INTEGRATED ENVIRONMENTAL & SOCIAL SENSITIVITY MAPPING

GUIDANCE FOR EARLY OFFSHORE WIND SPATIAL PLANNING

REPORT

WORLD BANK GROUP
THE WORLD BANK IBRD • IDA
IFC International Finance Corporation
ESMAP
PROBLUE

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Contents

List of Boxes, Figures, and Tables

Boxes

Figures

Tables

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The initiative was led by Lori Anna Conzo (Global Biodiversity Lead, IFC) and Mark Leybourne (former Offshore Development Program Co-lead, ESMAP). The lead authors are Lori Anna Conzo, Claire Fletcher (The Biodiversity Consultancy), Jennifer Hruza (Biodiversity Specialist; ESMAP consultant), Gabriela Factor (Chief Adviser, Danish Institute for Human Rights; former ESMAP consultant), and Michele Quesada da Silva (IOC-UNESCO MSP Global Coordinator; former ESMAP consultant). The team appreciates the overall guidance provided by Demetrios Papathanasiou (Global Director for Energy and Extractives Global Practice, World Bank) and Gabriela Elizondo Azuela (former ESMAP Practice Manager) and the constructive feedback received from peer reviewers Tris Allinson (Birdlife International), Raymi Beltran (IFC), Grant Binder (IFC), Peter Burston (The Biodiversity Consultancy), Alessandro Casartelli (IFC), Aonghais Cook (former British Trust for Ornithology), Zuzana Dobrotkova (World Bank), Juliana Castano Isaza (World Bank), Una Meades (World Bank), Peter Moore (World Bank), Rosa Orellana (IFC), Martin Perrow (Department of Geography, University College London), Ernesto Sanchez-Triana (World Bank), Pernille Skyt (ESMAP consultant) and Jorge Villegas (IFC). We thank them for their time and valuable comments. We also acknowledge the technical input from Julien Million (PROBLUE) and Jacqueline Alder (PROBLUE). Lastly, we thank Alyssa Pek (ESMAP consultant) for her support throughout the editorial and publication process.

Foreword

Scaling-up renewable energy in emerging markets is an important part of the World Bank Group's efforts to fight climate change and power sustainable development. Global decarbonization scenarios suggest that the world will need 2,000 gigawatts (GW) of offshore wind by 2050 to achieve net zero emissions and limit global warming to 1.5°C by the end of the century. Analysis from the World Bank Group estimates that emerging market countries' offshore wind potential is at least 16,000 GW, far surpassing the 2050 estimated need.

While offshore wind is critical to reducing carbon emissions and helping to achieve universal energy access as envisioned by the United Nations' Sustainable Development Goal 7, we must ensure that such turbines are installed in a way that they do not endanger marine life or harm human development. Coastal communities rely on a healthy ocean to run businesses, secure food, and prosper. Therefore, when planning and building offshore wind projects, stakeholders must consider appropriate environmental and social (E&S) sensitivities to protect biodiversity and marine and coastal ecosystem services that underpin economic activity and food security.

To help navigate the opportunities and challenges of offshore wind projects, the World Bank Group has developed the *Integrated Environmental and Social Sensitivity Mapping: Guidance for Early Offshore Wind Spatial Planning* (SenMap) as a tool for emerging market governments. Through the SenMap approach, government planners can integrate a participatory process and E&S considerations from an early stage of offshore wind market development.

Ensuring the sustainable development of offshore wind while helping other sectors—fisheries, tourism, shipping—thrive and maintaining biodiversity, requires careful planning. SenMap is designed to increase market confidence and reduce development risk when promoting the sustainable growth of the vital offshore wind sector.

The World Bank Group's Offshore Wind Development Program was launched in 2019 by the Energy Sector Management Assistance Program (ESMAP) and the International Finance Corporation (IFC), with the aim of accelerating the uptake of offshore wind in emerging markets. Since its inception, the program has worked with more than 25 countries, providing the support they need to make offshore wind a part of their long-term energy mix. The World Bank multi-donor Trust Fund, PROBLUE, has supported the integration of E&S aspects in this program since its inception, including the development of SenMap.

Valerie Hickey
Global Director,
Environment Natural
Resources, and
the Blue Economy;
World Bank

Tania Kaddeche
Director,
ESG Sustainability
Advice and Solutions;
International Finance
Corporate (IFC)

Demetrios Papathanasiou
Global Director,
Energy and
Extractives Global
Practice; World Bank

EXECUTIVE SUMMARY

Executive Summary

In order to avoid the worst impacts of climate change, offshore wind will need to make an increasing contribution to the global effort to reduce greenhouse gas emissions in line with the Paris Agreement. At the same time, it is imperative that offshore wind development is undertaken responsibly, considering both coastal communities and biodiversity. Especially in emerging market[1] countries, coastal communities often rely heavily on the sea for their livelihoods, and the marine environment can be a vital part of their cultural norms and beliefs.

Given the need to accelerate the deployment of offshore wind, governments in emerging markets are eager to progress quickly and some have already awarded seabed rights for projects, sometimes without adequate consideration of environmental and social (E&S) sensitivities. Poorly sited projects in areas where offshore wind could have significant impacts on communities and biodiversity will encounter difficulties throughout the permitting process, leading to delays and cost increases, and potentially resulting in projects failing to proceed. The detrimental impacts of projects deployed in these sensitive areas could lead to irreversible or costly impacts for people and biodiversity, stakeholder objections, weakened social acceptance, and negative implications for further deployment of offshore wind in the country.

Poorly sited projects may also face challenges in securing finance. Delivering large capacities of offshore wind in emerging markets is likely to require financing that pushes or exceeds the capacity of many local lenders. To provide a sufficient volume of finance at an affordable rate, projects will often need to secure international finance to supplement local sources. To meet the requirements of international lenders and development finance institutions,[2] offshore wind projects will need to align with Good International Industry Practice (GIIP)[3] for environmentally and socially sustainable development. Avoidance is often the easiest, cheapest, and most effective way of reducing potential negative impacts. Therefore, it is imperative that projects are sited in areas where offshore wind is less likely to have significant impacts on communities and biodiversity while entirely avoiding areas where the likelihood of impacts is high.

This guidance document, *Integrated Environmental and Social Sensitivity Mapping—Guidance for Early Offshore Wind Spatial Planning* (SenMap), is designed to support government planners in emerging market countries to identify potential areas for offshore wind development with the lowest E&S sensitivity. The resulting outputs—E&S sensitivity maps—can help identify broad potential development areas for offshore wind, at the earliest stages of government-led spatial planning. Sensitivity maps can support planning for

1 For the purposes of this report, "emerging market" economies are those considered to be "low-income," "lower-middle income," and "upper middle-income" economies as per the World Bank Country Classifications.

2 Such as the World Bank Environmental and Social Framework and International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability, which have become globally accepted GIIP. The Performance Standards have been adopted by commercial banks who are signatories to the Equator Principles.

3 As defined in IFC Performance Standard 3 (IFC 2012a) the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances, globally or regionally.

avoidance, directing development away from areas where sensitivity is highest. While primarily a government-led planning tool, SenMap outputs could also be used to inform offshore wind project developers of the likely highest E&S sensitivities and enable them to select more suitable sites, plan mitigation measures, and integrate cost contingencies into competitive tenders. SenMap could also be used by developers and regulators alike to inform project-specific Environmental and Social Impact Assessment, through collating regional-scale E&S data in advance of more detailed, site-specific data collection efforts.

The E&S sensitivity maps should result from a participatory and inclusive stakeholder engagement process which identifies the most important E&S attributes—that is, the features that could potentially be sensitive to offshore wind development. For this reason, the SenMap approach and outcomes are underpinned by good practice principles for stakeholder engagement. This is vital to develop an enabling environment for stakeholder participation, with the aim of improving transparency and increasing stakeholder acceptance. This is key to help reduce the risk of stakeholder pushback that could arise later in response to poorly sited projects. This, in turn, could delay both licensing and permitting processes, impede project developers' access to finance, and ultimately slow down the pace of the global energy transition.

There are several existing approaches to inform the integration of E&S attributes into spatial planning, with different levels of effort and different spatial scales, including Strategic Environmental and Social Assessment (SESA) and Marine Spatial Planning (MSP). For example, the World Bank multi-donor PROBLUE program has published a *Marine Spatial Planning for a Resilient and Inclusive Blue Economy Toolkit*[4] (the MSP Toolkit). This toolkit is a series of guidance notes and factsheets to improve understanding of the benefits of MSP (ecological, social, and economic) and to provide guidance on topics, including: (i) identifying entry points; (ii) climate-smart MSP; (iii) integrating cross-cutting themes; (iv) identifying key data and tools for MSP; and (v) formulating/implementing a plan. Lessons learned in established offshore wind markets have shown that MSP is considered good practice and significantly helps to reduce risk.[5]

At the same time, full-scale MSP and SESA-type approaches are often resource-intensive, multi-year, and costly endeavors. They may not always be readily accessible in emerging markets that are experiencing accelerated development timeframes for offshore wind to meet climate targets,[6] increase energy security, and meet other country priorities. This means that, in some cases, offshore wind development areas and project sites may be chosen well before a country's MSP is complete or SESA has been undertaken. The SenMap approach was developed to fill this gap, addressing a need for a pragmatic and proportionate approach to guide early spatial planning for the sector. Such an approach must also be one that can be rolled out at scale in the near term and one that can

4 The MSP Toolkit and the associated Guidance Notes and Knowledge Factsheets can be accessed at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/448511636704037044/problue-climate-informed-marine-spatial-planning-supporting-mitigation-and-resilience

5 World Bank Group 2021a, 38-41

6 Such as those established by The Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC). https://unfccc.int/process-and-meetings/the-paris-agreement

serve as a precursor to—and is compatible with—climate-informed MSP initiatives and SESA. SenMap outputs are not intended as a replacement for MSP or SESA. Rather, the E&S sensitivity maps are complementary and can be direct inputs to, and inform, ongoing or future MSP and SESA activities.

SenMap is a four-step process where E&S considerations are addressed in parallel. These steps are as follows:

- **Step 1. Desk-based review:** Collate and screen data to identify the most important E&S attributes that could potentially be sensitive to offshore wind development and allocate preliminary sensitivity scores.
- **Step 2. Stakeholder engagement:** Map and engage with key stakeholders (via appropriate mechanisms for the country context) to review and validate Step 1 outcomes, better understand potential sensitivity, and identify key high-level data gaps that can be addressed via Step 3.
- **Step 3. Filling the gaps:** Address high-level data gaps through additional strategic primary data collection (field survey) or knowledge co-generation, to enable review of sensitivity scores and contribute to the spatial data available to produce sensitivity maps in Step 4.
- **Step 4. Sensitivity mapping:** Prepare high-level, landscape/seascape-scale sensitivity maps to inform early-stage offshore wind spatial planning.

The starting point for these four steps is to define a broad E&S sensitivity mapping area (termed the SenMap area) to help guide biodiversity and social data collection (and sensitivity mapping) over an area aligned with a country's jurisdiction for offshore wind development. The focus of the sensitivity mapping is the biodiversity and social attributes. These attributes, as termed in this guidance[7] , are the most important E&S features that could potentially be sensitive to offshore wind development. Here it is noted that the attributes (and associated summary information on potential impacts) identified in this guidance are indicative only—they are not intended to be exhaustive or restrictive. Other potentially sensitive attributes may be identified, depending on the E&S characteristics of the country where this guidance is implemented.

With respect to biodiversity, SenMap focuses on the following attributes:

- Species:
  - Birds (seabirds, shorebirds, and non-migratory land birds)
  - Bats (migratory and non-migratory)
  - Fish (benthic, demersal, and pelagic—both bony and cartilaginous)

7 The term 'attribute' is used in order to distinguish from terms with specific definitions used elsewhere in broader sensitivity mapping literature, such as ecological and socioeconomic assets (e.g. NEA and UNEP-WCMC 2019), biodiversity values in IFC Performance Standard 6, and environmental and social impact receptors in project-level Environmental and Social Impact Assessment.

    - Marine mammals (cetaceans and pinnipeds)
    - Sea turtles
- Natural habitats (including associated communities and threatened or unique ecosystems)
- Legally Protected Areas, Internationally Recognized Areas, and other designated areas

With respect to the social dimension, SenMap focuses on the following attributes:

- Coastal communities
    - Coastal municipalities
    - Indigenous Peoples
- Fisheries and aquaculture
    - Subsistence fisheries
    - Commercial fisheries
        - Artisanal and small-scale
        - Semi-industrial and industrial
    - Aquaculture
        - Artisanal and small-scale
        - Industrial
    - Processing
- Cultural heritage
    - Tangible Maritime and Underwater Cultural Heritage (MUCH)
    - Intangible MUCH
- Recreation and tourism
    - Water sports
    - Natural tourist attractions
    - Recreation and tourism infrastructure and housing

In the first step, spatial and non-spatial data is collated for E&S attributes and each attribute is then scored on a recommended five-point scoring system from highest to lowest sensitivity through a multi-stakeholder engagement process. A review and validation of the existing data and preliminary sensitivity scoring leads to the identification of key data gaps. These gaps become the focus of primary data collection, and/or knowledge co-generation, with respect to social attributes. Knowledge co-generation is defined as iterative and collaborative processes involving diverse types of expertise, knowledge, and actors to produce context-specific knowledge. In alignment with the latest trends in MSP, the co-production of knowledge is highlighted as a promising approach in the social sciences that, when implemented alongside traditional scientific approaches, provides for scientific integrity while also exploring solutions related to competing uses of marine landscapes and resources.

Finally, the SenMap process draws together all the information gathered through the previous steps to develop spatial, grid-based, sensitivity maps for each attribute. The primary outputs are one consolidated biodiversity sensitivity map and one consolidated social sensitivity map for the SenMap area. These maps rely on the spatial data compiled, evaluated, and standardized in a central geodatabase. As the spatial data allows, maps will indicate areas of relatively higher and lower biodiversity and social sensitivity, serving as planning tool for avoiding offshore wind development in areas of the highest sensitivity.

It is envisioned that government agencies responsible for offshore wind spatial planning will either have the appropriate skills and knowledge to lead the SenMap approach or will engage a suitably qualified organization. In this guidance, this entity is referred to as the SenMap Lead. The remit of the SenMap Lead is diverse and includes liaising with relevant government agencies and partners, including helping to understand how the approach could be integrated into relevant existing government processes and systems, and how the sensitivity mapping outputs can be disseminated and used to inform decision-making. Whether the SenMap Lead is a national or regional governmental entity or an organization or consortium working on their behalf, coordination with various government actors will comprise an important part of their work.

SenMap outputs could be used to prioritize broad areas for offshore wind development, and to provide key inputs to competitive bidding processes. They could also be used to inform bilateral processes where developers are involved in early-stage work to determine suitable sites. What constitutes a potentially suitable area will depend on other uses and users of the marine space, and on technical and physical factors influencing the feasibility and economic viability of offshore wind development in that area.

Finally, it will also be important to establish suitable mechanisms for sharing SenMap data and disseminating the outputs, supporting collaborative and transparent planning with effective stakeholder contributions. This includes ensuring transfer of the knowledge and capacity to use and develop SenMap data and outputs, as well as considering access to and platforms for visualization of the data.

Given the significant offshore wind technical potential in emerging market countries, the clear role of offshore wind in countries' transition to sustainable energy systems [8] and the urgent pace of action required to achieve climate targets, the SenMap approach can be tailored to the country context and deployed rapidly to guide early spatial planning for sustainable offshore wind development.

8 According to the UN Net Zero Coalition, the energy sector is the source of around three quarters of greenhouse gas emissions today. Replacing polluting coal, gas, and oil-fired power with energy from renewable sources, such as wind or solar, would dramatically reduce carbon emissions. See https://www.un.org/en/climatechange/net-zero-coalition

CHAPTER ONE— PLANNING FOR SUSTAINABLE OFFSHORE WIND DEVELOPMENT

1 Introduction

Offshore wind will need to make a vital contribution in the global effort to rapidly reduce greenhouse gas emissions and keep global temperature rise to at least below 2°C (preferably to 1.5°C[1]). Since the world's first offshore wind farm was installed in 1991 at Vindeby in Denmark, offshore wind technology has rapidly matured and substantially increased in scale, which has driven down costs by 60 percent over the past decade.[2] Offshore wind is now operating in 19 countries around the world[3] and at least 30 other countries[4] are looking to develop their own capacity.

For many emerging market[5] countries, offshore wind offers an abundant, reliable, and local source of clean electricity. To aid in this global rollout, the World Bank Group (WBG) established its Offshore Wind Development Program[6] with the aim of accelerating the uptake of offshore wind in emerging markets. The Program estimates[7] that there is over 16,000 GW of technical potential[8] for offshore wind in emerging markets, highlighting a vast, untapped opportunity. To provide a sufficient volume of finance at an affordable rate, projects in emerging market countries will often need to secure international finance to supplement local sources. To meet the requirements of international lenders and development finance institutions,[9] offshore wind projects will need to align with Good International Industry Practice (GIIP)[10] for environmentally and socially sustainable development. Development that is not aligned with GIIP will likely not attract international lending.[11]

The WBG report *Key Factors for the Successful Development of Offshore Wind in Emerging Markets* (hereafter, the Key Factors report) outlines the most important elements to help emerging markets build successful offshore wind sectors that follow GIIP while reflecting the unique contexts of each country.[12] The Key Factors report recognizes the importance of early-stage technical assessments, including analysis of the wind resource potential and access to the transmission network. These early-stage assessments also include environmental and social (E&S) sensitivity mapping to highlight areas of relatively higher or lower sensitivity, as well as areas of the highest sensitivity that are unsuitable for offshore wind development and should be avoided altogether.

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1 As agreed under the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement, adopted by 196 Parties at Conference of the Parties 21 in Paris, December 2015, and in force since November 2016.

2 Between 2010 and 2021 the global average levelized cost of electricity of offshore wind farms fell 60 percent. From its peak in 2007, it has fallen by 65 percent (IRENA 2022).

3 In 2023, the total global installed offshore wind capacity was just over 60 gigawatts (GWEC 2023).

4 According to internal research by the WBG's Offshore Wind Development Program. https://www.esmap.org/esmap_offshore-win

5 For the purposes of this report, "emerging market" economies are those considered to be "low-income," "lower-middle income," and "upper middle-income" economies as per the World Bank Country Classifications.

6 This initiative is being jointly delivered by the World Bank's Energy Sector Management Assistance Program (ESMAP) and the International Finance Corporation (IFC). For further information on the WBG Offshore Wind Development Program, see https://esmap.org/esmap_offshore-wind

7 Offshore wind technical potential is an estimate of the amount of generation capacity that could be technically feasible, considering only wind speed and water depth (ESMAP 2024).

8 Offshore wind is defined as technically feasible where wind speeds are greater than 7 meters per second and where water depths are less than 50 meters for fixed wind farms and between 50 - 1,000 meters for floating wind farms (ESMAP 2019). Note that these analyses are initial high-level estimates that do not account for other technical, environmental, social, or economic constraints.

9 Such as the World Bank Environmental and Social Framework and IFC Performance Standards on Environmental and Social Sustainability, which have become globally accepted GIIP. The Performance Standards have been adopted by commercial banks who are signatories to the Equator Principles

10 As defined in IFC Performance Standard 3 (IFC 2012a) as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances, globally, or regionally.

11 World Bank Group 2021a

12 The Key Factors report distills experiences from established offshore wind markets into key success factors to help emerging markets build successful offshore wind sectors that follow international GIIP while reflecting the unique contexts of each country. There are four pillars: Strategy, Policy, Frameworks, and Delivery. The Frameworks pillar explores key factors for MSP, leasing, permitting, offtake and revenue, grid connection, health and safety, and standards and certification. SenMap is a tool designed to support MSP under the Frameworks pillar.

1.1 Why SenMap?

Our ocean is a precious resource, and it is imperative that development in the marine realm is undertaken responsibly, considering both coastal communities and biodiversity. Especially in emerging market countries, coastal communities often rely heavily on the sea for their livelihoods and wellbeing. The marine environment can be a vital part of their cultural norms and beliefs. However, marine ecosystems from coastal waters to the deep sea now show the influence of human actions—nowhere in the ocean is entirely unaffected.[13] Changes in the uses of the sea and coastal land are a key driver of impact,[14] and biodiversity loss is currently recognized as one of the most severe risks to the ocean on a global scale over the next ten years.[15] This loss is weakening the ocean and its ability to withstand disturbances, to adapt to climate change, and to act as a global ecological and climate regulator.[16] A variety of ecosystems are at risk of tipping over into self-perpetuating and irreversible change that will accelerate and compound the impacts of climate change.[17]

To facilitate responsible offshore wind development from the earliest stages, rigorous spatial planning offers several opportunities and long-term advantages to reduce the potential for further adverse E&S impacts in the marine realm due to poorly sited projects. Spatial planning also informs the strategic planning of shared infrastructure (such as electrical transmission grids and ports) and strategic assessments of cumulative impacts.

There are several existing approaches to strategic and coordinated spatial planning, with different levels of effort and different spatial scales. Internationally recognized and applied approaches include multi-sector marine spatial planning (MSP), Strategic Environmental & Social Assessment (SESA), and to a lesser degree, Environmental and Social Impact Assessment (ESIA). Cumulative Impact Assessment (CIA) is also an important input (for more information, see Annex 1). The specifics of each methodology vary but identifying and mapping E&S sensitivities during planning, with the aim of avoiding and minimizing the potential for development impacts later, is a common theme. For example, the World Bank multi-donor PROBLUE program has published a *Marine Spatial Planning for a Resilient and Inclusive Blue Economy Toolkit*[18] (the MSP Toolkit). This Toolkit is a series of guidance notes and factsheets to improve understanding of the benefits of MSP (ecological, social, and economic), and to provide guidance on topics including: (i) identifying entry points; (ii) climate-smart MSP; (iii) integrating cross-cutting themes; (iv) identifying key data and tools for MSP; and (v) formulating and implementing a plan.

13 Halpern et al. 2019; IPBES 2019
14 IPBES 2019
15 WEF 2024
16 See Ocean and Climate Platform 2024; IPCC 2019.
17 WEF 2024
18 The MSP Toolkit and the associated Guidance Notes and Knowledge Factsheets can be accessed at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/448511636704037044/problue-climate-informed-marine-spatial-planning-supporting-mitigation-and-resilience

Experience in established offshore wind markets, such as United Kingdom, Germany, and Netherlands[19] has shown that government-led spatial planning helps to minimize the E&S impacts of development. However, full-scale MSP and SESA-type approaches as implemented in mature markets are often resource intensive, multi-year, and costly endeavors, which may not always be readily accessible in emerging markets considering their accelerated timeframes for offshore wind development (notably to meet climate targets[20] and to establish energy security). Given the significant offshore wind technical potential in emerging market countries, the clear role of offshore wind in countries' transition to sustainable energy systems,[21] and the urgent pace of action required to achieve climate targets, there is a need for a pragmatic and proportionate approach to guide early spatial planning for the sector. Such an approach must also be one that can be rolled out at scale in the near term and that can serve as a precursor to—and is compatible with—climate-informed MSP initiatives (see Annex 2) and SESA. This document, *Integrated Environmental and Social Sensitivity Mapping—Guidance for Early Offshore Wind Spatial Planning* (or SenMap) has been designed to address this need.

Using the SenMap approach to inform spatial planning for the offshore wind sector will help government planners identify broad offshore wind development areas of the lowest E&S sensitivity. This is expected to lead to streamlined E&S permitting processes, through avoidance of those areas of highest E&S importance, where poorly sited development could lead to irreversible or difficult to mitigate E&S impacts. Access to SenMap outputs could also support developers to understand and integrate E&S costs into the tender process for the highest risk elements and inform a project's ESIA process.

SenMap's purpose and objectives are more fully outlined in Section 2.1

19 For example: United Kingdom—see The Crown Estate—Marine Planning; and *Designing Leasing Round 4;* Germany—see Ordinance on spatial planning in the German exclusive economic zone (EEZ); Denmark—see Danish Experiences from Offshore Wind Development; Netherlands—see Policy Document on the North Sea 2016-2021.

