

A cost-effective survey strategy for offshore wind development should prioritise early deployment of surveys with the longest data collection periods and most influence on consenting risk. In practice, this means initiating DAS, vessel-based bird and marine mammal surveys, tagging surveys (birds, bats), PAM, and long-term BRUVs/eDNA sampling surveys at the earliest feasible stage, as these survey options typically require regular seasonal coverage over one to two years (or longer). This will ensure the time is allowed to establish robust baselines and cover variability across seasons and years. Early effort for these survey types maximises the opportunity to collect datasets that comply with regulations while also allowing shorter-duration investigations, such as benthic ecology and habitat surveys, to be sequenced later and informed by preliminary site understanding.

This phased approach can reduce overall expenditure by enabling survey integration where possible, and ensuring that high-cost field campaigns are targeted efficiently. Suggested survey integration options are to conduct both birds and marine mammals during DAS or vessel-based campaigns, if possible. Additionally, combining BRUV deployments and eDNA sampling can reduce field mobilisation costs.

Survey sequencing should also be aligned with key consenting milestones in South Korea, including the environmental impact assessment (EIA) process, occupancy and use consultations, fisheries stakeholder engagement, and electricity business permitting processes. Early collection of ornithological and marine mammal datasets is especially important because these receptors generally face higher levels of regulatory and public scrutiny, and have the potential to directly influence project design, impact assessment, mitigation requirements, and ultimately consent determination. Consequently, ensuring that long-lead time surveys align with the anticipated consenting programme helps to both minimise schedule risk and optimising survey budgets and data use.

Summary



6. Summary

At the planning stage, recommended survey efforts focus on broad, strategic data collection to inform early decision-making before specific sites are identified. Birds are particularly important during this stage due to high uncertainty and permitting sensitivity. Medium-priority groups like marine mammals, sharks and rays, and bats require targeted research to fill key ecological gaps or information reviews to better understand how existing research applies. Lower-priority groups are either well understood or unsuitable for early-stage surveys without defined project areas.

Survey priorities for offshore wind development at the project stage are driven primarily by gaps in ecological knowledge, and by permitting risk and public concern. Birds receive the highest priority due to their susceptibility to offshore wind farm impacts and the need for better data on flight behaviour and cumulative effects. Medium-priority groups of marine mammals, benthic habitats, sharks, rays, and fish species, turtles, and bats, require targeted, site-specific surveys to establish baselines and address key uncertainties such as habitat use and breeding areas. Corals are a lower-priority group that poses fewer permitting constraints and therefore requires less immediate attention.

Across all priorities, there is a strong emphasis on efficient, multi-taxa survey approaches to maximise data collection while managing cost.

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About Ocean Energy Pathway

Ocean Energy Pathway accelerates global offshore wind growth through programmes which support the energy transition, enhance marine ecosystems and empower local communities. We provide expert, independent support to governments and key decision makers to fast-track offshore wind worldwide. Through collaboration with leaders in policy, industry, and conservation, we help shape sustainable solutions for the long-term growth of offshore wind. Ocean Energy Pathway owns the offshore wind POWER Library, in collaboration with Climate Policy Radar, to help policymakers easily find curated reports and policies related to offshore wind. Headquartered in the UK, we work in Australia, Brazil, Colombia, India, Japan, Mexico, the Philippines, South Korea, and Vietnam with ongoing projects in several other countries.

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About The Biodiversity Consultancy

Where business and nature thrive

The Biodiversity Consultancy exists to make positive biodiversity impact second nature for business. We help companies turn nature ambition into action, combining scientific expertise with commercial insight to deliver measurable outcomes. A nature positive future is integral to business resilience and growth. We make it viable, verifiable, and valuable.

Since our founding, science and innovation have been at the core of our approach, ensuring that the businesses we work with, and the standards we help set, are taking robust action that benefits nature. Being leaders in the underlying science of biodiversity, we continue to actively engage in scientific research - collaborating with research organisations to develop practical and robust solutions that improve business engagement with nature.

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