20 Such as those established by The Paris Agreement of the UNFCCC. https://unfccc.int/process-and-meetings/the-paris-agreement

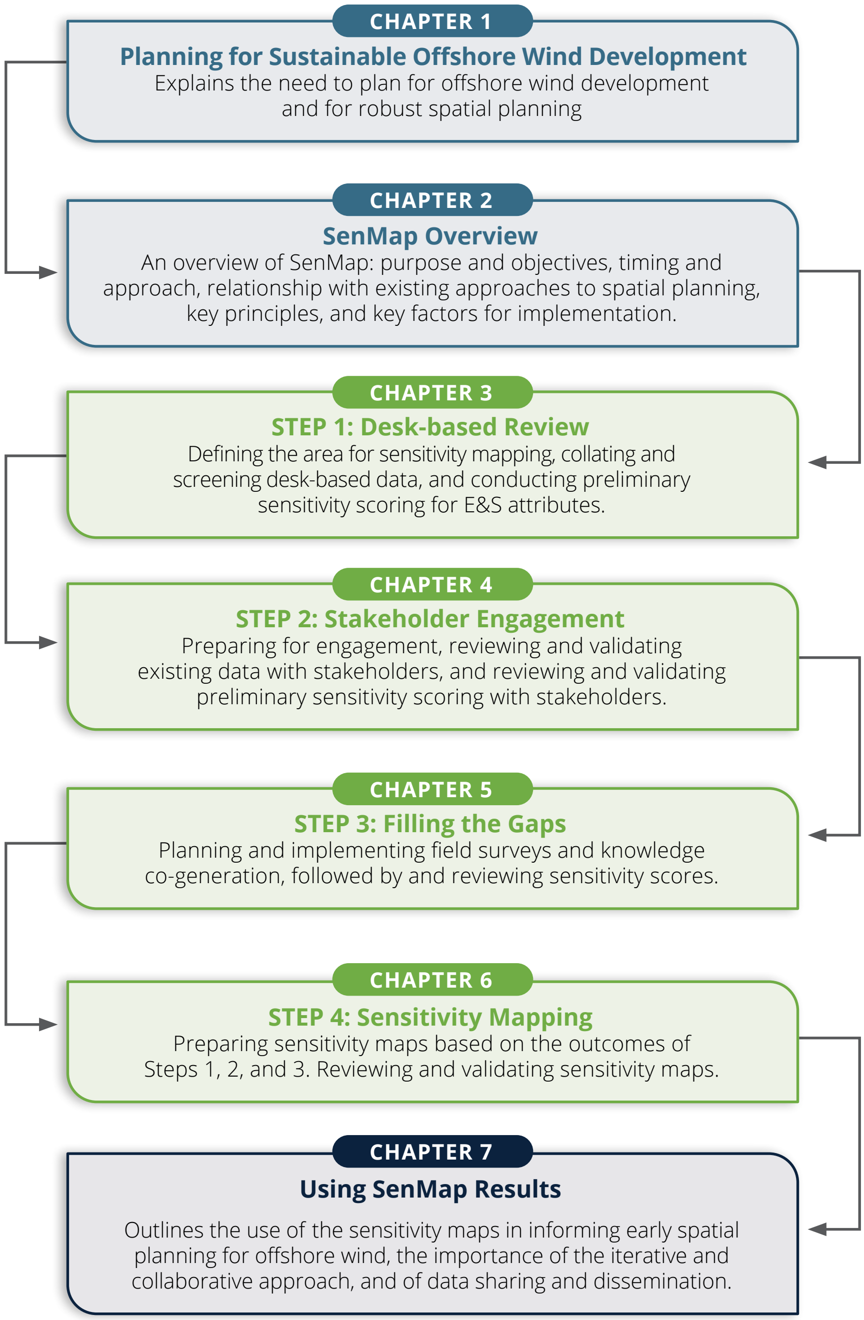
21 According to the UN Net Zero Coalition, the energy sector is the source of around three quarters of greenhouse gas emissions today. Replacing polluting coal, gas, and oil-fired power with energy from renewable sources, such as wind or solar, would dramatically reduce carbon emissions. See https://www.un.org/en/climatechange/net-zero-coalition

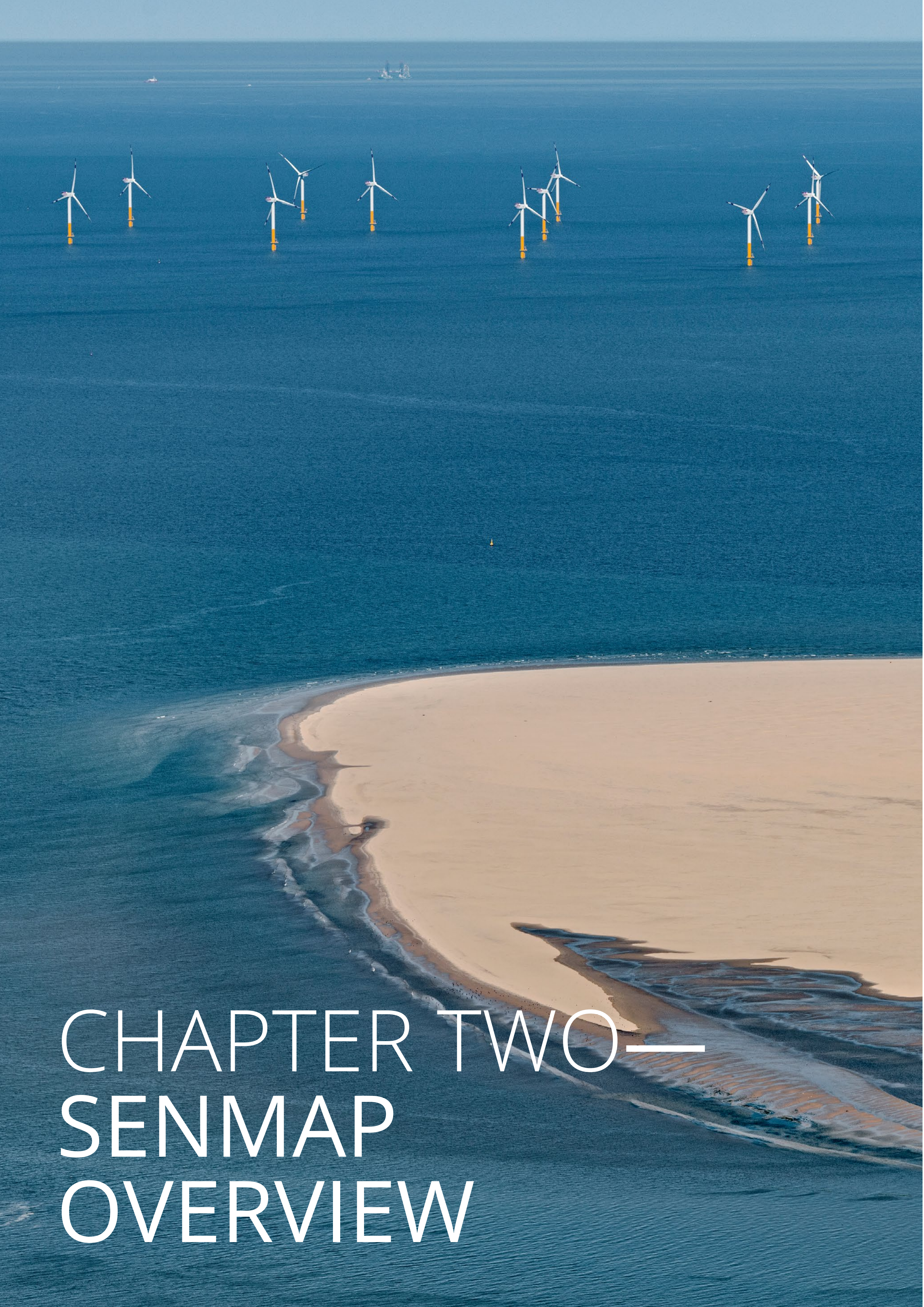
Given the significant offshore wind technical potential in emerging market countries and the urgent pace of action required to achieve climate targets, there is a need for a pragmatic and proportionate approach to guide early spatial planning.

1.2 Navigating this Document

The remainder of this document presents the SenMap approach. Section 2 provides an overview of the purpose, objectives and key principles. Sections 3-6 describe the four process steps. Section 7 covers the use of the sensitivity maps to inform early spatial planning for the sector. Figure 1 illustrates the structure of the document to aid reader orientation and navigation.

FIGURE 1:
Structure of the Document





CHAPTER TWO— SENMAP OVERVIEW

2 SenMap Overview

This section provides an overview of the purpose and objectives of SenMap, summarizes the expected timing relative to other planning and development processes, and outlines the broad approach to implementation. It also introduces the key principles underpinning the approach, and highlights some of the factors, considerations, and key skills required for its implementation.

2.1 Purpose and Objectives

This document is a guide for early-stage E&S sensitivity mapping,[22] underpinned by the key principles outlined in Section 2.3. The SenMap approach offers a proportionate and less resource-intensive entry into spatial planning than wider and full-scale processes like MSP.[23] It is a practical approach, aligned with the characteristics, considerations, and principles of MSP and single sector planning for offshore wind[24] (see Section 2.2.1 and Figure 2). SenMap is flexible and iterative (see Section 2.2.2 and Figure 3) and intended to be tailored to the country context. It is applicable to both fixed bottom and floating offshore wind technologies. Its spatial scope is designed to align with a country's jurisdiction for offshore wind development (see Section 3.1).

For government planners, implementing the SenMap approach is a way to ensure E&S considerations are reflected in the earliest stage of strategic spatial planning for offshore wind.[25] The sensitivity maps can help identify broad areas likely to be of lower E&S sensitivity, that can be offered for offshore wind development. The sensitivity maps support planning for avoidance, directing development away from areas where sensitivity is highest. For governments and developers alike, implementing the SenMap approach can offer early insights into the potential challenges of managing E&S risks in the planning area in accordance with GIIP and the E&S standards of international financial institutions and development banks—particularly where MSP or SESA has not yet been carried out. Sensitivity maps highlighting areas of relatively lower or higher E&S sensitivity, including areas that should potentially be excluded from development, can contribute to improving market confidence in the potential to develop bankable projects downstream.

22 The broadest extent of which is defined as the country maritime area under national jurisdiction, plus the coastal zone—see Section 3.1.
23 See Annex 1 for more information.
24 See Annex 1 for more information.
25 Alongside other relevant technical considerations such as wind resource and geotechnical conditions, and infrastructure considerations including, but not limited to, shipping, navigation, and maritime transport; oil and gas; submarine cables and pipelines; marine aggregates; marine and coastal access issues; and defense and national security.

While it is important to note that the approach is not designed to support or replace individual site- or project-level activities such as those that are part of permitting,[26] the sensitivity map outputs can inform the scope of more detailed studies and assessments further on in the planning and development process. This could include providing a resource to help developers scope the priority issues for project-specific ESIAs as part of aligning with international lender standards.

The approach is participatory, relying on stakeholder contributions throughout (see Section 2.4.3). Government-led spatial planning processes that balance the uses of the marine space need to be collaborative and bring together users of the ocean and local communities to make informed and coordinated decisions about how to use marine resources sustainably.[27] Implementing SenMap can help to identify key stakeholders early on and provide a basis for continued engagement in the offshore wind development process as the sectoral spatial plan progresses. It can highlight key information gaps and help to prioritize addressing them.[28]

Sensitivity mapping to inform offshore wind development also provides a first step towards addressing wider calls and recommendations from the international conservation community of practice with respect to renewable energy development and early spatial planning. For example, Birdlife International's 2021 position paper on *Renewable Energy at Sea and Nature Conservation*[29] recommends a strategic and ecosystem-based MSP approach, including sensitivity mapping nationally and at the sea-basin scale, before areas of seabed are leased or licensed to a developer.[30] The United Nations (UN) Global Compact Ocean Stewardship Coalition's 2021 *Roadmap to integrate clean offshore renewable energy into climate-smart marine spatial planning*[31] notes that strategic-level planning and early identification of biodiversity risks are effective tools to avoid placing developments in areas of high biodiversity sensitivity.

2.2 Timing and Approach

The following sections outline broadly when SenMap is expected to be implemented (relative to other wider spatial planning processes and the overall stages of offshore wind planning and development) and summarize the suggested stepwise approach.

26 World Bank Group 2021a, 42–60

27 World Bank Group 2021a, 31–79

28 Whether as part of the SenMap approach, or outside of it—for example, via other complementary approaches to strategic and coordinated spatial planning (see Figure 2).

29 BirdLife International Europe and Central Asia, 2021.

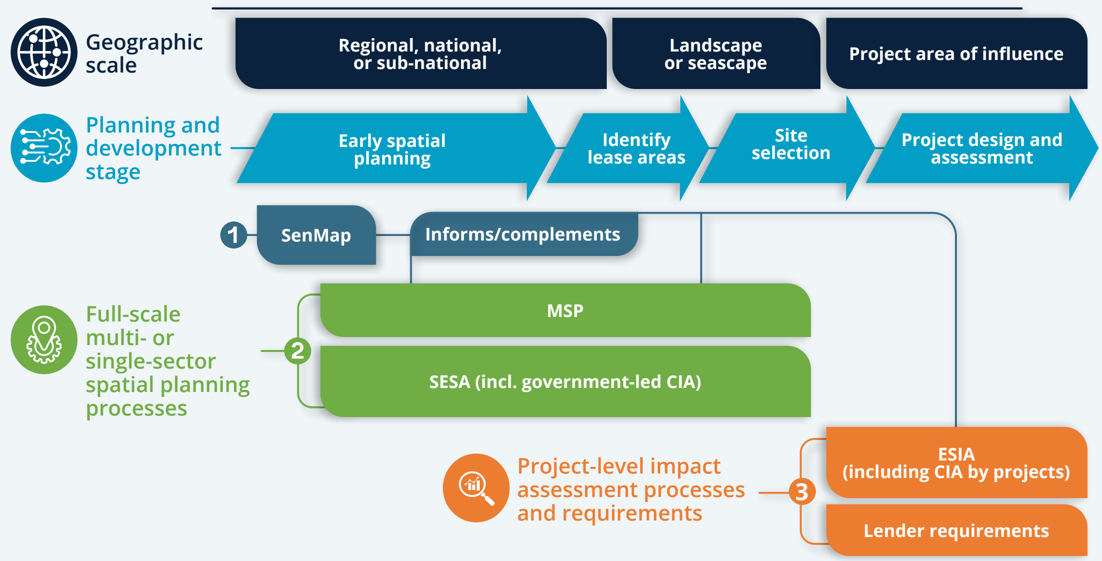
30 BirdLife International Europe and Central Asia 2021. BirdLife also notes in the 2021 position paper that 'project specific detailed assessments will always be necessary to determine the appropriateness of individual projects'.

31 UN Global Compact 2021

2.2.1 Relationship with Existing Approaches to Spatial Planning

The SenMap approach is designed to be implemented in the earliest stages of government-led spatial planning as an input to the identification of potential offshore wind leasing or development areas. It can be implemented as a stand-alone process, or it can be complementary (or a precursor) to wider MSP and SESA or single sector planning processes. Figure 2 shows the relationship of SenMap to existing spatial planning processes along the continuum from early strategic planning and lease/site selection, to detailed project-level assessments. Annex 1 provides further information outlining how SenMap is complementary to MSP, SESA, and ESIA.

FIGURE 2:
Relationship of SenMap with Existing Spatial Planning and Project-level Impact Assessment Processes



1 **SenMap** A high-level means of identifying potential E&S sensitivities as early as possible in the planning process.

2

MSP **Multi-sector.** It enables comprehensive and integrated decision-making across different sectors/activities. Generally carried out by governments at a **national scale**. SenMap can be a precursor or input to MSP.

SESA **Multi- or single-sector:** A family of approaches on a continuum from spatial mapping and impact analysis to institutional assessment. Can be informed by MSP, used to evaluate draft MSP outputs, or carried out separately. Often also assesses cumulative impacts of multiple developments. Usually carried out by government at a **regional or national scale**. SenMap can be a precursor or input to SESA.

CIA **Multi- or single-sector:** Input to, or informed by, MSP/SESA. Responsibility of government and regional planners. Carried out at the geographic scale at which effects are aggregating and interacting. Can also be carried out from the individual project perspective. SenMap can inform the scope of CIA.

3

ESIA Comprehensive assessment of direct, indirect, and cumulative impacts of an **individual project**, carried out by the developer. SenMap can inform the scope of project-specific assessments.

Lender requirements Studies required to align with lender standards (e.g., World Bank Environmental & Social Framework, International Finance Corporation (IFC) Performance Standards, and those of the Equator Principles Financial Institutions).

2.2.2 A Flexible Stepwise Approach

The SenMap approach is a four-step process where E&S considerations are addressed in parallel, as follows:

- **Step 1 |Desk-based Review**: Collate and screen data to identify the most important E&S attributes (see Section 2.4.2) that could potentially be sensitive to offshore wind development and allocate preliminary sensitivity scores.
- **Step 2 |Stakeholder engagement:** Map and engage with key stakeholders (via appropriate mechanisms for the country context) to review and validate Step 1 outcomes, better understand potential sensitivity, and identify key high-level data gaps that can be addressed via Step 3 (see Section 2.4.3).
- **Step 3 |Filling the Gaps:** Address high-level data gaps through additional strategic primary data collection (field survey) or knowledge co-generation, to enable review of sensitivity scores and contribute to the spatial data available to produce sensitivity maps (see Section 2.4.4) in Step 4.
- **Step 4 |Sensitivity mapping:** Prepare high-level, landscape/seascape-scale sensitivity maps to inform early-stage offshore wind spatial planning (see Section 2.4.4).

For each step, this guidance identifies key tasks and provides high-level recommendations on how to approach them. Text found in boxes throughout this report highlights key concepts, considerations, and important definitions that will aid implementation.

SenMap implementation is flexible and need not be strictly sequential, as illustrated in Figure 3. Preliminary sensitivity mapping could be carried out after Steps 1 and 2, using existing data and with feedback from key stakeholders. This could be beneficial where circumstances affect implementation of Step 3.[32] Further, Step 4 sensitivity mapping is not necessarily contingent on fully completing Step 3 activities. Primary data and co-generated knowledge can be processed on a rolling basis as soon as possible after collection, and the information can be fed into the sensitivity mapping process (notwithstanding the completion of other data collection activities). Challenges related to primary data collection and knowledge co-generation need not delay progress. The approach is designed to be iterative, and it may be possible to prepare draft sensitivity maps in Step 4 with updates to follow as additional information becomes available.

32 Such as resource/capacity limitations, inclement weather offshore, or prolonged schedules for conducting face-to-face interviews with stakeholders on the ground—see Step 3.

Adaptability is a critical component of SenMap because of factors including data availability, variation in the appropriate technical approach, and issues such as stakeholder availability to engage in the process. Rather than become barriers to the preparation of (preliminary) E&S sensitivity maps, the iterative approach allows for these considerations to inform subsequent refinements of the process and the resulting maps. Thus, the overall timeline for implementation of the SenMap steps (and iterations) is expected to be variable and context-specific.[33]

In addition to E&S sensitivity mapping, early-stage spatial planning is also informed by spatial analysis of other relevant factors (or constraints) potentially influencing the suitability of areas for offshore wind development. Factors to consider include technical and physical constraints like water depth, wind resource potential, seabed geotechnical conditions, access to the transmission network, and other infrastructure and users of the marine space (e.g., submarine cables and pipelines, shipping, navigation and maritime transport, oil and gas installations, marine aggregates activity, defense, and national security). The process of collating the available spatial data relevant to such technical and physical factors and overlaying it to understand implications for locating offshore wind lease or development areas is termed 'constraints mapping.' It is recommended that this guidance is implemented in parallel with constraints mapping and other early-stage investigations into the feasibility of offshore wind development, including grid connection studies and economic viability assessments[34] (see Box 1). As noted, the approach is participatory—hence, implementation will require coordination and collaboration with relevant government agencies and a suite of other stakeholders (see Section 2.4.3). The decision about when to move forward from early-stage sensitivity mapping to E&S investigations at more refined spatial scales is not fixed. It is important that the approach continues to be risk-based, proportionate, and informed by other relevant available information on the suitability of a given area for offshore wind development (see Box 1 and Section 7.2).

33 And is likely to be influenced by requirements related to the funding mechanism, for example, international lender standards. Further, in countries with good wind resource, there may already be inroads to planning and sites are being identified for development in the absence of early screening. The approach described in this guidance is flexible and can complement other processes already underway.

34 For example, spatial modelling of the Levelized Cost of Energy (LCOE) can help identify the most economically promising areas for development—see Chapter 3 of World Bank Group 2021a, 31.

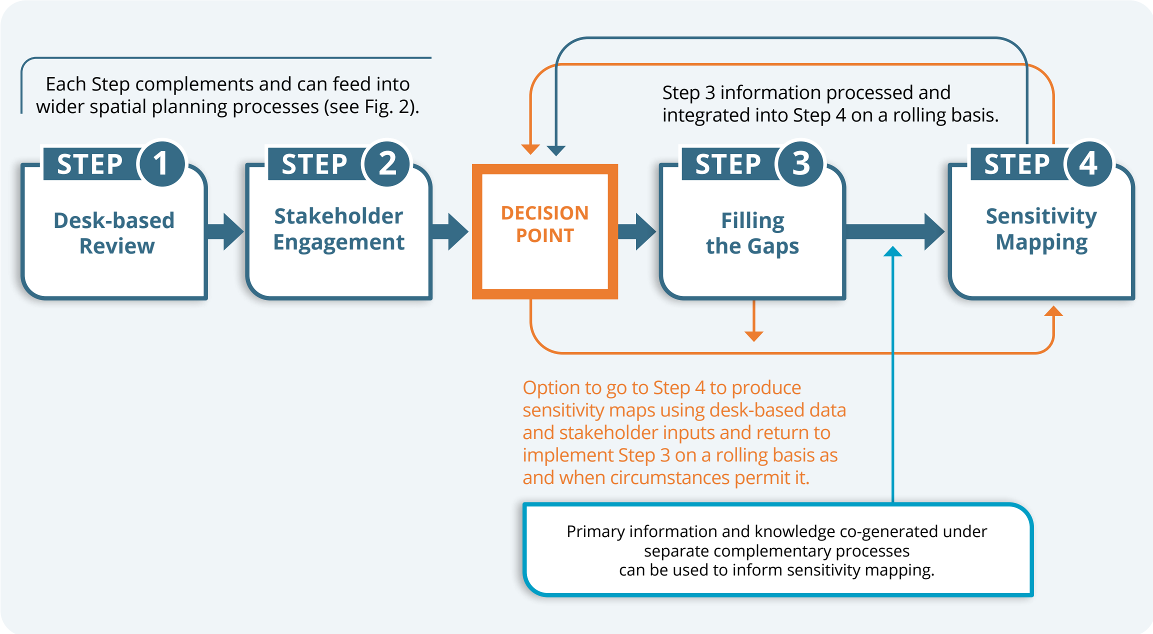
Box 1 Mapping Other Types of Constraints

Constraints mapping at the early planning stage may represent the first time that multidisciplinary and multisectoral spatial information has been compiled. The process helps to identify potential spatial conflicts, recognizing that some constraints will be fixed, and others may have some flexibility in terms of where they are located and whether they could coexist with components of offshore wind development (e.g., potential for a designated passage for recreational boating through wind farm areas). It is beneficial to carry out constraints mapping in parallel with E&S sensitivity mapping to avoid spending time and resources focusing on areas that are clearly technically unsuitable for development. Examples of constraints mapping exercises to date tend to come from well-established offshore wind sectors, and include The Crown Estate Resource and Constraints Assessment for Offshore Wind Leasing Round 4 (2019[35]), the Offshore Renewable Energy (ORE) Catapult constraints mapping for floating offshore wind in the Celtic Sea (2020[36]), a map of geological and geotechnical constraints for offshore renewable energy in the Irish Sea (Coughlan et al 2020[37]), and the Energy Sector Management Assistance Program (ESMAP) high level global offshore wind technical potential analysis (2019[38]). A method for assessing spatial constraints and future scenarios has also been illustrated using a United Kingdom case study (Putuhena et al, 2023).[39]

Collectively, E&S sensitivity mapping and constraints mapping inform decisions on the overall feasibility of offshore wind development, which in turn helps understand economic viability. Economic viability can also be considered spatially through the modelling of the Levelized Cost of Energy (LCOE). LCOE is defined as the lifetime average cost for the energy produced and is used to evaluate and compare the cost of electricity production from different locations and different technologies, as relevant (see the WBG Key Factors report). More discussion on economic analysis in terms of MSP more broadly can be found in the PROBLUE MSP Toolkit guidance note *Applying Economic Analyses to Marine Spatial Planning.*[40]

35 The Crown Estate 2019
36 ITPE 2020
37 Coughlan, M., Long M., and Doherty, P. 2020
38 World Bank 2019
39 Putuhena, H., White, D., Gourvenec, S. and Sturt, F. 2023
40 World Bank 2022a

FIGURE 3:
Flexible Implementation of the SenMap Approach



2.3 Key Principles

The SenMap approach is based on the following key principles:

The mitigation hierarchy: The mitigation hierarchy (avoidance, minimization, restoration, and offsetting/compensation) is central to good practice for managing and mitigating impacts on people, biodiversity, and ecosystem services. Preventative measures are prioritized over remediation in the mitigation hierarchy.[41] Avoidance is fundamentally important in planning for sustainable offshore wind development. It is the lowest cost mitigation approach, and it is the one with the greatest certainty of success and prevention of E&S-related conflict. The SenMap approach helps to ensure offshore wind development is avoided in areas of the highest E&S sensitivity. It may also help to avoid potential delays and the subsequent requirement for expensive and uncertain offset studies and social mitigation and compensation plans. Implementing the mitigation hierarchy is an iterative process, involving feedback and adaptive management throughout the planning and development cycle.

The precautionary approach: In the environmental context, the precautionary approach states that where there are threats of serious or irreversible damage, or of significant reduction of loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation

41 As described in Bennun et al. 2021, avoidance and minimization measures prevent or reduce impacts, while restoration and offset measures remediate impacts that have already happened.

and avoid or minimize such threats.[42] In SenMap, this definition is extended to include negative social outcomes. A precautionary approach should incorporate the knowledge of stakeholders and traditional and local users of the marine space.[43]

A gender-based approach: Offshore wind development has the potential for complex and context-specific implications in terms of gender roles and norms, gendered livelihoods, and gendered uses of marine and coastal resources.[44] Such considerations are fundamental for SenMap implementation. Women's work in the maritime sectors is too often overlooked or underrepresented in statistics. This means that if their livelihoods and wellbeing are affected by offshore or coastal infrastructure and activities, it is often inadequately compensated.[45] A gender-based approach will support the integration of gender-specific issues and women's values and priorities in the sensitivity mapping. Box 3 outlines several considerations that should inform the SenMap process.

Knowledge co-generation*:* For social attributes, this guidance uses the term knowledge co-generation instead of alternative terms like data collection or research.[46] Data collection or research emphasizes the role of specialists who identify issues, conduct the research, and then deliver the knowledge to society. In contrast, knowledge co-generation is defined as iterative and collaborative processes involving diverse types of expertise, knowledge, and actors to produce context-specific knowledge and pathways towards a sustainable future.[47] An increasing number of voices within MSP highlight the co-production of knowledge as a promising approach that, when implemented alongside traditional scientific approaches, provides for scientific integrity while also exploring solutions related to competing uses of marine landscapes and resources.[48]

Participatory approach: Participatory approaches are tools that help deliver knowledge co-generation. It is argued that for people to sustainably enjoy the full benefits of the ocean, traditional planning methods must be strengthened by social science methods (e.g., participatory mapping). Such complementary methods can inform spatial mapping and account for diverse local cultures, values, and identities, as well as livelihood strategies and resource management practices. Such approaches support transparency, accountability, and social inclusion. SenMap implementation should be driven by an accessible engagement process, with the aim of empowering communities—including disadvantaged and vulnerable groups—to participate in and inform the outcomes. Moreover, these methods may help to identify issues of misrepresentation and inequitable resource distribution, as well as misrecognized ocean and coastal knowledge, rights, vulnerabilities, and status. Once identified, there is an opportunity to address these issues.[49]

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42 This is outlined in Principle 15 of the Rio Declaration on Environment and Development, adopted by the UN Conference on Environment and Development in 1992 and the preamble to the Convention on Biological Diversity (CBD). In 1995, the CBD Conference of Parties adopted Decision II/10, which states that "The work of the Secretariat on marine and coastal biological diversity will incorporate explicitly the precautionary approach in addressing conservation and sustainable use issues."

43 See Cooney 2004

44 For further information on this topic, see Food and Agriculture Organization (of the UN) 2017 and the Danish Institute for Human Rights 2019.

45 Fröcklin et al. 2013

46 To state Norström et al. 2020

47 Scheinider et al. 2021

48 Scheinider et al. 2021

49 Gilek et al. 2021

2.4 Key Factors for Implementation

2.4.1 The SenMap Lead

It is envisioned that government agencies responsible for offshore wind spatial planning will either have the appropriate skills and knowledge to lead the SenMap approach or will engage a suitably qualified organization to be the SenMap Lead. Due to the unique combination of skills required, it may be appropriate for the SenMap Lead to form a consortium of firms and individuals which may include qualified Non-Government Organizations (NGOs) with specialized expertise. In this guidance, this entity is referred to as the SenMap Lead.[50] Key prerequisites for this role include:

- Broad E&S skillsets[51] including strong national and local expertise in coastal and marine environments, as well as international experience to ensure approaches are aligned with GIIP.
- Familiarity with the offshore wind development process.
- Experience convening and facilitating complex stakeholder engagement processes across multiple stakeholder types and groups (see Section 2.4.3).
- Experience or familiarity with spatial planning and sensitivity mapping approaches.
- Strong geographic information systems (GIS) capabilities (the SenMap process is driven by spatial data, see Section 2.4.4 and Annex 4).

The remit of the SenMap Lead includes:

- Liaising with relevant government agencies and partners, including helping to understand how the approach could be integrated into existing government processes and systems (such as for spatial data management and sharing, or for multi-stakeholder engagement), and how the sensitivity mapping outputs can be disseminated and used to inform decision-making.
- Work planning and overseeing the consortium to deliver sensitivity maps.
- Responsibility for overall E&S data handling and management.
- Leading stakeholder mapping and stakeholder engagement processes for both biodiversity and social attributes as separate workstreams, ensuring these processes align with GIIP and that biodiversity and social stakeholders integrate on cross-cutting issues.
- Responsibility for administration, facilitation, and coordination of stakeholder engagement and establishing a mechanism for addressing stakeholder grievances associated with the SenMap process.
- Providing quality control to ensure consistency in E&S approaches and that the sensitivity maps are fit for purpose.

50 In terms of funding, this approach could be donor-funded, government-funded, or some combination thereof. In the SenMap context of flexibility and iterative development, the costs will be variable. There are a number of factors that influence cost. For example, see European Commission et al. 2020.

51 Bearing in mind that focused stakeholder engagement with subject matter experts and legitimate representatives on specific E&S values is an integral part of each of the SenMap process. See Section 3.3.

Whether the SenMap Lead is a national or regional governmental entity, or an organization or consortium working on their behalf, coordination with various government actors will comprise an important part of their work. Strong government coordination is essential to delivering large-scale, affordable, offshore wind capacity.[52] Although addressing such complex institutional challenges is beyond the scope of this guidance, careful consideration should be given to identifying relevant government entities with licensing, management, and/or enforcement responsibilities in the marine environment and their input should inform the SenMap process and outputs. This is because it is beneficial to conduct the E&S sensitivity risk mapping described in this guidance alongside other types of constraints mapping being carried out by institutions with regulatory authority related to relevant sectors such as navigation, oil and gas, or submarine cable systems (see Box 1 and Section 7.2).

2.4.2 E&S Attributes

E&S attributes, as termed in this guidance,[53] are the most important E&S features that could potentially be sensitive to offshore wind development. They are the focus of sensitivity mapping. The attributes (and associated summary information on potential impacts) identified in this guidance are indicative only—they are not intended to be exhaustive or restrictive. Other potentially sensitive attributes may be identified, depending on the E&S characteristics of the country where SenMap is implemented. It is also important to be aware that the area for offshore wind sensitivity mapping is not entirely marine (see Section 3.1–Step 1); therefore, E&S attributes can be expected to be associated with the marine, coastal, and terrestrial realms. The following sections define E&S attributes further.

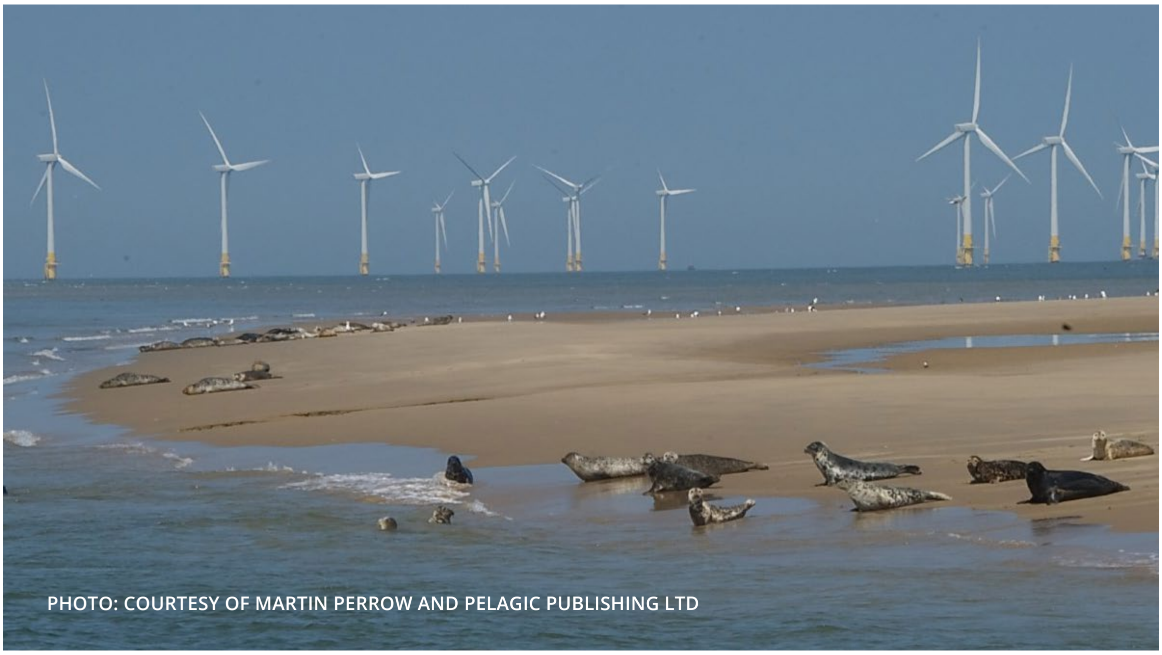

PHOTO: COURTESY OF MARTIN PERROW AND PELAGIC PUBLISHING LTD

52 For further information, see World Bank Group 2021a.

53 The term 'attribute' is used in the SenMap guidance to distinguish from terms used elsewhere with specific definitions, such as ecological and socioeconomic *assets* in the broader sensitivity mapping literature (e.g., NEA and UNEP-WCMC 2020), biodiversity *values* with respect to IFC Performance Standard 6, and environmental and social impact *receptors* in detailed project-level ESIA.

Biodiversity Attributes

The SenMap approach is focused on biodiversity attributes[54]—key groups of biodiversity known to be sensitive to impacts from poorly sited offshore wind development, according to the scientific literature associated with experiences from countries with well-developed offshore wind sectors.[55] They are as follows:

- Species:
  - Birds (seabirds, shorebirds, and non-migratory land birds)
  - Bats (migratory and non-migratory)
  - Fish (benthic, demersal, and pelagic—both bony and cartilaginous)
  - Marine mammals (cetaceans and pinnipeds)
  - Sea turtles
- Natural habitats[56] (including associated communities, and threatened or unique ecosystems)
- Legally Protected Areas (LPAs), Internationally Recognized Areas (IRAs), and other designated areas[57]

The biodiversity attributes are further defined in Table 3.1 of Annex 3, with a summary of the potential impacts of offshore wind, and the potential outcomes for biodiversity.[58] A key cross-cutting consideration for both biodiversity and social attributes is ecosystem services, further discussed in Box 2.

In general, there is good availability of spatial data on biodiversity at multiple scales (global and regional, and in many cases, national and local levels). This spatial data, combined with an understanding of biodiversity sensitivity to offshore wind informed by work in established markets, provides a good starting point for early spatial planning of offshore wind development in emerging market countries.

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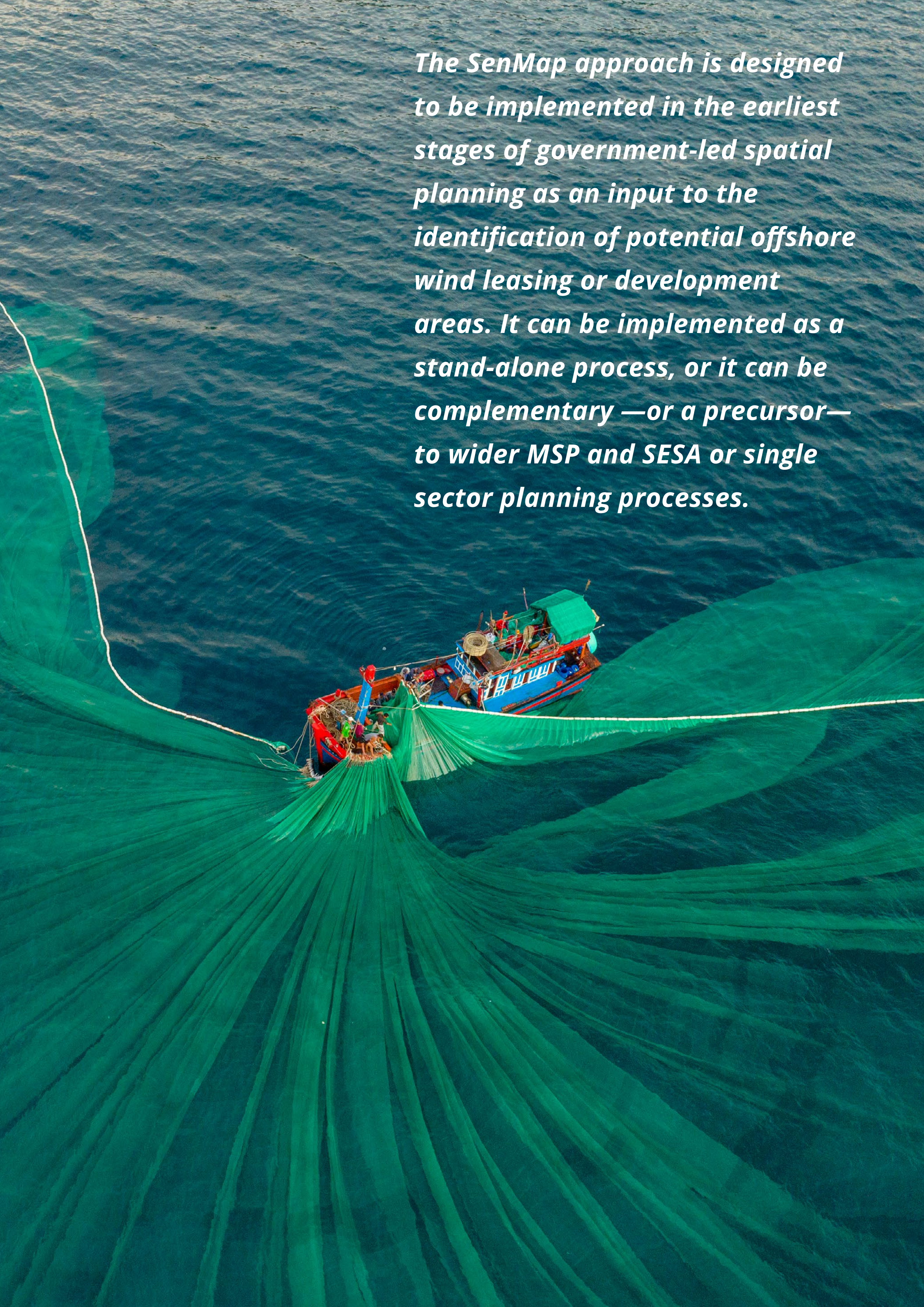
54 Acknowledging that in the term E&S, the 'environment' component is broader than this, including all living (e.g., animals and plants) and non-living (e.g., water, air, rock) elements and their interactions. Some non-living components can influence or constrain spatial planning (e.g., rock/geology), but are not necessarily said to have characteristics making them susceptible to development impacts. These can be captured through more direct mapping of simple physical/fixed constraints to development. Other non-living components are potentially susceptible to development impacts (e.g., impacts on air and water quality through noise, sediment/dust or light pollution), but susceptibility is generally influenced more by development parameters such as design and construction/operational methods and protocols than by the specific characteristics of the water or the air. Further, non-living components do not adjust, adapt, or otherwise respond to development activity in the same way living components do. Hence, sensitivity mapping in general focuses on living environmental components, with assessment of potential impacts on non-living components expected to be addressed through project-specific ESIA.

55 For example, see the comprehensive *Wildlife and Wind Farms, Conflicts and Solutions*, Vol 3 and 4 (Perrow 2019a, 2019b), which collate and synthesize the available evidence for potential effects of wind farms on wildlife and local ecosystems, as well as the potential solutions.

56 Defined as per IFC Performance Standard 6 (IFC 2012b).

57 According to IFC Performance Standard 6 definitions (IFC 2012b), see Annex 3.1. Note that while key definitions from IFC Performance Standard 6 are used here and for natural habitat, SenMap does not include critical habitat as a biodiversity attribute—please see Section 3.3.1 for more explanation.

58 The potential for ecosystem-level effects of offshore wind development are acknowledged, but not addressed further herein because they are currently poorly understood, difficult to define spatially, and difficult to define until more is understood about project siting and design. See Annex 6.2 for a summary.



The SenMap approach is designed to be implemented in the earliest stages of government-led spatial planning as an input to the identification of potential offshore wind leasing or development areas. It can be implemented as a stand-alone process, or it can be complementary —or a precursor— to wider MSP and SESA or single sector planning processes.

Box 2 Ecosystem Services

Ecosystem services are the benefits that people derive from ecosystems.[59] This includes: (i) the products we obtain from ecosystems (provisioning services like fish and fisheries); (ii) the benefits received from the regulation of ecosystem processes (regulating services like flood protection and climate regulation); (iii) non-material benefits we get from ecosystems (cultural services like natural areas that are sacred sites or important for recreation and tourism); and (iv) natural processes that maintain other services (supporting services like nutrient cycling). Ecosystem services are inextricably linked to coastal communities' identities, livelihoods, and wellbeing.[60] For example, healthy fisheries depend on a range of provisioning, regulating, and supporting services that are closely tied to cultural identity. Flood regulation and resilience in the coastal zone is dependent on healthy coastal wetland and intertidal habitats.

In some cases, it might be possible to include ecosystem services in sensitivity mapping. Some can be mapped spatially (e.g., coastal habitats or fisheries) and might already be captured as biodiversity or social attributes. Others are more difficult to map (e.g., nutrient cycling). Identifying biodiversity and social attributes that are associated with ecosystem services, and therefore potentially also important for socioeconomic reasons, could be one option for integrating consideration of ecosystem services into early sensitivity mapping. This is likely to require consultation between relevant biodiversity and social stakeholders on a case-by-case basis.

Social Attributes

The SenMap approach is focused on the people who live and work in the coastal and marine space, and the assets and activities associated with them that may be potentially sensitive to impacts of offshore wind development. Within this context, Indigenous Peoples and other disadvantaged or vulnerable groups should receive careful consideration. Such groups have potentially irreplaceable ties with marine and coastal ecosystems, and strongly depend on them for their livelihoods, wellbeing, and cultural survival. See Annex 3.2 for further context on the vulnerability of these communities. In this guidance, these communities and their associated assets and/or activities are termed social attributes, as follows:

- Coastal communities
  - Coastal municipalities[61]
  - Indigenous Peoples
- Fisheries and aquaculture

59 IFC Performance Standard 6 2012b
60 World Bank 2022b
61 This term was selected due to the defined spatial component. Depending on the country context, another term may be more appropriate. Other local administrative units could be used to define/map coastal communities.

    - Subsistence fisheries
    - Commercial fisheries:
        - Artisanal and small-scale
        - Semi-industrial and industrial
    - Aquaculture
        - Artisanal and small-scale
        - Industrial
    - Processing
- Cultural heritage:
    - Tangible Maritime and Underwater Cultural Heritage (MUCH)
    - Intangible MUCH
- Recreation and tourism
    - Water sports
    - Natural tourist attractions
    - Recreation and tourism infrastructure and housing

It is important to note that the coastal communities attribute captures the sensitivity of the *people* who live and work in the sensitivity mapping area. The other attribute groups refer to the assets and/or activities (associated with people) that are potentially sensitive to offshore wind development. Gender is a cross-cutting consideration for all the social attributes and is discussed in Box 3.

Annex 3.2 defines these social attributes and includes a summary of the potential impacts of offshore wind that might be experienced by affected communities. This guidance recognizes that, in contrast to biodiversity attributes, spatial data related to social attributes may be scarce and incomplete, especially with respect to emerging market countries. Further, identifying and defining social attributes is more complex, requiring considerable emphasis on stakeholder engagement and consultation using participatory approaches. Hence, this guidance emphasizes the importance of identifying social attributes through participatory co-generation of social data (see Section 5.1.2).

Box 3 Gender and the Social Attributes

As described in the World Bank PROBLUE publication, *Marine Spatial Planning for a Resilient and Inclusive Blue Economy Toolkit, Factsheet: #1 Gender, Marginalized People, and Marine Spatial Planning*, women are often excluded from decision-making processes in sectors and activities potentially affected by offshore wind.[62] This is despite the fact that while fishers are mostly men, women can represent most of the workforce in the fisheries supply chain, primarily in fish trade and in seafood processing, where they represent 90 percent of the workforce.[63] Men are linked to higher value, offshore capture fisheries, while women are linked to lower value, shore-based harvesting.[64]

Other social attributes also have important gender considerations, including cultural heritage and tourism. Interactions with cultural heritage are influenced by gender, such as in relation to safeguarding, interpreting, accessing, and feeling represented by it. Women are usually underrepresented or invisible in the production and preservation of cultural heritage.[65] Intangible cultural heritage is strongly connected to gender as some traditions (e.g., festivals, rituals) have specific gender roles and restrictions.[66] Maritime activities have historically been portrayed in Western culture as masculine endeavors, influencing a masculine maritime archaeology.[67] A gender-based approach can reinterpret and enlarge the scope of a heritage as well as help to understand social structure and cohesion.[68]

The tourism industry is also highly gendered.[69] Although women comprise up to 70 percent of the global tourism labor force,[70] it tends to be dominated by men in terms of decision-making and management.[71] Women's work in tourism is predominantly informal with characteristics including high staff turnover, long working hours, subcontracting, the prevalence of casual workers, and seasonal variations in employment. Gender-related inequalities are rife due to the horizontal and vertical segregation of occupations in the sector.[72]

To help counter these biases, relevant women's organizations, or other relevant stakeholders, must be represented in SenMap stakeholder engagement, the identification of E&S attributes and collaborative sensitivity scoring.

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62 See also FAO 2017 and Turpie et al. 2022.
63 Castano Isaza et al. 2021a; Danish Institute for Human Rights 2019; FAO 2017
64 Fröcklin et al. 2013
65 UNESCO 2014
66 Janse 2019
67 Ransley 2005
68 Studies have shown that women and men might show different degree of interest depending on the type of MUCH. In France and Northern Ireland, for example, women were more interested in heritage related to biodiversity, small objects, and intangible cultural heritage, while men were more interested in heritage related to maritime activities, boats and buildings (PERICLES 2020; UNESCO 2014).
69 Ferguson 2011
70 ILO 2013
71 Mangwangi 2015
72 WTO 2019

2.4.3 Stakeholder Engagement

Stakeholder engagement aligned with good practice principles[73] underpins the SenMap approach and outcomes. It will inform and guide the identification of E&S attributes (see Section 2.4.2), the collection, analysis, and utility of both spatial and non-spatial data throughout the process, and the approach to sensitivity scoring and mapping (see Section 2.4.4).

In (multi) sectoral planning processes, it is important to maintain regular and continuous dialogue with stakeholders to maintain interest and trust throughout.[74] Key stakeholders identified early on are likely to continue to engage in the process at important points as the sectoral spatial plan progresses. While critical, stakeholder engagement can be a challenging process that should be tailored to suit local norms and cultures.[75] It should incorporate meaningful dialogue and feedback or there is a risk of undermining legitimacy and credibility of, and trust in, the process.[76] Stakeholder engagement should be based on sound science and appropriate consideration of indigenous, local, and traditional knowledge.

In areas where Indigenous Peoples are present, engagement processes should be agreed upon together with their leaders and organizations. In these contexts, there may be additional country-specific procedures and regulations to consider. In coastal and maritime areas within Indigenous Peoples territories (or claimed land and marine resources and

73 Such as IFC Performance Standard 1 (IFC 2012c), the International Association for Public Participation (IAP2) Core Values (IAP2 2017) and Spectrum of Public Participation (IAP2 2018). For examples related to participatory processes in marine spatial planning, see Ehler and Douvere 2009, 47; UNESCO – IOC 2021, 52–53; Quesada-Silva 2019, 7.

74 Ehler and Douvere 2009

75 World Bank Group 2021a

76 A common term for this is 'social licence to operate'. Many of the associated challenges experienced by ocean industries relate to conflicting social and political values (Voyer and van Leeuwen 2019).

spaces), other social attributes and different approaches to understanding sensitivity may be more appropriate and relevant or expressed in terms different from those suggested in this guidance.

There will be inherent stakeholder sensitivities to manage during the SenMap process, and this is especially relevant for social attributes. For example, whereas some biodiversity attributes have a pre-determined threat-based conservation status (e.g., based on global or national Red Listing processes), there is no equivalent for social attributes. This means it will be important to ensure there is a robust and carefully managed process for considering the range of stakeholder inputs to determining the sensitivity of social attributes. The SenMap Lead will need to work closely with stakeholders to maintain relationships, facilitate discussions, and document any controversial issues raised. This may provide insight into potential areas of conflict with respect to stakeholder interests and offshore wind development.

2.4.4 Sensitivity Scoring and Mapping

E&S sensitivity maps will indicate areas of relatively higher versus lower sensitivity and help to guide development towards the most appropriate locations (i.e., areas where impacts are likely to be low). Some types of spatial data are more suitable as indicators of the presence of an attribute than other types of data, thus it will be important to understand which datasets can contribute directly to the preparation of the sensitivity maps (see Section 6). Hence, a robust process for spatial data handling, management, and quality assurance will be essential (see Annex 4).

To produce grid-based sensitivity maps (see Chapter 6), biodiversity attributes will be allocated a sensitivity score based on a variety of factors, including their ecological and behavioral characteristics. Social attributes will be allocated a sensitivity score based on a broad range of considerations, including socioeconomic or other relevant characteristics, the presence of vulnerable communities, and the presence of valued and/or unique social attributes. The sensitivity score for *both* social and biodiversity attributes should consider their conceptual susceptibility to the potential impacts of offshore wind.[77] Maps will be prepared for each attribute using the available spatial data. These will then be used to develop one consolidated map of biodiversity sensitivity, and one consolidated map of social sensitivity[78] (with the individual attribute maps providing the supporting detail to understand specific drivers of sensitivity). These biodiversity and social sensitivity maps should be considered in parallel. They should also be reviewed alongside other relevant sectoral or multisectoral planning information available (e.g., wind resource mapping, geotechnical information, and other information on different kinds of development constraints, (see Box 1 and Section 7.2) to support an integrated early understanding of the range of potential E&S sensitivity and technical potential for development.

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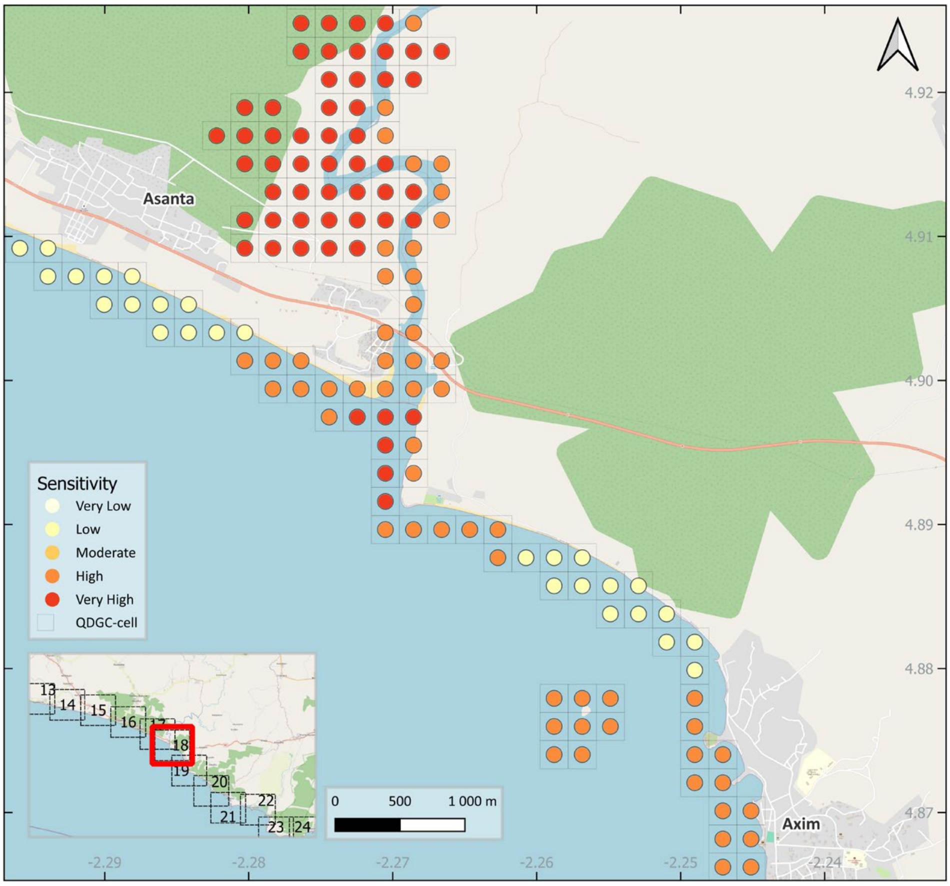
77 It is important to remember that sensitivity scores for E&S attributes cannot at this stage be defined in terms of the likelihood or magnitude of a particular impact from a given individual offshore wind project—that is the role of detailed project-specific ESIA later in the planning process. See Figure 2.

78 Biodiversity and social sensitivity are not directly comparable, thus it is not appropriate to consolidate both into a single map.

SenMap is aligned with existing approaches to sensitivity mapping and is expanded to include social attributes in addition to biodiversity ones. Figure 4 shows an example environmental sensitivity map developed using the Mapping Environmentally Sensitive Assets, or MESA, methodology. Annex 5 includes further information on this tool. The approach to scoring and mapping should be informed by GIIP and proportionate with the early stage of spatial planning and the country context. An appropriate sensitivity scoring scale will most likely be one that is concise and qualitative, representing highest to lowest risk. This guidance offers insights for suitable approaches but does not prescribe a specific technical method for scoring/categorizing sensitivity. This is because several other related guidance documents and sensitivity mapping tools and processes already exist (see examples in Annex 5), and approaches are expected to continue to develop and emerge. Further, the range of available data, capacity, and technical resources in implementing countries is likely to be variable, which could influence the appropriate approach.

The following sections (Sections 3, 4, 5, and 6) outline the considerations for and recommended approach to implementing each of the four SenMap steps.

FIGURE 4:
Example Grid-based Environmental Sensitivity Map



SOURCE: ENVIRONMENTAL PROTECTION AGENCY GHANA 2020

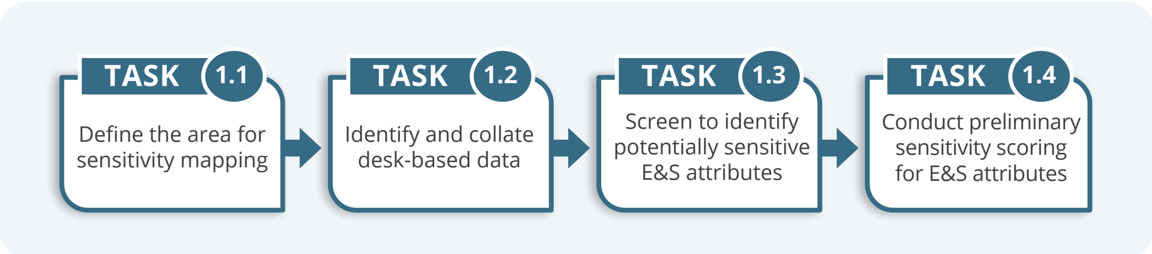
CHAPTER THREE— STEP 1: DESK-BASED REVIEW

3 STEP 1: Desk-based Review

Step 1 is a desk-based data collation and screening exercise intended to identify the most important E&S attributes that could potentially be sensitive to offshore wind development and allocate preliminary sensitivity scores to them. The E&S attributes identified in Step 1 will be the focus of stakeholder engagement in Step 2, primary information gathering or knowledge co-generation in Step 3 (as relevant), and sensitivity mapping in Step 4.

There are four key tasks detailed in the following sections:

FIGURE 5:
Overview of Step 1 and Key Tasks



3.1 Task 1.1: Define the Area for E&S Sensitivity Mapping

SenMap is designed for implementation at the earliest stages of spatial planning (see Section 2.1). Therefore, for both biodiversity and social attributes, the first task is to define a single broad E&S sensitivity mapping area (termed the SenMap area) to help guide biodiversity and social data gathering (and sensitivity mapping) over an area aligned with a country's jurisdiction for offshore wind development. This area should be spatially defined in a central geodatabase (see Annex 4). It is recommended that it comprises the following:

- The maritime area under national jurisdiction (Figure 6); and
- The coastal zone, if this area has been defined in any national coastal law or policy (e.g., for integrated coastal zone management). If there is no formal definition for what constitutes the coastal zone, it is recommended that the sensitivity mapping area includes: (i) the maritime area under national jurisdiction; plus (ii) a terrestrial buffer to ensure that land-sea interactions (see below) are broadly captured in sensitivity maps.[79]

79 A nominal buffer could be measured from the coastline or from the low-water line. The approach to determining an appropriate terrestrial buffer should be balanced and pragmatic to avoid the inclusion of large terrestrial areas unrelated to the offshore wind sectoral spatial plan, considering for example information on the potential location of onshore infrastructure (if available), and the location of coastal communities.

An indicative SenMap area is illustrated in Figure 7. It is important to note that while the SenMap area may be large, comprehensive detailed survey coverage of this entire area is not necessary.[80] Rather, desk-based data collection (Step 1) and stakeholder engagement will identify priority *high-level* data gaps (Step 2) that will drive primary data collection and knowledge co-generation requirements across the area (Step 3).

There are two main (interconnected) reasons for including both maritime and coastal areas in the sensitivity mapping area:

- **Flexibility:** The SenMap approach is designed with the flexibility to be implemented at the earliest stages of offshore wind development planning, even before a wind resource assessment has been completed. This means that, hypothetically, development of offshore wind and associated infrastructure could take place anywhere where there is national jurisdiction to do so. That said, it is recognized that where potential offshore wind leasing or development areas have already been identified or where relevant technical information is available (e.g., wind resource assessment maps), the SenMap area could be refined to focus on these areas, guided by qualified E&S specialists. See also Box 1 on constraints mapping.
- **Capturing land-sea interactions:** An offshore wind development is not entirely marine. It includes infrastructure sited in the marine, intertidal and coastal, and terrestrial zones: turbines, foundations, and array cables offshore; the export cable landfall at the coast; and grid connection infrastructure onshore. It involves introducing infrastructure throughout the water column from the seabed (benthic zone), through the water column (pelagic zone), and extending above the sea surface. It may also involve the development of new or existing ports and harbors to facilitate construction and operational logistics. Moreover, it is often the case that many sensitive E&S attributes are concentrated in coastal and intertidal areas. To promote the sustainable use of the maritime and coastal space, early planning should consider these land-sea interactions,[81] and each of these zones (marine, intertidal and coastal, and terrestrial) should be considered in sensitivity mapping.[82] Where there is information available on potential port locations or sites for bringing power ashore, this can also inform the mapping area.

Available E&S spatial data may span the boundary of the mapping area (e.g., contiguous areas of seagrass habitat along the coast of neighboring countries, wide species ranges offshore, or shared fisheries). It is important to ensure that E&S data centralized in the SenMap geodatabase (see Annex 4) are maintained at their respective spatial scales and are not artificially clipped or limited based on the boundary of the sensitivity mapping area itself. This will provide early insight into potential for transboundary E&S issues for consideration in broader scale planning (e.g., regional), or later in more detailed and quantified assessments (e.g., SESA, MSP, or site-specific work).

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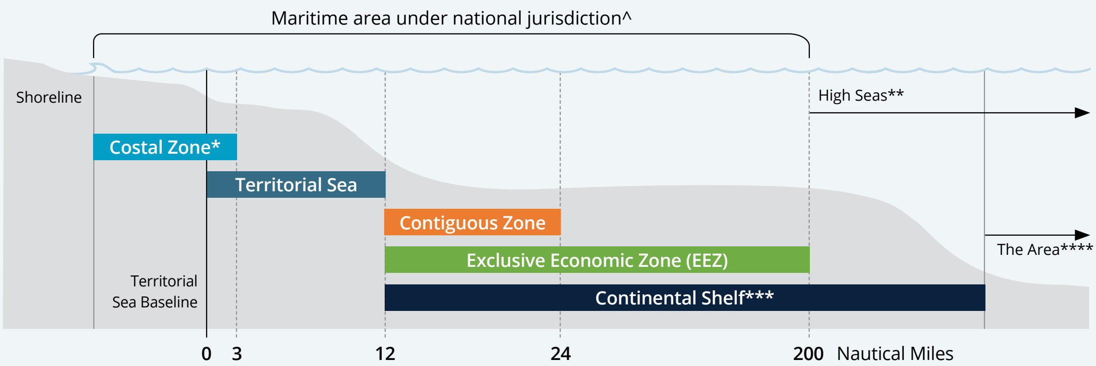
80 In Step 3 of the SenMap approach, effort should be aligned with the objective for early stage spatial planning, and designed specifically to address priority data gaps.
81 For example, this is a requirement of the European Union Directive 2014/89/EU on establishing a framework for MSP.
82 Including in cases where the SenMap area has been refined to focus on areas where technical conditions are favorable for offshore wind.

In the case of geographically large countries, countries with variable, complex, or more than one coastline, or countries where the wind resource is found in distinct areas, it may be appropriate to identify more than one SenMap area, or to subdivide the SenMap area. This might be especially relevant for social attributes, for example where coastal communities, community composition, and the assets and activities associated with them (see Section 2.4.2) could be quite different. Subdivisions of the mapping area may then require a separate sensitivity scoring process for E&S attributes in each subdivision.

FIGURE 6:
The Maritime Area under National Jurisdiction



^ Includes all the marine areas delimited in the United Nations Convention on the Law of the Sea (UNCLOS) out to 200 nautical miles. See UNCLOS 1982 for more information.

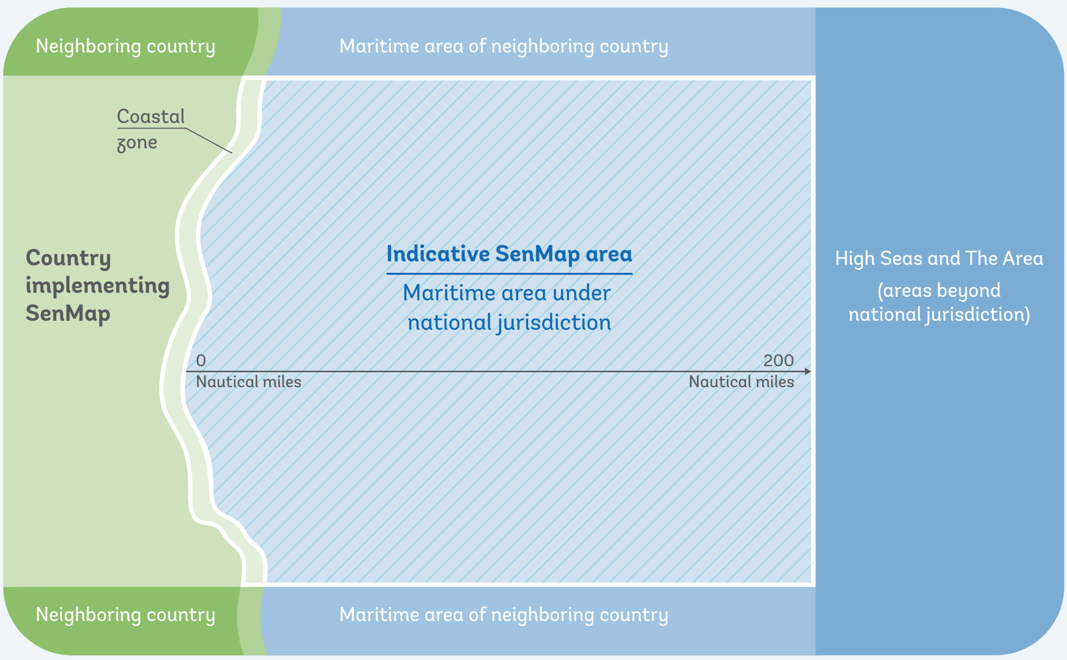
* The Coastal Zone is defined according to applicable national coastal law or policy or could be defined by applying an appropriate buffer measured from the low-water mark.

** Where the Continental Shelf extends beyond 200nm, submission is required to UNCLOS to confirm rights in that portion.

*** All parts of the sea that are not included in an EEZ, territorial sea, or internal or archipelagic waters of a state.

**** The seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction.

FIGURE 7:
Illustrated Example of the SenMap Area



3.2 Task 1.2: Identify and Collate Desk-based Data

Task 1.2 involves the identification and collation of existing publicly available[83] spatial and non-spatial data for biodiversity and social attributes relevant to the SenMap area. These data will be screened and reviewed in Task 1.3 to determine an initial list of attributes likely to be most sensitive to the potential impacts of offshore wind (see Section 3.3). The data will also be the basis of preliminary sensitivity scoring in Task 1.4 (see Section 3.4) and will be shared with and reviewed by key stakeholders in Step 2.

Spatial data on biodiversity and social attributes is fundamental to the SenMap process and the sensitivity maps to be developed in Step 4 (and essential for a basic MSP[84]). Non-spatial data can be used to help characterize the E&S attributes and the potential impacts posed by offshore wind development, and to inform sensitivity scoring of E&S attributes (see Task 1.4).

It is recommended that the SenMap Lead consider a variety of potential sources of spatial and non-spatial data for E&S attributes, including:

- Online databases.
- Publicly available literature (e.g., scientific and peer reviewed publications, academic sources, NGOs, civil society organizations (CSOs), and grey literature).
- Regulatory and policy documents.
- Citizen science.[85]
- Direct engagement (e.g., with subject matter experts).

Confidence and credibility across all these different sources will be variable, hence validated and quality-controlled datasets should be prioritized.[86] Stakeholders will have a key role in validating the utility, confidence, and credibility of E&S data (see Section 4). The SenMap Lead will be responsible for ensuring that the collated data are properly acknowledged and cited, as well as for aligning with any access requirements and copyright restrictions.

Spatial data for both biodiversity and social attributes should be collated in a central geodatabase see (Annex 4). Non-spatial data should be tracked and consolidated in a format suitable to facilitate stakeholder review and validation in Step 2.[87] It is important to emphasize that the format used to organize the non-spatial data should be structured and rigorous. The SenMap Lead may also be able to identify information in non-spatial

83 That is, data or information that is accessible to anyone in the general public, potentially with subscription or pay-to-use requirements and other caveats, such as appropriate citation, or conditions related to commercial use.

84 The MSP Toolkit (2022c) includes guidance on Blue Economy Data and Tools and a checklist of potential data needs.

85 Where volunteers participate in science and research.

86 In general, if the confidence, limitations, and uncertainties are understood and appropriately acknowledged, all these types of information potentially have value for sensitivity scoring and mapping. It is also important to understand the restrictions on data access and use, which can vary from the requirement to cite the data source appropriately, to subscription-based models for commercial use of the data. If there is doubt, clarification should be sought from the data owner/originator.

87 Such as short literature reviews consolidating key evidence or summary factsheets or profiles for social attributes. If there is more than one SenMap area, or the SenMap area has been sub-divided, it may be necessary to consolidate information review separately for each area or subdivision.

sources that can be digitized (i.e., translated into spatial format) and incorporated into the geodatabase.[88]

The following sections address specific considerations for biodiversity and social data, respectively.

3.2.1 Biodiversity

The available spatial biodiversity data are likely to reflect different parts of the SenMap area (e.g., marine, intertidal, coastal, and terrestrial zones—see Task 1.1), with different degrees of coverage and at different spatial scales, from global and regional, to national and local level.[89] It is recommended that the SenMap Lead collate relevant data from the following sources and include it in the geodatabase (see Section 2.4.4 and Annex 4):

- **Global and regional datasets:** There are a range of existing credible and widely used spatial datasets that have either global or regional coverage, for example indicating biogeographic regions, ecosystem and habitat type and extent, location of key habitat features, modelled indicative habitat suitability, species range maps, verified point records of species occurrence, or the boundaries of globally important LPAs and IRAs. See Annex 6.1 for a summary.
- **Country-level and local datasets**: The resolution and accuracy of global and regional biodiversity datasets can potentially be refined using more localized and country-specific data, where available. For example, country-specific species atlases and habitat mapping can be used to refine broad global species distributions from the International Union for Conservation of Nature (IUCN) Red List of Threatened Species,[90] or country-level information may include protected areas not listed in the World Database of Protected Areas (WDPA).[91]

Non-spatial biodiversity information could also be important for informing sensitivity scoring (see Task 1.4), particularly in data-poor environments, for example by helping to estimate or infer biodiversity occurrence and distribution. It is recommended that the SenMap Lead consider any relevant non-spatial information that helps:

- To identify links between species and habitats.
- To understand broadly where species or habitats occur in the SenMap area, and when (e.g., pinniped breeding haul-out sites).
- As a proxy for a biodiversity attribute, for example using seabird foraging range data,[92] or ranges from known colonies in other countries, as proxies for species identified in the implementing country.

88 For example, point locations of recorded and verified species occurrence.
89 Note that in general, spatial datasets are biased towards the location of sampling effort. Hence, absence of data does not necessarily indicate that a particular biodiversity value is not present in an area, or that suitable habitat does not exist there. Again, engagement with key stakeholders will be essential to discuss and establish the likelihood of presence/absence of specific biodiversity values.
90 IUCN 2024
91 For example, if the national definition of LPA/IRA differs from the IUCN and the CBD definition (UNEP-WCMC 2019) followed by WDPA, or because national classification systems are different.
92 For example, see Woodward et al. 2019.

In addition to spatial and non-spatial data, there may be other types of (non-biodiversity) information (e.g., related to physical processes in the ocean) that could be useful for understanding biodiversity in the SenMap area and informing subsequent steps. Annex 6.2 gives a brief overview.

3.2.2 Social

There are currently few comprehensive or up-to-date spatial datasets for social attributes that have global or regional coverage. Compared to biodiversity attributes, it is expected that spatial social data will be relatively scarce, and that most of what is available will be at national and subnational levels.[93] Thus, non-spatial sources of information (e.g., in research reports and other existing literature) on social attributes may be more readily accessible and useful for informing the sensitivity scoring of the social attributes (see Task 1.4).

Relevant non-spatial information could come from a variety of sources. It is recommended that the SenMap Lead seek information that helps to characterize the risks potentially posed by offshore wind development, as well as to understand the underlying vulnerability of social attributes and the outcomes for potentially affected groups and communities. This could include data from the following type of sources (which may include a mixture of both spatial and non-spatial information):

- **Global and regional datasets:** Available datasets at these levels include databases indicating potential risks and threats to people living and working in the coastal and marine space (e.g., natural disasters and hazard viewers). Datasets also include information relating to assets and activities in the marine and coastal space that are important for these people (e.g., fishing activity and traffic, fisheries statistics, databases of historically or culturally important heritage sites, or maps of important tourism sites). Annex 6.3 summarizes potentially useful global and/or regional data sources.
- **Country-level and local datasets:** While it is difficult to generalize the wide variety of country-level and/or local data that might be available (spatial or non-spatial), useful information could include national census information, existing indices of social vulnerability, fisheries and aquaculture certification schemes, national studies of coastal economic activity (e.g., fisheries), and national and local tourism plans or assessments. See Annex 6.3 for additional information.

Box 4 outlines example types of non-spatial data that could be relevant for social attributes and thus inform preliminary sensitivity scoring in Task 1.4.

93 In terms of sub-national spatial data availability, there are open data initiatives that are expanding to include an increasing number of countries with coverage at the regional and provincial level including the SDG Data Alliance: https://www.sdg.org/pages/about-us. This builds on an earlier UNs' initiative, the Open SDG DataHub. https://unstats-undesa.opendata.arcgis.com/. The 2021 iteration of the World Bank's Global Subnational Atlas of Poverty has expanded to include sub-regions (corresponding to provinces or states) across 166 countries. This dataset is part of a wealth of spatial data available with relevance for the social attributes accessible from: https://maps.worldbank.org/datasets

Step 1 is intended to identify the most important E&S attributes that could potentially be sensitive to offshore wind development.

Box 4 Identifying Non-spatial Data for the Social Attributes

In broad terms, the types of data that may be useful include that which helps to:

- Identify the presence of social attributes in the SenMap area.
- Identify the links between coastal communities and other social attributes in the SenMap area (e.g., community involvement in or dependence on a fishery or marine resource for food security, a tourist attraction, or a place of historical or cultural importance).
- Understand the (broad) scale and/or intensity of an activity.[94]
- Understand the relative socioeconomic importance of an attribute or activity (e.g., for individual communities and/or at the country level or across the entire sensitivity mapping area, as relevant).
- Understand the existing social circumstances and social vulnerabilities[95] which may influence sensitivity to offshore wind development.

By social attribute, the types of data that may be useful includes:

- **Coastal communities:** Main economic activities; indicators of social development including poverty, inequality, and health education; conflicts such as those involving water or land use or rights; natural disasters; climate change vulnerability; and security context.
- **Indigenous peoples:** Name of Indigenous Peoples and level of recognition and implementation of their rights, including access rights; main livelihood activities; current or recent events of conflict; and natural disasters involving Indigenous Peoples.
- **Fisheries and aquaculture:** Key species and main fishing or harvesting methods; production volume and value; density of fisheries; fishing effort; employment generation and relevance for national economy (percent of gross domestic product (GDP)); amount of people or percent of workforce involved; percent of women in the workforce; key ecosystems; and degree to which these ecosystems are threatened and species related to this ecosystem service.
- **Processing:** Key species; main destinations; international certifications; production volume and value; employment generation and relevance for national economy (percent of GDP); amount of people or percent of workforce involved; and percent of women in workforce.
- **Tangible and intangible MUCH:** Key cultural or historical information; traditions considered meaningful for SenMap area inhabitants; key ecosystems and species related to this ecosystem service (if any); key features of coastal culture and life; conflict; recognition or appreciation of the value's significance or uniqueness; degree of legal protection; and legal restrictions for use.
- **Recreation and tourism—water sports, natural tourist attractions, and recreation and tourism infrastructure:** Volume of business and jobs generated; key ecosystems and species related to this ecosystem service; volume and profile of visitors; seasonality of tourism; relevance for national economy (percent of GDP); and percent of women in workforce.

94 The detailed quantification of scale/intensity or economic importance is not necessary for the purposes of characterizing social attributes to support sensitivity mapping.

95 For example, existing or recent conflicts of any kind (military or civil).

3.3 Task 1.3: Screen to Identify Potentially Sensitive Attributes

Task 1.3 involves identifying the biodiversity and social attributes that are potentially most sensitive and susceptible to the impacts of offshore wind development.[96] This comes from a preliminary screening and review of the attributes identified through data collated in Task 1.2. With this screening complete, the SenMap process can proceed with the best possible awareness of which attributes are priorities for sensitivity scoring and mapping (and to address key data gaps through primary information gathering and knowledge co-generation, as necessary).

Task 1.3 is not intended to be an exhaustive or quantitative review of each individual attribute captured in the existing data—rather, it is designed to filter out those that are likely to be the most sensitive or susceptible attributes based on factors including socioeconomic characteristics, the presence of vulnerable communities, the presence of valued and/or unique attributes, conservation status, and ecological, behavioral characteristics.[97] It is an *initial* screening, to guide preliminary sensitivity scoring in Task 1.4, which will be validated with stakeholders in Step 2—at which point it is anticipated that the outcomes may be amended based on stakeholder inputs and feedback (e.g., via additional spatial and non-spatial data provided by stakeholders or based on stakeholder experience or expertise).

The SenMap Lead should be aware that following screening, the list of attributes considered potentially sensitive and susceptible to offshore wind impacts could still be comparatively long. Moreover, the outcome of Task 1.3 does not guarantee that sensitivity scoring and mapping will be possible for each individual attribute identified through screening and review. The availability of suitable knowledge and spatial data will determine which attributes (or groups of attributes) can be scored and represented in a sensitivity map (see Section 6). Preliminary sensitivity scores will be allocated in Task 1.4 depending on the available information. Key data gaps will be identified and addressed through Step 2 and Step 3, and the utility of the available spatial data for sensitivity mapping will be determined in Step 4.

The following sections address screening and review of biodiversity and social attributes respectively.

96 And understand whether they relate to the marine, intertidal/coastal, and/or terrestrial zones, as discussed in defining the SenMap area in Task 1.1.

97 Existing tools are available (e.g., the Integrated Biodiversity Assessment Tool, IBAT) that could support the initial screening by enabling the interrogation of several key biodiversity datasets with global coverage at the same time. See Annex 6.1.

3.3.1 Biodiversity

The existing biodiversity data collated in Task 1.2 could indicate a relatively long list of individual biodiversity attributes present or potentially present in the SenMap area.[98] Hence, it is recommended that the SenMap Lead carry out carry out the preliminary screening using the qualitative criteria outlined in Box 5. This should be recorded systematically, retaining the initial list of attributes, and indicating (where relevant) which criteria are considered applicable for each one. The SenMap Lead could also refine the screening to flag any attributes considered unlikely to be present in the SenMap area, pending stakeholder engagement (e.g., species considered unlikely to be present based on availability of suitable habitat, or attributes erroneously identified in the available data).

The criteria in Box 5 are based on GIIP[99] and are therefore aligned with international lender requirements and expectations for screening potential biodiversity risk. They are designed to identify attributes potentially most sensitive to offshore wind development and to enable grouping of similar attributes. Criteria are not intended as a means of ranking individual attributes relative to one another—they are independent of each other, and biodiversity attributes may align with more than one criterion.

Using these criteria will be an iterative process, to be revisited and refined at key points highlighted through this guidance. The biodiversity attributes known or considered likely to be sensitive to offshore wind development may change throughout the spatial planning process. Hence, regular review (and update, as required) of the screening process is important because it could be influenced by, for example:

- Changes in conservation threat status (global and/or national) of a given species.
- New information enabling review of attributes included on a precautionary basis.
- New protected areas that have been established in, or overlapping with, the SenMap area.
- Inputs, advice, and additional data sources from credible specialist stakeholders not involved in the current iteration of the sensitivity mapping.
- Field data collection (both as part of implementing sensitivity mapping (see Section 5) and other relevant data collected in the SenMap area by other organizations).
- Evidence or research emerging from offshore wind developments elsewhere (e.g., evidence of impacts from monitoring of operational wind farms).

98 For example, screening the SenMap area against the comprehensive IUCN Red List of Threatened Species (see Annex 4.1) could indicate a large number of species with range overlapping mapping area.

99 Criteria are in part based on IFC Performance Standard 6, a benchmark standard that includes the concept of critical habitat. Critical habitats are areas of high biodiversity value identified via a specified set of criteria and associated quantitative thresholds, for an ecologically appropriate areas of analysis defined for each biodiversity feature. Although it takes a landscape/seascape approach, Critical Habitat Assessment (CHA) is a project-level process, and it is not the intention of the SenMap approach to conduct this type of detailed assessment. Where required, developers seeking international financing will be required to conduct CHA along with an internationally aligned ESIA (see Figure 2). The Box 5 criteria are also in line with a range of other definitions of priorities for biodiversity conservation in use by the conservation community and incorporated in related governmental legislation and regulations (such as the Convention on Biological Diversity scientific criteria for identifying areas of significant ecologically or biologically significant marine areas (EBSAs), IUCN Red List of Threatened Species; KBAs; Important Marine Mammal Areas (IMMAs); and the Convention on Wetlands of International Importance (the Ramsar Convention).

Box 5 Recommended Criteria for Screening Biodiversity Attributes

Qualitative screening criteria to identify biodiversity attributes that are potentially most sensitive to offshore wind development are as follows:

Critically Endangered (CR) and Endangered (EN) species	These species already face an extremely high or high risk of extinction in the wild, making them very sensitive to any additional pressures. Both global conservation status (according to the IUCN Red List[100]) and national status (if available) should be considered.
Endemic and restricted range species	These species have a limited range and therefore could be disproportionately affected by poorly sited offshore wind development. Ranges that define what is considered restricted range can be found in IFC Guidance Note 6.[101]
Migratory or congregatory species	Migratory species are those where a significant proportion of the population cyclically and predictably moves from one geographic area to another. Congregatory species gather in large groups on a cyclical or regular or predictable basis. Hence, specific locations, routes, and patterns of movement are highly important, meaning developments sited in such locations could disproportionately affect these species.
Species with other traits indicating potential sensitivity to offshore wind	Some potentially sensitive attributes may not be immediately identifiable through existing spatial data alone. They are more likely to be identified through literature and evidence from established offshore wind markets, and consultation with key stakeholders in Step 2, based on: **Behavior and morphology.** For example: in addition to species that migrate or congregate, birds that typically fly at turbine rotor height are potentially susceptible to collision, while risk-averse and wary species could be more vulnerable to displacement impacts. Large, slow-flying birds with high wing loading or those with limited visual field are potentially more susceptible to collision with and electrocution on shore-based powerlines. Marine mammals and fish could be impacted by underwater noise from offshore wind farm construction.

100 IUCN 2024
101 IFC 2019

	Life history traits. For example: some species are more susceptible to population-level impacts because of their slow reproductive rate and high level of adult survival, which are typical traits of many seabirds and marine mammals. **Habitat-species associations.** For example: where the occurrence and distribution of a species is closely associated with (or entirely dependent upon) a particular habitat type, development risks affecting both species and habitat—such as coastal habitats like seagrass beds, mangroves, coral reefs that provide refuge or nursery habitat for groups such as fish or sirenians (manatees and dugongs), or offshore habitats that are important for large predatory fish, seabirds, or cetaceans. Potential sensitivity increases where habitats are already fragile and/or patchy, or the species and/or habitat type already threatened. **Habitat fragility and patchiness.** These factors generally increase sensitivity because (like highly threatened species) impacts could lead to the disappearance of what is already limited habitat. For example, patches of coral or coastal seagrass disturbed by offshore wind export cable installation.
Highly threatened and/or unique ecosystems	These are in danger of disappearing and/or they are very rare and do not occur widely. This includes: • Areas classified as CR or EN on the IUCN Red List of Ecosystems.[102] • Areas that are otherwise high priorities for conservation in systematic assessments prepared by government bodies, academic institutions, or other relevant qualified organizations (e.g., NGOs). • Ecosystems with limited extent or distribution and/or not known to occur elsewhere outside the sensitivity mapping area.

102 IUCN-CEM 2022

Discrete natural habitats	Natural habitats are defined as areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.[103] In practice, habitats exist on a continuum that ranges from largely untouched and pristine natural habitat, to intensively managed modified habitat.[104] It is likely that a large proportion of an area the size of the SenMap area would be defined as natural habitat (e.g., large expanses of offshore benthic and pelagic habitats). Hence, the key for sensitivity mapping is to identify discrete mapped areas of natural habitat where sensitivity is demonstrably higher, such as (but not limited to) seagrass habitats, mangroves, reefs (coral and other types), and beaches important for breeding turtles.
Species and habitats of cultural, traditional, symbolic, and/or socioeconomic importance	These attributes are important for reasons other than (or in addition to) biodiversity conservation or threat status—such as for their ecosystem services importance. This includes attributes that have sacred value (i.e., cultural or symbolic), have recreational or aesthetic value (i.e., natural tourist attractions), or are economically valuable (e.g., fishery target species or areas of habitat or ecosystems on which local communities depend, but which may not be formally defined or protected). Such biodiversity attributes may not be identified using desk-based data alone and might be identified separately through a review of social data and attributes (see Section 3.3.2). Cross-consultation between biodiversity and social stakeholders will be important to prevent duplication in screening and sensitivity scoring, and to ensure all the relevant attributes are captured.
LPAs, IRAs, and other areas designated for biodiversity and conservation purposes	These are likely subject to different degrees of legal protection and different rules governing access and permissible use. Their management and conservation objectives may be incompatible with offshore wind development, which may need to be restricted to align with those objectives. Screening should include candidate and proposed LPAs and IRAs as far as possible.

103 IFC 2012b
104 IFC 2019

3.3.2 Social

In comparison to the biodiversity attributes, it is more difficult to define a set of criteria for identifying those social attributes that could be relatively more sensitive to offshore wind development. This is partly because social attributes do not have pre-determined threat-based conservation status (e.g., through global and national red lists) in the same way as some biodiversity attributes do. Hence, the importance of robust and transparent stakeholder engagement (see Section 2.4.3 and Step 2).

In Task 1.3, it is recommended that the SenMap Lead review the information collated in Task 1.2 in readiness for stakeholder discussions in Step 2, to confirm which social attributes it relates to, consolidate information for specific attributes, and make a preliminary evaluation of data quality and confidence. It is suggested that the outcome of this review could be recorded in the reference or literature database (or equivalent resource) established in Task 1.2 (see Section 3.2.2). Note that Step 2 includes further preparatory activities to develop the materials necessary to support effective stakeholder engagement and meaningful discussions on attribute sensitivity—hence, there may be some overlap between this review and the recommended activities in Step 2, Task 2.2.

The SenMap Lead should be aware that while the list of social attributes identified at this stage could be relatively long (as it is for biodiversity), it is the availability of suitable spatial data that will determine which attributes (or groups of attributes) can be represented in a sensitivity map. Therefore, for social attributes where existing spatial data are generally expected to be relatively scarce, stakeholder engagement and knowledge co-generation will be fundamental.

3.4 Task 1.4: Conduct Preliminary E&S Sensitivity Scoring

In Task 1.4, the SenMap Lead is responsible for defining and documenting a preliminary approach to sensitivity scoring for biodiversity and social attributes respectively, and for allocating preliminary sensitivity scores to identified attributes. This is intended to provide a basis for stakeholder engagement in Step 2—both the approach to and the outcomes of Task 1.4 will be subject to stakeholder review and feedback to validate the existing data, the approach to sensitivity scoring, and the preliminary scores. If there is more than one SenMap area (see Section 3.1), sensitivity scores should be allocated separately for each one.

The objective of scoring sensitivity is to determine how sensitive the overall attribute type could be in general with respect to offshore wind impacts[105] (e.g., considering the potential implications of locating offshore wind in areas important for biodiversity and social attributes). Allocating sensitivity scores to attributes will be done considering all the available information, both spatial and non-spatial. However, representing these scores in a sensitivity map depends entirely on the available *spatial* data, which therefore could influence the chosen approach to sensitivity scoring.[106] Considerations for spatial data and sensitivity maps are discussed in Step 4. Note that the number of attributes for which data are available for scoring and mapping could be increased through stakeholder engagement in Step 2 and through primary data gathering and knowledge co-generation in Step 3.

It is recommended that the SenMap Lead define a five-point color-coded scale for sensitivity scoring and mapping of both biodiversity and social attributes. Table 1 provides an example scale, which is indicative only—proposed categories should be discussed with stakeholders during engagement in Step 2 (see Section 4.3). Each point on the scale will need to be defined in terms of the implications for offshore wind spatial planning. Exclusion areas that are recognized by governments and/or international finance institutions (IFIs), which may vary, should also be accounted for in the sensitivity scoring. These may include World Heritage Sites or Alliance for Zero Extinction Sites.[107] It is essential that the rationale for preliminary scores is documented for each attribute or group of attributes,[108] to enable review with stakeholders in Step 2 and to facilitate subsequent iterations of the SenMap approach.

105 For example, see IPIECA-IOGP 2012.
106 Noting that spatial data coverage for both biodiversity and social attributes is likely to be variable and incomplete for the SenMap area.
107 See Annex 3.1 (IRA and other designated areas of biodiversity importance) and Annex 3.2 (cultural heritage).
108 Including any cases where there is insufficient information to allocate a sensitivity score.

Considerations for sensitivity scoring of biodiversity and social attributes respectively are outlined in the following sections.

TABLE 1:
Example Five-point Scale for Scoring or Categorizing Sensitivity of Attributes

SCORE	CATEGORY	EXAMPLE IMPLICATIONS OF SENSITIVITY MAPPING FOR OFFSHORE WIND SPATIAL PLANNING
5	**Highest sensitivity**	Based on the available evidence, **development in these areas will likely need to be avoided.** These areas are of the highest importance.[109] The impacts of development on the biodiversity and social attributes are likely to be irreversible and mitigation, if possible, is likely to be extremely limited and challenging. Further detailed studies and in-depth consultation are essential at the regional and/or project level.[110]
4	**High sensitivity**	Based on the available evidence, **restrictions on development are highly likely to be required**. Mitigation of development impacts line with the mitigation hierarchy[111] may be challenging and uncertain. To inform decisions on the development potential of these areas before projects are sited, further detailed investigations and stakeholder consultation are required to better understand the specific attributes and the type of offshore wind impact(s) to which they could potentially be susceptible.
3	**Moderate sensitivity**	Based on the available evidence, **development may be possible, with restrictions in line with the mitigation hierarchy**. To determine what kind of restrictions may be appropriate (e.g., timing of construction activity, or specific construction protocols), further detailed investigations and stakeholder consultation are required at the project level.
2	**Low or Negligible sensitivity**	Based on the available evidence, **development in these areas is likely to be acceptable**, in line with the mitigation hierarchy and subject to detailed project-level investigations and stakeholder consultation to confirm low sensitivity.
1	**Unknown[112]**	**Further information is required to understand development potential**. Development should be considered following further work (e.g., additional data collection or knowledge co-generation activities and stakeholder consultation) to understand the characteristics of these areas and confirm the level of sensitivity.

109 For the biodiversity scoring, this may include sites with high biodiversity values and high levels of protection. For the social scoring, these may be areas that are inhabited by coastal communities with the highest socioeconomic vulnerability, and/or areas of the highest socioeconomic importance.

110 Recommendations for project-level studies are outside the scope of the SenMap approach. Other potential studies/consultation could potentially be done as part of subsequent iterations of the SenMap approach, or addressed outside the scope of SenMap.

111 See Section 2.3 Key Principles.

112 Note that this category represents an indicative option for capturing attributes for which sensitivity is not yet understood. An important aim of stakeholder engagement in Step 2 is to identify any key data gaps that could be addressed with additional existing spatial data (e.g., provided by stakeholders), or via primary data collection and knowledge co-generation in Step 3. In practice, scenarios in which it is not possible to draw evidence based and stakeholder-informed conclusions on the conceptual sensitivity of an attribute are unlikely. However, whether sensitivity can be represented on the grid-based map depends on the availability of relevant spatial data.

3.4.1 Biodiversity

The screening criteria in Box 5 are a good starting point for allocating preliminary sensitivity scores, supported by the summary information on susceptibility in Annex 3.1. In general, factors that enhance the sensitivity of the species and habitat attributes fall into these categories: (i) species characteristics (e.g., morphology, behavior, and migratory behavior); (ii) habitat characteristics (e.g., fragility and species associations and dependence); (iii) population dynamics (e.g., life history traits); and (iv) conservation status (e.g., on global, regional, or national red lists). For example, discrete areas of mapped natural habitat (e.g., corals) are likely to be allocated high sensitivity scores because of their role in protecting and stabilizing coastlines and providing nursery or refuge habitat for species, which have clear implications for offshore wind spatial planning. It may be useful to group attributes with similar behavioral traits and characteristics (e.g., seabirds) and allocate a sensitivity score on that basis. It is anticipated that for some attributes, sensitivity scores can be allocated based on proxy information, such as from closely related species. For example, foraging range approaches can be used to identify likely core foraging ranges for seabirds from coastal colony locations, and then to determine broad offshore areas over which foraging birds could be sensitive to development. To do this, it could be necessary to apply foraging ranges documented for similar species elsewhere. However, note that even between taxonomically close species, behaviors and responses can vary significantly.

LPAs, IRAs, and other designated areas are subject to different degrees of legal protection (and even sometimes without legal protection like in Key Biodiversity Areas (KBAs) and Important Marine Mammal Areas (IMMAs), as well as different rules and regulations governing access and permissible use. Nonetheless, a simple approach to sensitivity scoring, at least on a preliminary basis, could be to assume the highest level of sensitivity for them all, based on a broad assumption that offshore wind development would be incompatible with the protected area management objectives. This is true for some sites, such as those with high biodiversity value and a high level of protection (e.g., IUCN Protected Area Categories Ia, IIb, and III) which should undoubtedly receive the highest sensitivity score. The potential for development in other area types (e.g., KBAs, Ecologically and Biologically Sensitive Areas (EBSAs), and IMMAs) is likely to be case-specific, not least because they can be relatively large areas.[113] Other more refined approaches to sensitivity scoring might be able to consider, the biodiversity attributes for which an area has been designated, the existence and level of legal protection, and the potential for alignment of offshore wind development with the protected area management objectives. Wherever possible, sensitivity scoring based on protected area type and level of protection should involve consultation with key stakeholders, relevant protected area authorities, sponsors and managers, and local communities.

113 Development in some protected areas may need to be subject to restrictions depending on: the type and nature of the area (including its biodiversity attributes); the level of legal protection and conservation objectives of the area (e.g., IUCN category VI permits sustainable use of natural resources compatible with nature conservation); consultation with a range of key stakeholders; and national interest—e.g., considering the importance of offshore wind development in meeting the objectives of the Paris Agreement, or other targets related to offshore energy and/or marine protected areas.

3.4.2 Social

In allocating preliminary sensitivity scores to social attributes, it is recommended that the SenMap Lead consider the evidence for their susceptibility or vulnerability to offshore wind development and the potential consequences of co-locating offshore wind infrastructure in areas important for the social attributes. For certain attributes, such as those that are an ecosystem service (e.g., fisheries, nature-based tourism, coastal recreation), it may also be relevant to consider the extent of dependency of the affected communities on the attribute and its irreplaceability. As noted earlier, the paucity of such evidence (compared to biodiversity attributes), as well as of spatial data, is a challenge. Hence, the role of stakeholders in determining sensitivity and co-generating knowledge must be again emphasized (see Step 2 and Step 3).

The highest sensitivity social attributes are likely to be those that are already vulnerable, with little capacity or means to absorb change, while the least sensitive attributes could be those that are not considered vulnerable and have adequate capacity or means to absorb changes.[114] The factors that influence sensitivity scoring could include the presence of:

- Indigenous Peoples or vulnerable coastal communities.
- Fisheries that are important for food security or represent a significant proportion of household consumption for coastal communities.
- Valued and unique attributes, including maritime and underwater cultural heritage, marine and/or coastal tourism, and recreation sites.
- Underlying pressures, associated with current or recent crises, such as conflicts, natural disasters, climate change or security context, on communities who are highly reliant on natural resource-based livelihoods. Such pressures may compound their susceptibility to the consequences of offshore wind development.

114 Vulnerability could be risk of impoverishment—e.g., landlessness, unemployment, homelessness, marginalization, food insecurity, loss of access to common property, or social disarticulation. See Rowan 2012.

- Social attributes that are a significant source of household income or employment (e.g., as a percentage of total employment).
- Social attributes that employ high percentages of women, youth, and other disadvantaged or vulnerable groups and/or are a significant source of income for them.

3.5 Summary of Step 1 Outputs

Table 2 summarizes the intended outputs of each task in Step 1.

TABLE 2:
Summary of Step 1 Outputs

TASK		OUTPUTS
1.1	**Define the area for E&S sensitivity mapping (the SenMap area)**	• SenMap area spatially defined in a central geodatabase (and sub-divided, if appropriate)
1.2	**Identify and collate desk-based data**	• Digitized spatial data (including spatial data that has been manually digitized, wherever possible) collated in a central geodatabase • Non-spatial data tracked and consolidated in a suitable format to facilitate stakeholder review and validation • Long list of biodiversity attributes present (or potentially present) in the SenMap area based on the existing data, organized systematically • Long list of social attributes present (or potentially present) in the SenMap area based on the existing data, organized systematically
1.3	**Screen to identify potentially sensitive attributes**	• Annotated list of biodiversity attributes screened using recommended criteria in Box 5 • Review of data collated for social attributes, confirming relevant attribute, quality, and confidence, etc.
1.4	**Conduct preliminary E&S sensitivity scoring**	• Defined approach to sensitivity scoring for biodiversity attributes and for social attributes • Preliminary sensitivity scores for biodiversity attributes and for social attributes, with rationale

CHAPTER FOUR—STEP 2: STAKEHOLDER ENGAGEMENT

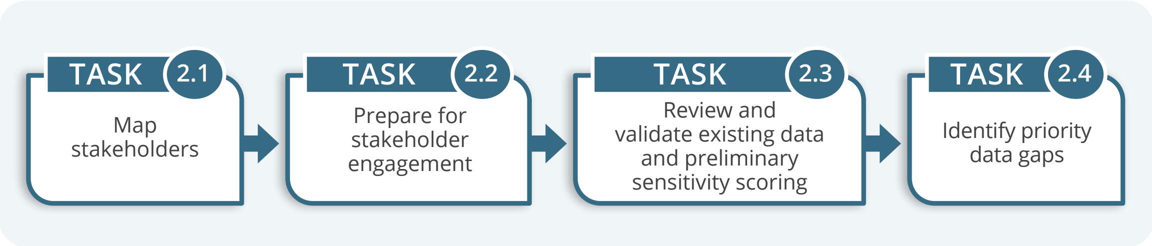
4 Step 2: Stakeholder Engagement

Step 2 is designed to initiate early and open dialogue with biodiversity and social stakeholders, to develop a landscape and/or seascape level understanding of the biodiversity and social context for offshore wind development,[115] to review and validate the information collated in Step 1, and to support planning for Step 3 primary data collection and knowledge co-generation.

There are four key tasks in Step 2, detailed in the following sections:

- Task 2.1: Map stakeholders
- Task 2.2: Prepare for stakeholder engagement
- Task 2.3: Review and validate existing data and preliminary sensitivity scoring
- Task 2.4: Identify priority data gaps

FIGURE 8
Overview of Step 2 and Key Tasks



4.1 Task 2.1: Map Stakeholders

In Task 2.1, it is recommended that the SenMap Lead conduct a stakeholder mapping exercise[116] for both biodiversity and social attributes, respectively. The aim is to identify the individuals and organizations with which it will be most useful to engage. This will likely lead to the identification of two distinct groups of stakeholders—one supporting sensitivity scoring and mapping for biodiversity attributes, and one supporting the social attributes.[117]

There should be representation for each of the broad groups of biodiversity and social attributes. Stakeholder should include both those with demonstrated technical expertise and those with legitimacy among the broader groups of stakeholders for each attribute. Ideally, stakeholders should include individuals and organizations closest to and most

115 As advocated for in IFC 2012b and IFC 2019.
116 For example, see IFC 2007, McKeegan and Torres 2021, and Quesada-Silva et al. 2019.
117 Note that in some cases, there may be the expectation that stakeholders are financially compensated for their participation. This may be related to local norms and other precedents. This guidance does not provide recommendations in this respect.

familiar with the available data relevant to the SenMap area,[118] and include both field and analytical expertise. Both country- and local-level specialists should be sought, with support from international experts where required, particularly with respect to the potential effects of offshore wind.

Considerations for stakeholder mapping are outlined in the following sections.

4.1.1 Biodiversity

Biodiversity stakeholders should be those with demonstrable experience in, and/or connection to, the biodiversity attributes identified in Step 1. Potential candidate organizations and individual stakeholders could include the following:[119]

- **Government:** national government departments, agencies, and statutory authorities with responsibility for environment, biodiversity, and conservation.
- **NGOs** and **CSOs** with a focus on biodiversity and conservation, including international organizations and their country-level affiliates; regional, national, and local conservation organizations (e.g., wildlife conservation organizations, trusts, and societies); grassroots conservation groups; and community organizations and citizen science groups with an interest in biodiversity.
- **Academic institutions and other organizations:** universities, research institutes, and independent researchers.
- **Individual specialists:** identified experts with specific biodiversity expertise and credentials, for example with respect to a particular Endangered or rare species.[120]
- **Indigenous Peoples and traditional land managers,** and groups with special ties to the SenMap area.
- **Other groups**, such as natural resource planners in the SenMap area.

4.1.2 Social

Social stakeholders should be specialists and legitimate representatives of organizations at the local and national levels, with demonstrated experience in, or connection to, the SenMap area and the social attributes identified in Step 1. Table 3 summarizes potential candidate organizations and individuals that may be well-placed to contribute. Where Indigenous Peoples are present, these should be represented through their organizations and/or through specialized and recognized national academic groups or NGOs. Where Indigenous Peoples representatives are engaged, specific engagement protocols may be necessary to support them and ensure meaningful and well-informed participation. In this context, engagement procedures and agreements on data use must be agreed with Indigenous Peoples representatives or designated organizations.[121]

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118 See Step 1 Task 1.1.
119 It will be important to identify 1 or 2 key points of contact from stakeholder organizations, to ensure consistent participation and accountability for inputs from that organization.
120 For example, members of the IUCN Species Survival Commission, or local field specialists.
121 For examples of participatory mapping and engagement protocols involving Indigenous Peoples sites (not coastal), see: https://amazonfrontlines.org/maps/waorani-territory/ and https://www.socioambiental.org/noticias-socioambientais/minha-floresta-minhas-regras

TABLE 3:
Potential Social Stakeholder Types

SOCIAL ATTRIBUTE	POTENTIAL STAKEHOLDERS
Coastal communities	
• Coastal municipalities • Indigenous Peoples	• National, regional, and municipal planning authorities • Women's organizations and female representatives of relevant stakeholder organizations including those representing female workers and producers' groups in coastal and marine sectors • Social welfare or social development authorities • Academic and research groups on social science or development • Indigenous Peoples' national and regional authorities • Indigenous Peoples' organizations • CSOs or NGOs, including those organizations that represent or support the rights and wellbeing of Indigenous Peoples and minority groups in the relevant coastal communities, such as human rights organizations
Fisheries and aquaculture	
• Subsistence fisheries • Commercial fisheries • Aquaculture • Processing	• Regional fisheries management organizations • National fisheries and aquaculture authorities • Fisheries and aquaculture associations or interest organizations that support them, including those representing women • Fisheries and aquaculture research centers; experts involved in fisheries management • Fish processing organizations • Indigenous Peoples fisheries associations and commissions
Cultural heritage	
• Tangible MUCH • Intangible MUCH	• Culture and cultural heritage authorities • Protected areas authorities • Representatives of the United Nations Educational, Scientific and Cultural Organization (UNESCO) • Universities, specialized research institutes, and independent researchers • Navy representatives • Dive companies and tour operators • Cultural and historical associations
Recreation and tourism[122]	
• Water sports • Natural tourist attractions • Recreation and tourism infrastructure	• Tourism administration authorities and tourist organizations • Water sports associations • Tour operators, including community-based tourism representatives • Environmental experts, authorities, or associations active in the management of ecosystems important for tourism • Hotels and restaurant owners' associations • Chambers of tourism and commerce • Homeowners' associations

122 Tourism is a highly segmented sector, with few trans-national and/or national representatives but with stakeholders at the local and regional levels.

Step 2 is designed to initiate early and open dialogue with biodiversity and social stakeholders.

4.2 Task 2.2: Prepare for Stakeholder Engagement

In Task 2.2, the SenMap Lead will complete the necessary preparation for stakeholder engagement. It is recommended that the SenMap Lead consider the following:

- **Identifying and facilitating an appropriate approach to stakeholder engagement:** This is expected to be influenced by the country context. Often, biodiversity and social stakeholder engagement is conducted separately, but this need not be the case if arrangements can be made to combine them effectively. Face-to-face workshop-type approaches are encouraged where circumstances permit it, supplemented with remote methods (e.g., webinar, online meetings) and follow up (e.g., one-to-one engagement) as necessary. Consideration should be given to stakeholder access to the internet and digital infrastructure.
- **Developing introductory materials:** To support engagement with a range of different stakeholders, it will be important to establish a common understanding of the SenMap approach and the stakeholders' role in it, as well as the planned timeframe[123] and intended outcomes. Similarly, the SenMap Lead may also need to consider the deployment of introductory capacity building and background information sharing on offshore wind development before engaging with stakeholders on technical topics. This is because the level of exposure to the offshore wind sector and offshore wind-related issues may vary between stakeholders. A variety of media should be considered, depending on the stakeholders involved and the format for engagement,[124] covering for example:
  - An overview of the SenMap approach and objectives, and of the roles and responsibilities of the various parties involved.
  - The purpose of sensitivity mapping and the concept of sensitivity scoring, explaining the role of the stakeholders and underscoring the difference between early stage sensitivity mapping and project-level impact assessments that come later in the permitting process.[125]
  - A general overview of a typical offshore wind development process (e.g., project phases and key activities), including pictures, maps, videos, or other visual aids that will help unfamiliar stakeholders understand the scope and scale of offshore wind projects.
  - A high-level summary of potentially sensitive types of E&S attributes and the potential implications of poorly sited offshore wind development.

123 The time frame for the SenMap steps and the approach overall is expected to be variable, depending on the country context and factors including existing familiarity with the available E&S data (Step 1), the process of identifying relevant stakeholders, establishing their interest and availability, and scheduling suitable dates/venues/platforms for engagement etc. (Step 2), planning/ logistics and the extent of the data gaps prioritized for additional data collection (Step 3), and the selected approach to sensitivity mapping (Step 4).

124 For example, information-sharing webinars, participatory workshops, or pre-workshop information packs. The methods should be appropriate for the different stakeholder groups, in terms of language, access to technology and other relevant social considerations.

125 Clarifying that the potential locations of specific offshore wind developments in the SenMap area are not yet known, and that the SenMap approach is not about individual site selection.

- **Developing technical materials on the biodiversity and social attributes:** Engagement with stakeholders will benefit from materials to support and visualize the technical topics for discussion. The format for these materials will depend on the selected method of stakeholder engagement.[126] Materials could include:
  - A summary of the existing spatial data and the biodiversity and social attributes identified in Step 1, with visualization of the available data wherever possible. This could include simple preliminary spatial maps (e.g., showing the location of social attributes or the distribution of a habitat type),[127] or use of online collaborative GIS platforms to view datasets in context. If there is more than one SenMap area (see Section 3.1), each area should be clearly distinguished.
  - Summaries of the non-spatial information available for attributes identified in Step 1, which may be particularly useful for social attributes for which spatial data are scarce.[128]
  - A summary of data gaps already identified.
  - A summary of the preliminary approach to sensitivity scoring established in Step 1, and an overview of the scores allocated.
  - An overview of how grid-based sensitivity mapping could be carried out (see Step 4).[129]

4.3 Task 2.3: Review and Validate Existing Data and Preliminary Sensitivity Scores

Task 2.3 is focused on engaging with biodiversity and social stakeholders to obtain feedback on the data collated in Step 1, validate the lists of attributes identified for sensitivity scoring and mapping, and to review and validate the preliminary scores allocated in Task 1.4.

The SenMap Lead should aim to ensure the following outcomes:

- Agree on the list of biodiversity and social attributes identified as potentially sensitive to offshore wind development in the SenMap area (see Section 3.3).

126 For example, digital information versus hard copies, as necessary for the engagement scenario and the different types of users (e.g., requirement for large-print).

127 Extensive data processing is not necessarily required at this stage, except as necessary to ensure maps can be comprehended.

128 For example, simple user-friendly factsheets that social stakeholders can review in support of discussions on preliminary sensitivity scores. Note that these summaries may need to be updated in subsequent steps to support continued stakeholder engagement.

129 Noting that the specific technical method may not yet be confirmed at this early stage.

- Review and validate the existing spatial data collated in Step 1,[130] including any additional data not already captured that stakeholders might provide (which should be added to the geodatabase). Stakeholders should be consulted on data quality, confidence, and limitations with respect to potential influence on sensitivity scoring and mapping.
- Review the appropriateness of the non-spatial data identified to inform sensitivity scoring (especially with respect to social attributes) and any additional non-spatial data identified by stakeholders (which should be added to the existing records of non-spatial data established in Step 1).
- Identify any cross-cutting issues between biodiversity and social attributes. For example, the identification of areas of importance for ecosystem services.
- Review and validate the approach to sensitivity scoring and the preliminary scores and document the rationale or any changes.

The outcomes of the discussions with stakeholders should be documented, identifying any actions for follow up, including responsibilities and timelines for doing so. Depending on the context and format of stakeholder engagement, it may be appropriate to give stakeholders the opportunity to review and confirm these outcomes.

4.4 Task 2.4: Identify Priority Data Gaps

In Task 2.4, stakeholders should be engaged in the identification and documentation of high-level priority data gaps, or areas of uncertainty, with respect to the attributes identified as potentially sensitive to offshore wind development. This will inform planning for primary data collection and knowledge co-generation in Step 3.

Identifying data gaps should be proportionate with the early stage and high-level nature of the SenMap process and the sensitivity map outputs. Additional data collection in Step 3 could, for example, focus on capturing land-sea interactions in the SenMap area (see Section 3.1), or address cases where there are no (or poor) data for a specific attribute, or for a particular season or a specific part of the SenMap area. It will be important to avoid confirmation bias (i.e., looking for information that supports a pre-existing hypothesis) and the potential pitfall of focussing only on what attributes are expected in the area.

130 Note that an effective way to do this with spatial data may be via collaborative access to the central geodatabase via an online GIS environment.

4.5 Summary of Step 2 Outputs

Table 4 summarizes the intended outputs of each task in Step 2.

At this stage in SenMap implementation, there is an option to proceed to Step 4 to develop preliminary sensitivity maps based on outcome of Steps 1 and 2 (see Figure 3). This could be beneficial to demonstrate or test the sensitivity mapping method selected, to consolidate the existing biodiversity and social spatial data collated so far, and to visualize relative E&S sensitivity across the SenMap area prior to beginning primary data collection and knowledge co-generation in Step 3. Preliminary sensitivity mapping can also be helpful at this stage in cases where there are resource or capacity limitations affecting implementation of primary information gathering. Preliminary maps could also inform wider spatial planning processes wider spatial planning processes wider spatial planning processes that might be planned or underway in a country, involving primary data collection (see Section 2.2.1).

TABLE 4:
Summary of Step 2 Outputs

TASK		OUTPUTS
2.1	**Map stakeholders**	• Documented stakeholder mapping
2.2	**Prepare for stakeholder engagement**	• Documented approach to stakeholder engagement • Introductory and technical materials to support stakeholder engagement
2.3	**Review and validate existing data**	• Agreed list of biodiversity and social attributes on which to focus sensitivity scoring and mapping, noting any changes from Step 1 • Geodatabase updated with additional spatial data identified by stakeholders • Additional non-spatial data identified by stakeholders • Validated sensitivity scores for biodiversity and social attributes, noting any changes from Step 1
2.4	**Identify priority data gaps**	• Documented, agreed priority biodiversity data gaps, to inform primary data collection in Step 3 • Documented, agreed priority social data gaps, to inform knowledge co-generation in Step 3

CHAPTER FIVE— STEP 3: FILLING THE GAPS

5 Step 3: Filling the Gaps

Step 3 is designed to address the high-level priority biodiversity and social information gaps identified in Step 2. Addressing these priority gaps will add to the available spatial data, which will in turn inform the review and validation of the attributes and the sensitivity scores that will be mapped in Step 4.

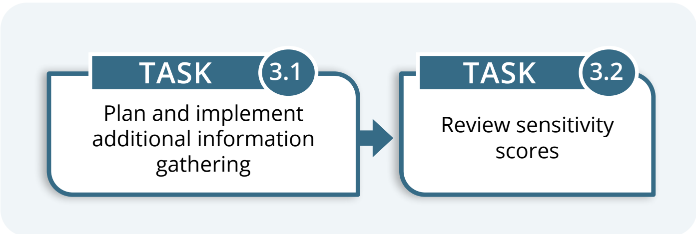
It is important that primary data collection and knowledge co-generation is planned on a scale proportionate with and appropriate to inform early-stage sensitivity mapping.[131] As discussed in Section 2.1, the SenMap approach is designed to complement and to feed into wider spatial planning processes like MSP or SESA. Thus, primary data collection and knowledge co-generation could feed into government-led spatial planning processes, and vice versa (information collected through MSP or SESA, etc. can be integrated into the SenMap approach).

When designing primary data collection and knowledge co-generation activities, if the data are available, it will be useful to identify areas that will likely be excluded from development based on other physical or hard constraints (e.g., other fixed infrastructure or uses of the marine space) (see Box 1). This will help to refine the spatial focus of Step 3 activities. It will be important for the SenMap Lead to liaise closely with relevant government agencies to identify effective and efficient approaches to data collection and knowledge co-generation, aligned with existing plans or programs. The aim will be to avoid duplicated effort and optimize the value and coverage of the information collected.

There are two tasks in Step 3, detailed in the following sections:

- Task 3.1: Plan and implement additional information gathering
- Task 3.2: Review sensitivity scores

FIGURE 9:
Overview of Step 3 and Key Tasks



131 Step 3 is not designed to inform detailed site selection or individual project or site-specific impact assessments, although it could provide a foundation for such necessary investigations later in the development process. Note that while wind resource mapping could assist in prioritizing field surveys, it is not the objective of Step 3 to specifically address the area of optimum wind resource (although it is useful to acknowledge that where there is a high degree of overlap between priority biodiversity values and optimum wind resource, the risk to biodiversity values of offshore wind development is potentially higher).

5.1 Task 3.1: Plan and Implement Primary Data Collection and Knowledge Co-generation

In this task, the role of the SenMap Lead is to oversee the planning and coordination of primary data collection and knowledge co-generation activities. This takes place in collaboration with relevant government actors and specialists with expertise in biodiversity survey and social knowledge co-generation techniques, drawing on stakeholder feedback as necessary. If there is more than one SenMap area, or the area has been sub-divided, it might be necessary to plan data collection and knowledge co-generation separately for each one.

Considerations for primary biodiversity data collection and social knowledge co-generation respectively are outlined in the following sections.

5.1.1 Biodiversity

There are two key components to addressing priority biodiversity data gaps through primary data collection: (i) strategic field surveys; and (ii) data review and integration into the sensitivity mapping approach.

PHOTO: COURTESY OF MARTIN PERROW AND PELAGIC PUBLISHING LTD

Strategic field surveys will likely be required to address priority biodiversity gaps and inform sensitivity mapping. A robust field survey plan will be necessary. It is important to note that while full-scale or comprehensive coverage of this area is not necessarily the objective of Step 3, information gathering with broad-scale spatial coverage may still be desirable. Although biodiversity data gaps identified in Step 2 could include some that are relatively discrete spatially and temporally and related to known biodiversity attributes, there might also be more general issues of confirmation bias, or data paucity over a much wider geographical area (or areas). Thus, broad-scale surveys have advantages, including the scope to capture:

- Wider confirmation of presence or absence of different types or groups of biodiversity attributes.
- Biodiversity attributes that have so far not been recorded, or are unexpected, in the SenMap area.
- Wider data coverage that could indicate other biodiversity attributes may be potentially sensitive to offshore wind development

A range of field survey platforms are available, several of which are capable of such broad-scale spatial coverage. Annex 7.1 summarizes these platforms and provides an indication of the relative effort and cost effectiveness for broad-scale coverage.

Surveys should be designed and conducted with the involvement of suitably qualified and experienced field ecologists with appropriate analytical expertise to ensure systematic and unbiased data collection. They should be based on accepted GIIP methods,[132] and involve the stakeholder inputs as required. It is anticipated that field survey reports will be prepared to document activities. Surveys are likely to require a flexible and iterative approach involving multiple survey campaigns to address different biodiversity attributes at different times and in different locations within the SenMap area. For example, multi-annual survey field visits will be necessary to consider inter-annual variation in species abundance and distribution, and seasonal variations and specific seasonal occurrence of some species. Other timing considerations for survey planning (e.g., monthly, daily, tidal) will also be relevant.

It will be important to monitor the progress and outcomes of field work to ensure objectives are being met, and identify any changes needed as they arise, if necessary.

Data review and integration: Raw data collected in the field will need to be checked and quality controlled, processed and/or analyzed by the relevant specialists responsible for data collection. The spatial information should be integrated into the central geodatabase[133] and field survey reports should capture associated data interpretation. Field specialists should provide an indication of data quality and confidence and potential biases.[134] It will be important to clearly highlight any biodiversity attributes that were not identified in Step 1 data collation, or in Step 2 by stakeholders, since these will need to be considered against the screening criteria in Task 1.3, and potentially allocated a sensitivity score (see Section 3.4).

132 GIIP survey methodologies, guidance, and advice on various aspects of marine environmental survey is widely available, including from countries with well-established offshore renewable energy and other marine sectors. E.g.: Bureau of Ocean Energy Management (BOEM) Guidance Portal (USA); Joint Nature Conservation Committee (JNCC) Resource Hub (UK), NatureScot Information hub (Scotland); Natural Resources Wales (Wales).

133 Most likely on a rolling basis.

134 For example, considering influence of field conditions such as sea state, or bias related to nocturnal species and survey timing.

It is important that primary data collection and knowledge co-generation are planned on a scale appropriate to inform early-stage sensitivity mapping.

It is possible that data from surveys can be reviewed and processed on a rolling basis as soon as possible after collection, and sensitivity scores can be reviewed for some attributes notwithstanding completion of work relevant to other surveys.[135] Offshore surveys can be prone to access and logistical challenges (e.g., due to inclement weather). Such challenges need not delay progress, because the approach is iterative, and because preparing a sensitivity map in Step 4 may still be possible even if further updates with additional data are needed.

5.1.2 Social

There are two key components to addressing priority social data gaps: (i) knowledge co-generation; and (ii) data review and integration into the sensitivity mapping.

Knowledge co-generation: Given the general assumption that georeferenced social data are likely to be scarce, addressing social data gaps to inform sensitivity mapping is likely to require the co-generation of knowledge with key stakeholders and community actors in a collaborative, iterative, and inclusive process (see Section 2.4.3). Knowledge co-generation may be required on two levels: (i) with the group of key stakeholders identified to support Step 2; and (ii) with organizations and people external to the SenMap process thus far. It is important that the ownership of co-generated knowledge is shared with those who provide inputs and local knowledge and, as such, these organizations and people should be recognized in the outputs.[136]

Knowledge co-generation should be guided by a clear plan, developed in collaboration with relevant stakeholders and with input from qualified national and local experts. The aims will be to address the data gaps identified in Step 2. Considerations for a knowledge co-generation plan include:

- **Data gaps:** A clear description of the information required to understand or characterize a social attribute and/or to inform sensitivity scoring.
- **Data types:** Identification of the type of data required, e.g., georeferenced, qualitative, or quantitative.
- **Data providers:** Identification of potential data providers—the persons or organizations who can access, share, generate, or collect the information required.[137]
- **Methods:**[138] Identification of the proposed methods.

135 In order to avoid stakeholder fatigue, consideration should be given to the frequency of stakeholder feedback required.
136 Including, for example, in the metadata associated with new spatial data layers generated.
137 Note that data providers are not necessarily the data owners; they may collect and process data from other sources. In this case, both the data providers and the source should be documented.
138 Where proposed engagement involves Indigenous Peoples, such methods should align with GIIP, such as those described in the social standards of international finance institutions (e.g., IFC 2012d).

The literature on social sustainability in MSP presents various ideas on how to develop and implement specific methods[139] to generate (often spatialized) information on social attributes. Participatory mapping (e.g., public participation geographic information system (PPGIS)) is generally considered an effective way to generate spatialized information on the social and cultural values, as well as the preferences of coastal and marine stakeholders.[140] These methods also serve to enhance transparency and collaboration and have been applied successfully to maritime activities such as artisanal fisheries and aquaculture. Scenario-based engagement[141] is also a useful method that could inform sensitivity scoring.[142] Budget and lead times for different knowledge co-generation activities will vary case-by-case.

It will be important to monitor the progress and outcomes of the knowledge co-generation plan to ensure objectives are being met, and identify any changes needed.

Review and integrate data: Co-generated knowledge and information will need to be reviewed and quality controlled by those specialists responsible for the knowledge co-generation plan. Spatial information (and information that can be spatialized) should be integrated into the central geodatabase.[143] It might be necessary to discuss and agree with the data owner(s) about how data should be reported and represented in spatial maps,

139 For example, Blake and Sherren 2017; Merrifield et al. 2013; and Strickland-Munro et al. 2016.

140 For example, the MSPglobal Southeast Pacific pilot project for the Gulf of Guayaquil (Ecuador/Peru) is an example of the type of output that can result from knowledge cogeneration, where desk-based research and participatory mapping were used to add new data layers to existing datasets. See https://www.mspglobal2030.org/msp-global/pilot-project-southeast-pacific/

141 A scenario can be defined as 'a plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces'. (UNESCO-IOC 2021, 12).

142 McGowan, Jay and Kidd 2019, 327–351

143 Most likely on a rolling basis.

especially where location information is sensitive (e.g., MUCH attributes). In some cases, it could be appropriate to limit the descriptive information shared more broadly, and to indicate relevant areas only generally in spatial mapping (as opposed to with a specific point location[144]). It will be important to highlight any social attributes that were not identified in Step 1 data collation, or in Step 2 by stakeholders, as these will need to be considered and potentially allocated a sensitivity score.

As with biodiversity field surveys, it may not be necessary to wait for full completion of Task 3.1 before proceeding with subsequent tasks. For example, co-generated information can be reviewed and processed on a rolling basis as soon as possible after it is gathered, and sensitivity scores can be reviewed for some attributes notwithstanding completion of activities relevant to other attributes.

5.2 Task 3.2: Review Sensitivity Scores

The data collected and co-generated in Task 3.1 should be reviewed by the SenMap Lead to confirm the attributes and sensitivity scores that will be represented in sensitivity maps. This might be done on a planned rolling basis, as different components of the field survey plan and knowledge co-generation plan are completed. It might also be appropriate or necessary to engage again with stakeholders to discuss and validate any changes or updates made, especially with respect to any newly identified attributes.

The review should:

- Follow the biodiversity and social sensitivity scoring approaches defined in Step 1 and validated in Step 2.
- Revisit the screening criteria for biodiversity attributes and the considerations for scoring social attributes in Task 1.3.
- Consider the guidance for collecting non-spatial data and information to help understand sensitivity of biodiversity and social attributes in Task 1.2.
- Include any additional attributes identified via field survey or knowledge co-generation, that were not already identified in existing data. The rationale for any changes made to the attributes and/or sensitivity scores should be documented.

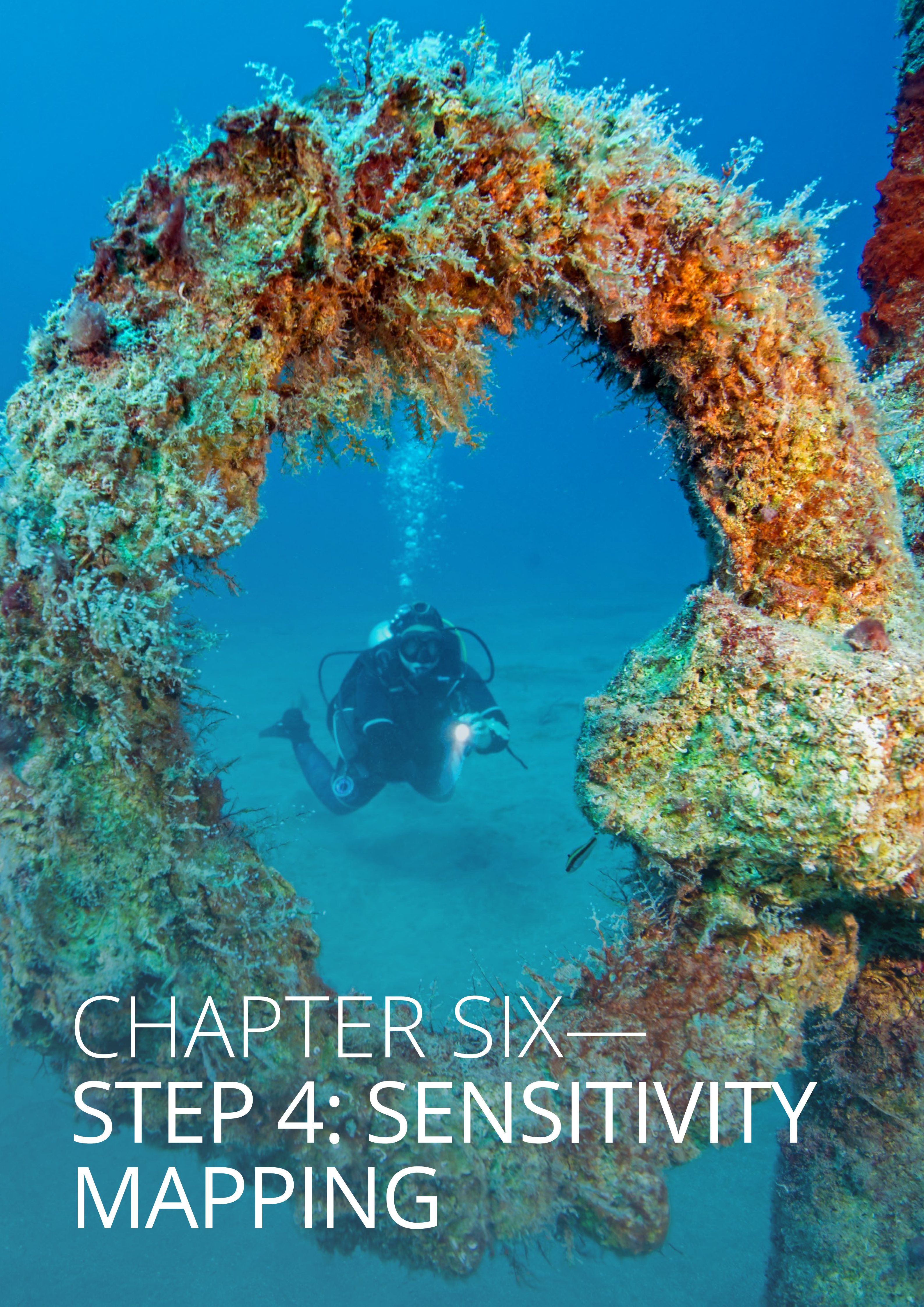
144 For example, due to the potential risk of looting, damage or destruction of tangible MUCH attributes.

5.3 Summary of Step 3 Outputs

Table 5 summarizes the intended outputs of each task in Step 3.

TABLE 5:
Summary of Step 3 Outputs

TASK		OUTPUTS
3.1	**Plan and implement primary data collection and knowledge co-generation**	Biodiversity: • Strategic field survey plan • Raw survey data and field survey reports • Processed, quality checked, and analyzed spatial data integrated into the geodatabase Social: • Knowledge co-generation plan • Co-generated data • Processed, quality checked, and analyzed spatial data integrated into the geodatabase
3.2	**Review sensitivity scores**	Updated list of attributes and sensitivity scores to represent in Step 4 sensitivity mapping



CHAPTER SIX—
STEP 4: SENSITIVITY MAPPING

6 Step 4: Sensitivity Mapping

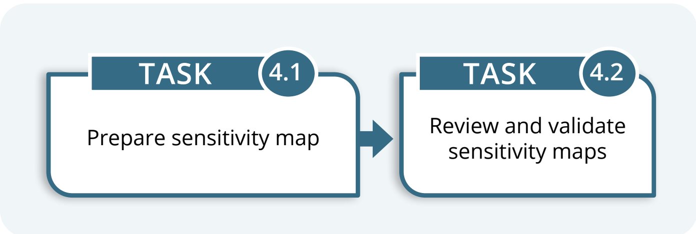
Step 4 draws together all the information gathered through Steps 1, 2, and 3 to develop spatial grid-based sensitivity maps for each attribute (or group of attributes), one consolidated biodiversity sensitivity map, and one consolidated social sensitivity map for the SenMap area (or areas). These maps will rely on the spatial data compiled, evaluated, and standardized in a central geodatabase throughout Steps 1, 2, and 3 (see Section 2.4.4 and Annex 4). As the spatial data allows, maps will indicate areas of relatively higher and lower biodiversity and social sensitivity.

Note that preliminary sensitivity maps can be prepared after completion of Step 2—see Figure 3 and Section 2.2.2.

There are two tasks in Step 4:

- Task 4.1: Prepare sensitivity maps
- Task 4.2: Review and validate sensitivity maps

FIGURE 10:
Overview of Step 4 and Key Tasks



6.1 Task 4.1: Prepare Sensitivity Maps

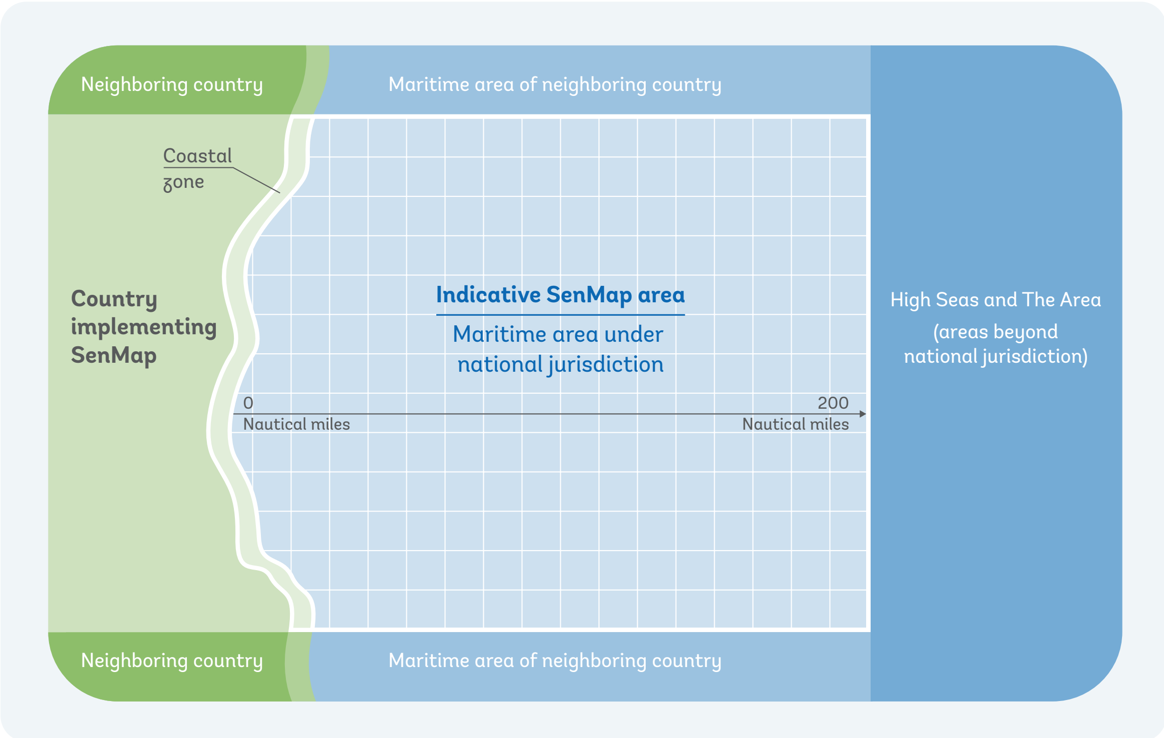
In Task 4.1, the preliminary sensitivity scores allocated to each attribute or group of attributes in Step 2 and/or Step 3 will be represented in grid-based sensitivity maps. The SenMap Lead is responsible for documenting a methodology for sensitivity mapping and for coordinating the practical development of sensitivity maps, which should be expert-led and involve appropriate GIS expertise (see Sections 2.4.1 and 2.4.4). It might be necessary to prepare sensitivity maps for more than one SenMap area (see Section 3.1), for example depending on the complexity of the coastline, or if there is more than one country coastline.

The following sections summarize some key considerations for sensitivity mapping.

6.1.1 Selecting an Appropriate Spatial Grid

To develop a sensitivity map, a grid is overlaid with the spatial data to standardize the sensitivity map and to help aggregate different data layers. Sensitivity maps are based on the intersection of the available spatial data with the grid, which determines whether an attribute is considered present in a grid cell (see Section 6.1.3). The appropriate grid cell size for sensitivity mapping will be determined by the resolution of the underlying datasets[145] and with the support of the GIS specialist. The same grid should be used for both biodiversity and social sensitivity maps, to ensure they can be reviewed in parallel.

FIGURE 11:
Illustration of the SenMap Area with a Spatial Grid Overlaid



145 A resolution of 1x1km² could be achievable using several of the global datasets identified in Step 1 (see Annex 6.1), but larger grid cells are also likely to be appropriate. For example, AVISTEP (see Annex 5) uses a 5km x 5km grid.

6.1.2 Identifying Suitable Spatial Data Layers

The nature of the different types and formats of spatial data is an important consideration for sensitivity mapping—data are typically generated for purposes other than sensitivity mapping, and some types of spatial data will be more suitable than others for use.

For some attributes, such as LPAs and IRAs and other designated areas for which spatial boundaries are legally (or otherwise formally or officially) defined, their presence and location in the SenMap area will be clear. It might be appropriate to apply a precautionary buffer to these boundaries (see Section 6.1.3).

In terms of other biodiversity attributes, habitat extent data are, in general, relatively reliable for sensitivity mapping, extent being either predicted based on modelling, or mapped based on direct or remote observations. Even in global datasets, mapped or modelled habitat extent is often relatively discrete (e.g., reefs, mangroves, or seagrasses). Again, it may be appropriate to add a precautionary buffer to the data. For species attributes, some types of spatial data are more suitable as indicators of the presence of an attribute than other types of data, as summarized in Box 6.

For social attributes, it is recognized that the relatively limited availability of spatial data may be a challenge (although there are a growing number of initiatives working to fill this gap, see Section 3.2.2). For this reason, this guidance particularly emphasizes the role of stakeholder engagement and knowledge co-generation to inform the spatial representation of social attributes.

Box 6 Considerations for Species Spatial Data and Sensitivity Mapping

For species, raw distribution data comes in two broad forms: (i) points or areas of occurrence (e.g., geographical coordinates where a species has been observed, or delineating the extent of a habitat type); (ii) and range maps (usually prepared by relevant experts).[146] Conflating range and occurrence can have consequences for ecological inferences,[147] and therefore for sensitivity mapping.

Range data (such as that provided in the global IUCN Red List of Threatened Species[148]) might be amongst the most prevalent type of biodiversity data available, especially in emerging market countries. Range is the geographical area within which a species can be found. It is a helpful starting point for understanding the potential sensitivity of an area. However, how a species is distributed across its range is variable. Range maps tend to overestimate the true occurrence of a species,[149] thus may not be a reliable indicator of species presence. For many species, especially marine species, the known range is very broad, and species may be infrequent even where they are known to occur. Some species' ranges could even encompass the entire sensitivity mapping area. This means using range data to inform a sensitivity map could lead to very large areas being mapped as highly sensitive, when actual species presence and occurrence are still uncertain. The exception might be for some restricted-range species, for which global range data could represent relatively small or limited areas and for which presence or occurrence might be better understood. This should be discussed with relevant stakeholders.

Point occurrence data can offer more confidence in the confirmed presence of a biodiversity attribute. This type of data includes georeferenced verified direct observations (e.g., eBird,[150] the Global Biodiversity Information Facility (GBIF),[151] or the Ocean Biodiversity Information System[152]—see Annex 6.1). It also includes known coastal bird colony locations (e.g., breeding, overwintering, and/or residential), or beach locations where sea turtle nesting has been documented by experts. However, this type of data can underestimate the true occurrence of a species,[153] partly because it reflects only areas where survey effort has been undertaken. To increase precaution in sensitivity maps, supporting information from the scientific literature or expert advice could also be used to apply buffers to occurrence data, for example capturing the potential wider foraging area around a seabird colony location.

146 Rotenberry and Balasubramaniam 2020
147 Alston et al. 2022
148 IUCN 2024
149 Rotenberry and Balasubramaniam 2020
150 eBird 2024
151 GBIF 2024
152 OBIS 2024
153 Rotenberry and Balasubramaniam 2020

6.1.3 Preparing the Spatial Data Layers

Once suitable data layers have been identified, some work is likely to be required to manipulate the data to fit the chosen spatial grid—i.e., to standardize, quantify, and interpret the data layers. The spatial data should be evaluated and may require some cleaning or additional processing[154] before use in sensitivity mapping. This is to ensure any limitations are accounted for, such as making sure to use only spatial data collected under good detectability conditions, or removing erroneous or outlying data (if appropriate). Other considerations may include confirming whether and how coverage in a dataset has been standardized, carefully reviewing the use of data in which confidence is lower, and verifying the suitability of older data or data that is not regularly updated.[155] The approach to sensitivity mapping will also need to ensure that the underlying data, likely to be sourced from several different organizations, are accessible so that sensitivity maps can be easily updated, as required. Preparatory tasks include:

- Standardizing and transforming the spatial data layers to convert them into the selected grid cell size (see Section 6.1.1).
- Applying buffers to the data. For some attributes and types of data (e.g., point locations), it might be appropriate to add a predefined buffer to the spatial data to incorporate additional precaution, and/or to address uncertainty (e.g., adding a buffer to a protected area, a seabird breeding colony location, or the location of a MUCH attribute). The use of buffers (and the appropriate width of buffers) may require input from relevant stakeholders.
- Determining E&S attribute data in each grid cell and preparing individual sensitivity maps. The simplest approach is where any degree of intersection between the spatial data layer and the grid equals presence (see Figure 12). Depending on the grid cell size, this may be overly conservative. Another approach could be to set a level of overlap, for example requiring at least 50 percent of a grid cell to intersect with the spatial data (including any buffer) (see Figure 13). Other approaches requiring more complex manipulation of the data should be guided by the GIS specialist.[156] Where there are multiple datasets for a given attribute, the GIS specialist (engaging with relevant stakeholders, as necessary) will need to determine whether and how they can be considered in combination.[157] To be precautionary, as far as possible, the combined spatial data used for an attribute should represent the most at risk scenario. For example, if recreation or tourism activities in the SenMap area increase during a particular season, or if the presence of a particular migratory species is greatest in July and August due to breeding, then the dataset(s) used to compile the respective sensitivity maps should capture these periods. Once the data representing a given attribute have been fitted to the grid, a sensitivity map for that attribute can be prepared (i.e., grid cells with relevant data can be color-coded according to the sensitivity score allocated to that attribute—see Figure 14 and Table 1).

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154 The nature and extent of which will be variable, depending on the dataset and the data collection methodology (for example).

155 It is usually not sufficient to use 'raw' spatial data directly in risk mapping. It may be helpful to review relevant literature regarding risk (sensitivity) mapping to understand how data have been handled, and what standardization has been applied in other instances. For example, various authors have reported on approaches to sensitivity scoring of seabirds to impacts with lessons that can be translated to data and mapping for other species groups (e.g., (not limited to) Avistep: Serratosa and Allinson, 2022; Bradbury et al. 2014; Garthe and Hüppop, 2004).

156 Some grid cells might not intersect with any biodiversity or social data. This is not (necessarily) evidence of the absence of attributes from that area, and may change with further primary information collection. Data availability is always a consideration in selecting the most suitable mapping approach. In general, approaches in the literature differ in their ability to handle the absence of data. Some methods might be more appropriate than others where the available data are limited (NEA and UNEP-WCMC 2019).

157 It may be appropriate to 'generalize' datasets or to combine multiple datasets of different resolution/accuracy to express them in a 'summary' format. Generalization is the selection and simplified representation of detail appropriate to the scale and/or purpose of a map (in NEA and UNEP-WCMC 2019).

- Determining the overall sensitivity score for a grid cell and developing consolidated sensitivity maps—one for biodiversity attributes, and one for social attributes. The approach to consolidating or aggregating the sensitivity scores for all the biodiversity or social attributes in a grid cell should be guided by the GIS specialist, with input from key stakeholders as appropriate. The simplest and most conservative aggregation approach is to use the score of the most sensitive attribute for a grid cell (Figure 15). This does not distinguish between cells with a single high sensitivity attribute and cells with more than one ,but could be the most suitable method depending on the available data. More nuanced (e.g., weighted) approaches could be applied to aggregate sensitivity scores for the consolidated maps, again depending on the available data. This should be determined with the necessary specialist support. Consolidated sensitivity maps will also be supported by the sensitivity maps for individual attributes, which can be viewed in parallel to understand the drivers of sensitivity as necessary.

FIGURE 12:
Illustration of Fitting Data to a Grid Based on Simple Presence or Absence (i.e., an attribute is considered present in any cell that overlaps with the data)

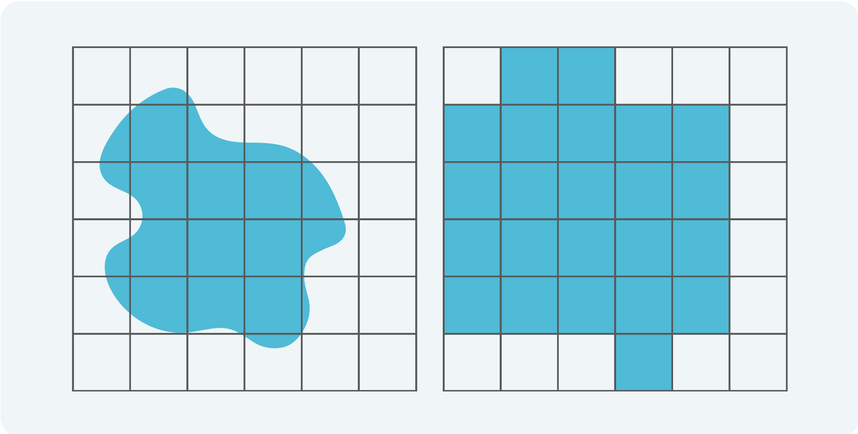
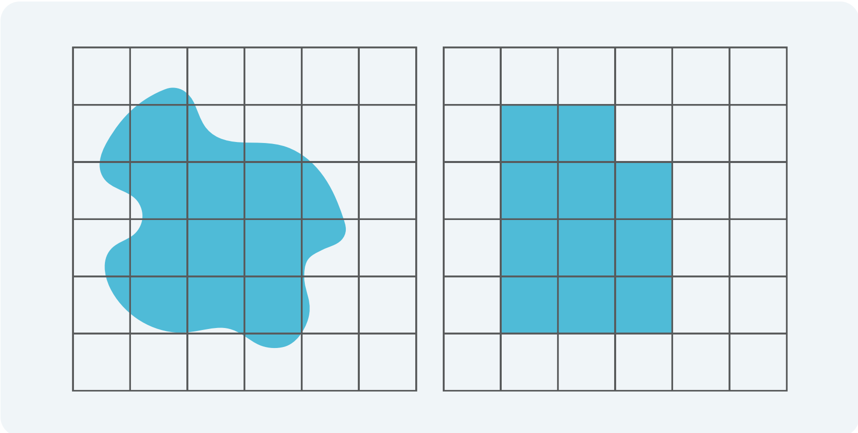
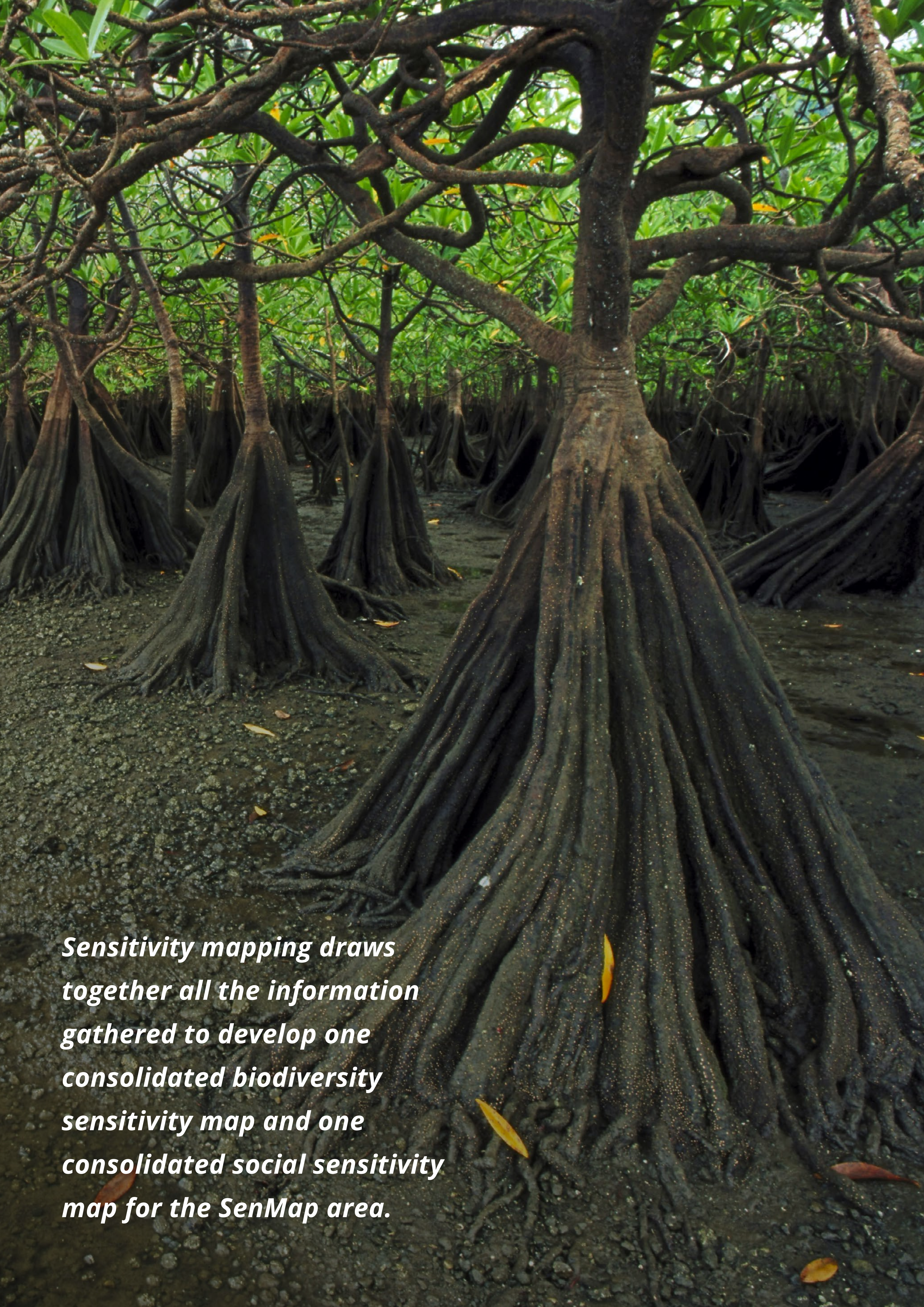


FIGURE 13:
Illustration of Fitting Data to a Grid Based on a 50% Level of Intersection (i.e., an attribute is considered present in any cell with ≥50% overlap with the data)



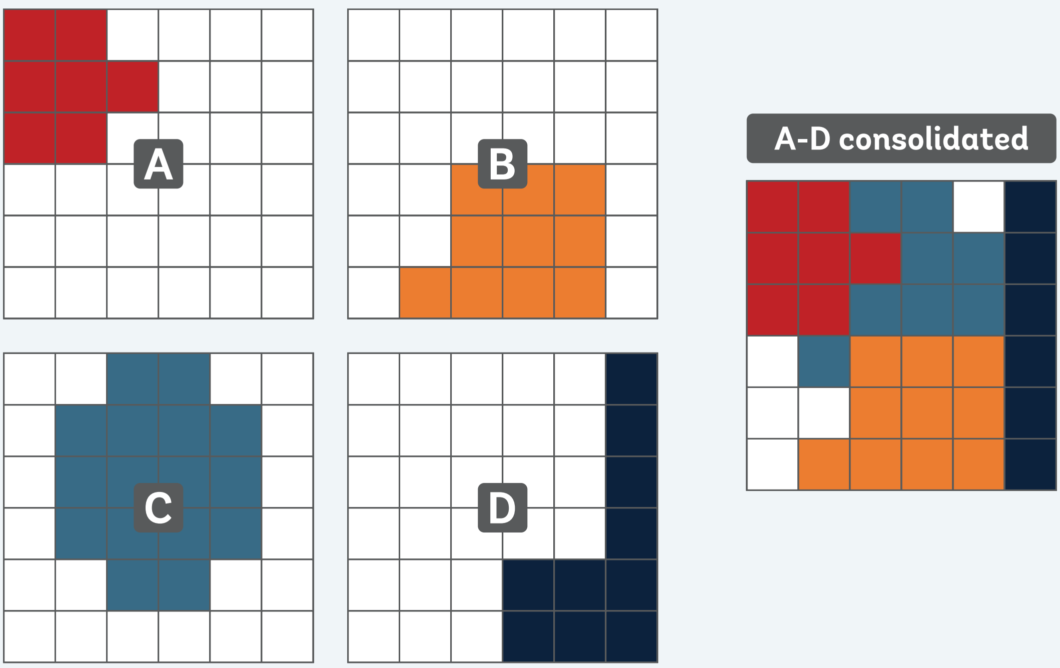


Sensitivity mapping draws together all the information gathered to develop one consolidated biodiversity sensitivity map and one consolidated social sensitivity map for the SenMap area.

FIGURE 14:
Example Sensitivity Score Categories and Color-codes for Mapping

Score	*Sensitivity Category*
5	Highest Sensitivity
4	High Sensitivity
3	Moderate Sensitivity
2	Low/Negligible Sensitivity
1	Unknown

FIGURE 15:
Illustration of Consolidated Sensitivity Scores: Left—Individual Grid Cell Sensitivity Maps for Separate Attributes (A = highest sensitivity, B = high sensitivity, C = moderate sensitivity, and D = low or negligible sensitivity). Right—Consolidated Map Based on the Highest Sensitivity Scoring Attribute per Grid Cell



6.2 Task 4.2: Review and Validate Sensitivity Maps

In Task 4.2, the sensitivity maps (individual and consolidated) should be validated with input from the stakeholders engaged previously in Step 2 (and any additional stakeholders, as necessary), considering for example: (i) coverage and representativeness of the SenMap area; (ii) confidence, data quality, and resolution etc.; and/or (iii) potentially anomalous grid cells.[158] Importantly, areas of the highest biodiversity sensitivity and areas of the highest social sensitivity may be different, and sensitivity could be driven by one attribute only, or several. Hence, it is essential to review consolidated biodiversity and social sensitivity maps in parallel, with the support of individual attribute maps as required. The sensitivity maps should then be updated or adjusted as necessary based on this review and feedback.

6.3 Summary of Step 4 Outputs

Table 6 summarizes the intended outputs of each task in Step 1 (see individual tasks for detail).

TABLE 6:
Summary of Step 4 Outputs

TASK		OUTPUTS
4.1	**Sensitivity mapping**	• Documented agreed approach to sensitivity mapping • Sensitivity map for each attribute, or group of attributes • Consolidated sensitivity map of biodiversity attributes • Consolidated sensitivity map of social attributes
4.2	**Review and validate sensitivity maps**	• Validated sensitivity map for each attribute, or group of attributes • Validated consolidated biodiversity sensitivity map • Validated consolidated social sensitivity map

158 For example, individual uncategorized grid cells surrounded by categorized cells, or cells for which the consolidated sensitivity score is markedly different from the surrounding cells.

CHAPTER SEVEN— USING SENMAP RESULTS

7 Using SenMap Results

Sensitivity maps that result from the SenMap process offer insight into the potential challenges of managing E&S risks in the planning area in accordance with GIIP and the E&S standards of international financial institutions and development banks—particularly where MSP or SESA has not yet been carried out. Their key utility is to both plan for avoidance of areas of highest E&S risk and support the identification of potential offshore wind development areas at the earliest stages of government-led spatial planning. These two uses are described here along with data sharing and dissemination examples.

7.1 Planning for Avoidance

The SenMap approach—a tool for planning for avoidance— is intended to help avoid and/or minimize potential impacts on biodiversity and social attributes by directing development away from areas of the highest sensitivity and informing the identification of broad potential areas for offshore wind that are likely to be of lower E&S sensitivity. Avoidance is the most effective, lowest cost mitigation option available. Planning for the avoidance of the highest E&S sensitivity areas is fundamentally important for sustainable development that supports a just transition to a lower carbon economy. The areas of the highest sensitivity, as identified in the consolidated biodiversity and social sensitivity maps, should broadly indicate where development could lead to project-level and cumulative impacts that cannot be compensated for, or for which mitigation would be technically challenging, prohibitively costly, and with highly uncertain outcomes for biodiversity and social attributes.

At the same time, it is also important to reiterate that sensitivity maps are indicative and, even where they have been informed by strategic primary data collection and knowledge co-generation, the sensitivity reflected might be confirmed to be lower at the project level, when more detailed studies and consultation are carried out. For this reason, SenMap could also be used as a tool to scope project-specific ESIA studies. For example, the coarse-scale data obtained through the SenMap process could highlight the need for potential restrictions related to timing of development activities (e.g., to avoid a sensitive time of year during which subsistence fishing activities are particularly important for coastal communities, especially vulnerable groups, or to avoid a sensitive time of year for biodiversity), or the need for specific construction and/or operational protocols (e.g., cable routing to avoid key tourism and recreation sites or vessel speed restrictions to minimize marine mammal collision risk). The project-level studies led by developers later in the planning process can be designed to confirm and refine any such restrictions.

7.2 Identifying Potential Offshore Wind Development Areas

SenMap outputs could be used to inform the location of broad areas potentially suitable for offshore wind development, and provide key inputs to competitive bidding processes to allocate seabed areas. Outputs could also be used to inform any early-stage work undertaken by developers to identify and assess suitable sites. What constitutes a potentially suitable area will also depend on other uses and users of the marine space, and on technical and physical factors influencing the feasibility and economic viability of offshore wind development in that area (see Box 1).

It is likely that governments implementing the SenMap approach will have already established targets for offshore wind deployment volume or are in the process of doing so. Thus, ideally, identifying areas using the sensitivity mapping outputs should be done strategically, considering the amount of offshore wind energy a country seeks to enable. Alongside other relevant technical and economic information (when it is available), this will help understand whether targets are likely to be achievable within the limits of the available suitable offshore area(s) and to inform the potential need for trade-offs (e.g., in terms of a country's planned energy mix and other uses of the marine space).

Combined E&S and technical information is also useful to inform the content of tendering packages and minimum requirements of bidders. Further information on offshore wind volume and targets, and frameworks for offshore wind leasing or development areas, can be found in the WBG Key Factors report.[159]

159 World Bank Group 2021a

Planning for the avoidance of the highest E&S sensitivity areas is fundamentally important for sustainable development that supports a just transition to a lower carbon economy. Avoidance is the most effective, lowest cost mitigation option available.

7.3 Data Sharing and Dissemination

Collaborative and transparent planning processes require suitable mechanisms for data sharing and dissemination. Embedded in these mechanisms, there must also be measures to handle data confidentiality and sensitivity. This is a core part of enabling stakeholders to contribute effectively.

During implementation, the SenMap Lead is encouraged to work closely with the relevant government agency or agencies to ensure their familiarity with the process and to establish a platform and mechanism for sharing data and outputs (including open-source platforms where appropriate). Where the SenMap Lead establishes such a mechanism, it should align or be integrated with a government's existing approach to handling and managing spatial data. It is expected that, as part of setting up and managing the central geodatabase (see Annex 4), the SenMap Lead will have obtained permissions for data use, confirmed source references and any access limitations, and captured whether and how frequently datasets are maintained and updated by their respective third-party owners. Especially in cases where the SenMap Lead is an organization or consortium working on behalf of government, they will need to implement a clear plan for handing over the geodatabase and sensitivity map outputs. The plan should include transferring both the data and the knowledge and capacity to use the data (e.g., managing the geodatabase, and integrating new and updated datasets).

Data sharing and learning is encouraged to build an evidence base of E&S data related to sensitivity. As planning and development progresses, this evidence base can also extend to impacts and could be used as a platform to include project-specific data resulting from the CIA or ESIA processes.[160] Consideration can begin at the start of the SenMap process, considering collaborative data sharing, access, and visualization. Mechanisms can be for information only (e.g., static maps), or depending on the platform, there might be opportunities for interactivity, enabling users to interrogate the data layers in more detail. Box 7 outlines some examples of existing data sharing and dissemination mechanisms specific to the marine space and/or renewable energy.

160 See 'Policy' pillar of World Bank Group 2021a, 11–29.

Box 7 Example Marine and Renewable Energy Data Sharing and Dissemination Platforms

At the global level, there are some notable examples of data sharing and dissemination, including the Ocean Decade Corporate Data Group—a working group launched by Fugro and the Intergovernmental Oceanographic Commission of UNESCO, focused on unlocking private sector ocean data, and Hub Ocean's open and collaborative platform to aggregate ocean data—the Ocean Data Platform.

In Europe, the European Marine Observation and Data Network (EMODnet) is a network of organizations supported by the European Union's integrated maritime policy, providing access to European marine data across seven discipline-based themes, including species and habitats, bathymetry, geology, and human activities. In the United Kingdom, the Crown Estate Open Data Portal offers free access to all the data the Crown Estate publishes, including spatial features layers, web mapping applications, and StoryMaps.[161] Part of Open Data is the Marine Data Exchange, a world leading collection of offshore marine industry data from several industries including offshore wind. Similarly, Marine Scotland Open Data Network is a free-to-access suite of resources providing information about the Scottish marine environment.

Several examples are also available from the United States, including the federal Bureau of Ocean Energy Management (BOEM) Renewable Energy website, which centralizes information on mapping and data, BOEM-funded scientific research, stakeholder engagement and partnerships, and environmental consultations (e.g., on endangered species). The regional Northeast Ocean Data Portal is a public source of expert-reviewed maps and data for ocean planning, facilitating decision-making by government agencies, business, NGOs, academics, and individuals, and including case studies. At the state level, the California Offshore Wind Energy Gateway assembles geospatial information (e.g., ocean wind resources, ecological and natural resources, ocean commercial and recreational uses, and community values) to help identify areas off the California coast that are potentially suitable for wind energy. With respect to onshore wind in the United States, the Department of Energy's (DoE) WindExchange is a platform with maps and charts showing wind energy data and trends by state, including tutorials. The DoE Bureau of Land Management hosts the West-wide Wind Mapping Project, which maps wind energy resources on public lands across eleven states and identifies existing land use exclusions and other potential resource sensitivities that may affect wind energy development opportunities.

The Canadian Government (Fisheries and Oceans Canada) has developed a Marine Planning Atlas—an interactive mapping tool for decision-makers and other end users to access information on ecological processes, bioregion features, and human activities in both the Atlantic and Pacific Canadian waters.

In Australia, the Australian Renewable Energy Mapping Infrastructure Project consolidates geospatial data from multiple renewable energy industry organizations into a free-to-access online mapping platform, intended to inform energy supply and infrastructure investment decisions, reduce the time and cost associated with early-stage project planning, and create opportunities for value adding analytical work within the public and private sectors.

In West Africa, the Benguela Current Convention (BCC) GeoData Portal (the MARISMA Project) is an online digital platform that provides access to spatial data (and related documents) on the marine environment and human societies in the Benguela Current Large Marine Ecosystem. It is designed to support access to and sharing of spatial data of the BCC contracting parties, Angola, Namibia, and South Africa.

161 ArcGIS StoryMaps 2024

7.4 Conclusions

Offshore wind has a clear role to play in many countries' transition to net zero and sustainable energy systems,[162] and there is significant potential in emerging market countries (see Section 1). In the unfolding global climate crisis, urgent action and accelerated pace of offshore wind deployment are required to achieve climate targets.[163] At the same time, rigorous spatial planning for offshore wind development, aligned with GIIP, is of paramount importance.

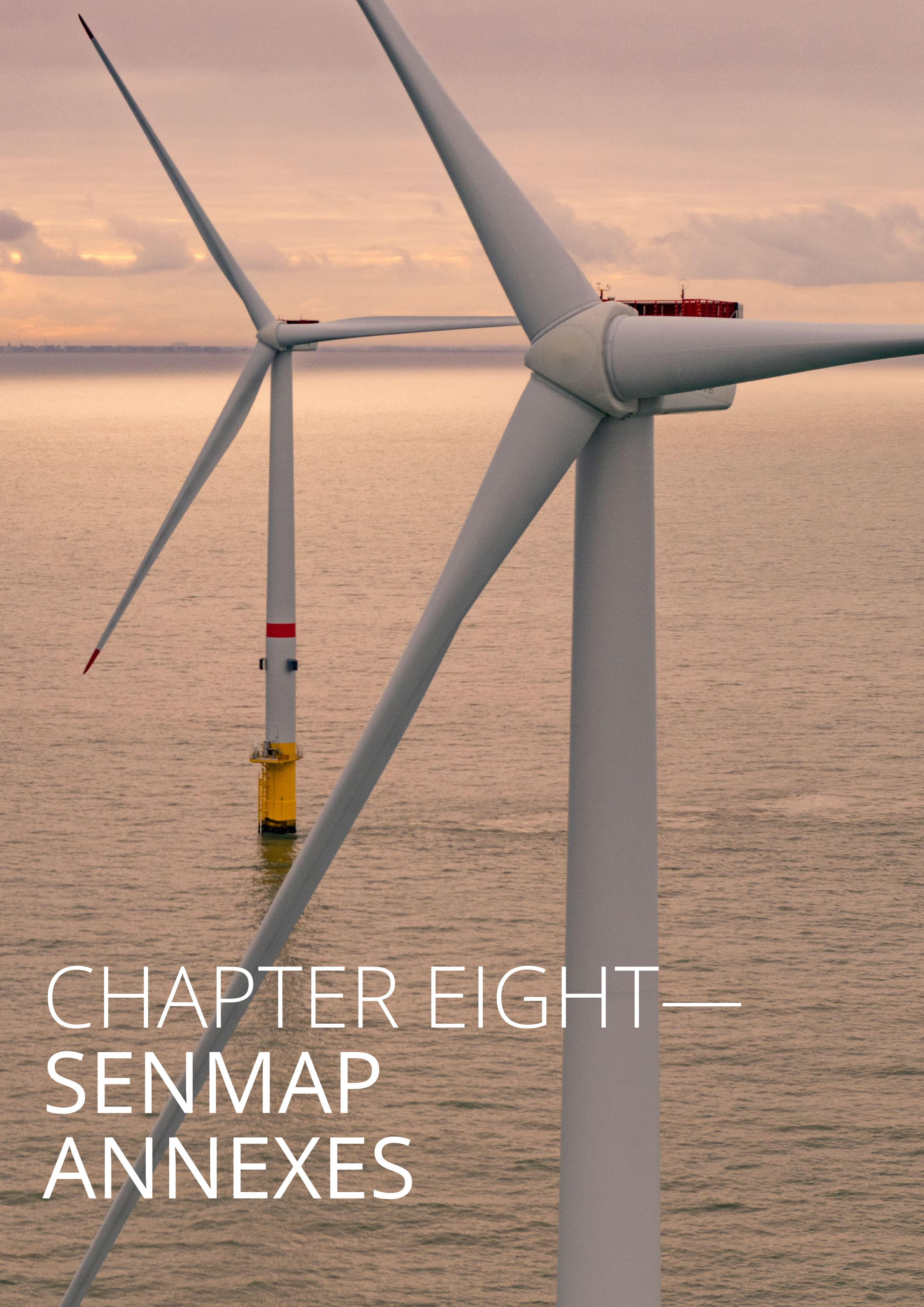
SenMap is a pragmatic way to ensure E&S considerations are included as soon as possible in strategic spatial planning. The approach supports government planners to identify broad, potential areas for offshore wind likely to be of the lowest E&S sensitivity and offers governments and developers alike early insight into the potential risks associated with GIIP E&S requirements of international financial institutions. As such, SenMap is a tool to leverage the long-term advantages that can be derived from early-stage spatial planning for offshore wind development, including:

- Establishing a foundation for GIIP early on (to be continued throughout the planning and permitting process).
- Reducing the potential for adverse impacts (including cumulative impacts of multiple projects).
- Informing the strategic planning of shared infrastructure, such as electrical transmission grids and ports.
- Increasing stakeholder acceptance of offshore wind projects.
- Potentially accelerating licensing and reducing permitting risk.
- Aligning with the E&S standards of international financiers.

These advantages help to increase market confidence and reduce development risk while promoting sustainable development of the offshore wind sector.

162 According to the UN Net Zero Coalition, the energy sector is the source of around three quarters of greenhouse gas emissions today. Replacing polluting coal, gas, and oil-fired power with energy from renewable sources, such as wind or solar, would dramatically reduce carbon emissions. See https://www.un.org/en/climatechange/net-zero-coalition.

163 UNFCCC 2016



CHAPTER EIGHT— SENMAP ANNEXES

Annex 1: Overview of Tools for Strategic Spatial Planning

This Annex provides an overview of existing approaches to strategic spatial planning, with different levels of effort and different spatial scales.

MSP: MSP is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process.[1] It is the primary tool for considering the inter-relationships between competing activities in the marine environment, and seeks to identify environmentally, socially, and commercially appropriate locations for various types of development in a way that balances different uses of the marine space. MSP is usually carried out by government at a national scale. Full-scale, multi-sectoral MSP often requires large-scale resourcing, both in terms of funding and personnel, and significant data collection effort. A key authoritative guidance document on MSP comes from the Intergovernmental Oceanographic Commission (IOC)—*Marine spatial planning: a step-by-step approach toward ecosystem-based management*.[2] The step-by-step guidance is intended primarily for professionals responsible for the planning and management of marine areas and their resources, and is especially targeted to situations in which time, finances, information, and other resources are limited.

The MSPglobal International Guide on Marine/Maritime Spatial Planning[3] draws from the IOC guide and discusses how to consider emerging MSP-related topics such as blue economy[4] and climate-smart MSP. MSPglobal gives examples of principles applied in MSP in different countries, many of which are reflected in the SenMap approach.

SenMap aligns with the IOC step-by-step approach (including defining a spatial planning area, organizing stakeholder participation, and collecting/mapping information about specific conditions in the marine area) and reflects many of the principles of MSPglobal (such as the need to involve coastal communities in the spatial planning process by providing a pariticpatory approach to identifying and mapping potential risks of offshore wind development.

MSP also provides a comprehensive and integrated investment framework and financial and social rationale for the Blue Economy, through reducing investment risk and improving investor certainty related to accessing marine resources. To improve understanding of the opportunities of MSP as an investment framework and to close knowledge gaps, the World Bank multi-donor PROBLUE program published a *Marine Spatial Planning for a Resilient and Inclusive Blue Economy Toolkit*,[5] comprising a series of guidance notes and factsheets on the

1 Ehler and Douvere 2009
2 Ehler and Douvere 2009
3 UNESCO-IOC/European Commission 2021
4 Patil et al 2016
5 Both volumes of the PROBLUE MSP Toolkit, guidance notes and factsheets can be found at https://www.worldbank.org/en/programs/problue/publication/marine-spatial-planning-for-a-resilient-and-inclusive-blue-economy-toolkit

benefits of MSP (ecological, social, and economic). The Toolkit is in two volumes: Volume 1 *Key Considerations to Formulate and Implement MSP*, and Volume 2 *Integrating Cross Cutting Themes into MSP.* It is accompanied by two guidance notes: *Applying Economic Tools to MSP* and *Blue Economy Data and Tools Catalogue,* and three factsheets: #1 *Gender, Marginalized People, and Marine Spatial Planning* , #2 *Climate-Informed Marine Spatial Planning* and #3 *Biodiversity, Ecosystem Services, and Marine Spatial Planning*.

The deployment of offshore wind in established markets has significantly benefited from strategic MSP. In Europe, over 25GW of offshore wind capacity has been installed, informed by a strong legal framework and policy initiatives.[6] Single-sector planning is complementary, integrated into the MSP process to enable a range of decision-makers responsible for different sectors and activities to make decisions in a more integrated way.[7] Where offshore wind is being considered in the near term (2 to 5 years), single-sector planning could be useful in the initial roll-out of the sector (or in conjunction with a full-scale multi-sector MSP, if one is underway or planned), to build and sustain market confidence. The SenMap approach can serve as a precursor or an input to MSP, providing a pragmatic and proportionate entry into spatial planning through sensitivity mapping.

SESA: SESA (also referred to as Strategic Environmental Assessment) is a systematic process for incorporating E&S considerations across different levels of strategic decision-making (the plan, program, and policy levels) as early as possible, with a high degree of government ownership.[8] SESA is usually carried out at the regional or national scale. The focus of SESA is deliberately broad, because understanding the effect of policies, plans, and programs on physical and environmental resources first requires understanding the social, cultural, economic, and institutional context within which resource exploitation will take place.[9] SESA can, for example, be carried out to evaluate the draft plans that result from MSP exercises. There is no single standard approach to SESA. Rather, it is a family of approaches on a continuum from impact analysis and spatial mapping through to institutional assessment. At one end of the spectrum SESA focuses on integrating biophysical and environmental effects into higher levels of decision-making. At the other end of the spectrum biophysical, environmental, social, and economic effects are considered in sustainability assessments. The SenMap approach is not designed to consider the E&S effects of a proposed plan, program, or policy, but to inform them through high-level sensitivity mapping. It could be implemented before a SESA or may be informed by one that has already taken place.

CIA and Cumulative Effects Assessment: These are generally synonymous terms for the process of: (i) analyzing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural E&S external drivers

6 Including the Strategic Environmental Assessment Directive (2001/42/EEC) and the Maritime Spatial Planning Directive (2014/89/EU).

7 Ehler and Douvere 2009

8 For further reading on this topic, please see the following resources from the European Union and World Bank: The SEA homepage of the EU's Capacity4dev initiative. Capacity4dev is the European Commission's online knowledge-sharing platform, available at https://capacity4dev.europa.eu/info/strategic-environmental-assessment; *Integrating Environmental Considerations in Policy Formulation: Lessons from Policy-Based SEA Experience* (World Bank 2005) at https://documents1.worldbank.org/curated/en/924191468136803756/pdf/327830white0co1vironmental01public1.pdf; *Strategic Environmental Assessment in Policy and Sector Reform: Conceptual Model and Operational Guidance* (World Bank 2011) http://hdl.handle.net/10986/2517; *Strategic Environmental Assessment for Policies: An Instrument for Good Governance* (World Bank 2013) at http://hdl.handle.net/10986/6461

9 For additional resources and a brief overview of SEA, see the International Association for Impact Assessment's SEA page at https://www.iaia.org/wiki-details.php?ID=24.

on E&S attributes over time; and (ii) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risks to the extent possible.[10] Traditionally, CIA considers past, present, and future activities, and should reflect the geographic and temporal context in which effects are aggregating and interacting (e.g., the landsacpe or seascape, catchment or community). Assessment may need to consider activities in multiple sectors. Thus, CIA is a core component of SESA. Government and regional planners have overall responsibility for CIA because it transcends the responsibility of a single project developer.[11] However, project-level CIA is a common component of ESIA, and is often required as a regulatory requirement. The outputs of government-led CIA should inform these project-level assessments.

CIAs can be complex, and it is good practice to focus the assessment on what are termed valued environmental and social components.[12] For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important based on scientific concerns and/or concerns of affected communities.[13] The high-level sensitivity mapping carried out using the SenMap approach can inform an early understanding of important issues that may need to be considered in CIA.

ESIA: ESIA is a comprehensive project-level process applied across sectors, and is the responsibility of project developers. The process generally consists of: (i) initial screening of the project and scoping of the assessment process; (ii) examination of alternatives; (iii) stakeholder identification (focusing on those directly affected) and gathering of E&S baseline data; (iv) identifying, predicting, and assessing the potential E&S impacts of a proposed project; (v) designing appropriate mitigation, management, and monitoring measures; (vi) assessing significance of impacts and evaluating residual impacts; and (vii) documenting the assessment process (ESIA report).[14] The focus and complexity of a project-specific ESIA should be informed by earlier, higher-level strategic planning like MSP or SESA (where they exist). ESIA is carried out based on specific technical project information (such as planned output, turbine characteristics, installation activities, subsea cable routing, etc.), and may be relatively resource intensive, depending on the scope of the issues to be addressed. ESIA should be well resourced and proportionate, meeting GIIP[15] standards, including robust baseline surveys. In addition to assessing the facilities and activities owned and operated by the developer, an ESIA should also consider associated facilities (such as onshore transmission lines).[16]

The SenMap approach is designed to identify potential E&S sensitivities in the early planning phase, well in advance of ESIA. This process will benefit the developer's project-specific ESIA and help align it with GIIP. SenMap outputs could also be used to inform competitive offshore wind leasing or tender rounds, as developers could more accurately cost in consideration of E&S sensitivity into their bid package.

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10 IFC 2013
11 IFC 2013
12 IFC 2013
13 IFC 2013
14 IFC 2021
15 As defined in IFC Performance Standard 3 (2012a) as the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same of similar circumstances, globally or regionally.
16 As defined in IFC 2012

Annex 2: Climate-informed Marine Spatial Planning

Climate change is a fundamental consideration for multi-sectoral spatial planning and development scenarios. Integrating climate change into wider MSP will be essential: a changing climate alters ocean conditions, and the redistribution of marine ecosystem services will affect communities, activities, and assets in the marine and coastal space.[17] Climate change is the primary driver for the transition to a low carbon economy, and a key factor influencing the financing decisions of international lenders,[18] where there is increasing cognizance of impacts of investments on nature, and the significant contribution the financial system can have in "reorienting global finance towards climate and Sustainable Development Goals."[19]

PROBLUE, the World Bank program that supports the sustainable and integrated development of marine and coastal resources, has developed an MSP Toolkit including a factsheet on climate-informed MSP[20] (defined as a participatory process that considers current and future climate risks and opportunities during design, planning, and implementation). Identified entry points for climate-informed MSP include reviewing the enabling conditions (e.g., governance and regulatory frameworks dealing with climate change and marine resources), and planning to identify in advance where people, assets, and ecosystems might be more vulnerable to climate impacts. Similarly, the MSPglobal initiative policy brief on climate change and MSP advocates "climate-smart MSP" (planning initiatives in the ocean space that integrate and may adapt to the effects of a changing climate).

MSP to support renewable energy development as part of a country's strategy for decarbonization will need to focus on sustainable and resilient infrastructure, hence early spatial planning to understand E&S sensitivities across the planning area is essential.[21] The pathways that link climate change effects, MSP, and ocean sustainability include ocean warming and acidification, as well as deoxygenation or sea level rise. The effects[22] are diverse and region-specific, and variable by sector. While efforts are being made to integrate climate change into spatial use scenarios, there is still limited knowledge on the complexity of the processes and underlying impacts.[23] It is thus difficult to incorporate climate change considerations directly into early-stage and proportionate sensitivity mapping, particularly in emerging markets where the availability of spatial data is expected to be variable. Separate, sector-specific analyses of climate-related vulnerability are often

17 Vassilopoulou 2021
18 For example, World Bank Group 2021a.
19 Finance in Common 2020
20 Castano Isaza et al. 2021b
21 The EU recently called on Member States to 'swiftly map, assess, and ensure suitable land and sea areas' are available for renewable energy projects, commensurate with their national energy and climate plans, contributions towards 2030 renewable energy targets, and other factors including the availability of resources and grid infrastructure. For more information see: https://joint-research-centre.ec.europa.eu/scientific-tools-databases/energy-and-industry-geography-lab/go-areas-wind-and-solar_en
22 Franzao Santos et al. 2020
23 Vassilopoulou 2021; Franzao Santos et al. 2020

conducted and can support wider MSP, strategic planning and "visioning processes"[24] (e.g., the Swedish Agency for Marine and Water Management tool for ecosystem-based MSP, called Symphony[25]). The SenMap approach is flexible with respect to the components for which sensitivity is evaluated and the GIIP technical methodologies used (e.g., for sensitivity scoring and mapping), which means that, while it is not an expectation of the approach, opportunities to integrate climate considerations could be included as appropriate for the implementing country context.

24 Franzao Santos et al. 2020
25 Swedish Agency Marine and Water Management 2020

Annex 3: E&S Attributes

This Annex summarizes the key biodiversity and social attributes that could potentially be susceptible to the impacts of offshore wind development and provides an outline of the nature of the potential impacts. The tables also provide further details on the definitions of the biodiversity and social attributes. The information about the potential effects on the attributes can be used to inform sensitivity scoring.

Annex 3.1: Biodiversity Attributes and Potential Impacts and Outcomes of Offshore Wind Development

Annex 3.1 identifies the groups and sub-groups of biodiversity attributes that are the focus of sensitivity mapping and summarizes the potential impacts of offshore wind development on each. The list is not exhaustive, and this summary is not intended to restrict the overall aim of the SenMap approach, which is to identify biodiversity attributes of the highest potential sensitivity to offshore wind development in the specific country context. Other groups and species might be considered, based on the biodiversity attributes of the implementing country.

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	**SUB-GROUP**	
Birds	Seabirds, including species totally reliant on marine waters (e.g., auks, tubenoses, sulids) and others foraging in the marine environment at particular times (e.g., seaduck, looks, some gulls, and terns)	• Seabirds are the primary group at risk of collision with turbine blades, and from displacement or ecosystem effects linked to presence of offshore wind farms. This is because they utilize the marine environment exclusively, or in particular seasons (e.g., for winter foraging). Only a few bird collisions have ever been recorded offshore due to the challenges of monitoring and collecting carcasses offshore.[26] Two parameters are especially important in understanding theoretical collision and displacement risk: time spent flying at rotor height[27] and species-specific avoidance behavior.[28] Species displaced from wind farms are expected to expend more energy finding alternative resources for which there is increasing competition, in turn affecting food intake rates and potential survival and breeding prospects.[29] • Many groups (e.g., loons, auks, seaduck, and Northern Gannet (*Morus bassanus*)) have been shown to be displaced from wind farms, sometimes to many kilometers,[30] although the mechanisms behind the response (such as fear or a lack of suitable prey) remain unclear. Displacement effects are species-specific and conceptually linked to wind farm location relative to breeding colonies (which may or may not be LPAs, IRAs, or otherwise designated—see later in this table) and foraging areas, habitat quality, the distribution and availability of prey. Displacement effects are also likely to vary with specific stages of the annual life cycle.[31] • Only a few species (e.g., Great Cormorant (*Phalacrocorax carbo*) and European Shag (*Gulosus aristotelis*[32])) have been found to be strongly attracted to offshore wind farms, which in the case of Great Cormorant has expanded their natural range further offshore.[33] Understanding the ecological consequences of changes in seabird distribution and quantifying the population level impacts of both displacement and collision remain crucial considerations.[34]
	Shorebirds, including near-coastal species	• Where wind farms are developed in nearshore or inter-tidal habitats, coastal or wetland birds such as wading birds and waterfowl may be vulnerable to collision with turbine blades. These birds are also vulnerable to displacement or disturbance where cable landfall and onshore coastal infrastructure impinges on breeding colonies, foraging areas, or regular movement pathways.
	Migratory land birds	• Migratory species that migrate by soaring flight (e.g., vultures, raptors, cranes, and storks) may be especially vulnerable to collision or to displacement and barrier effects from offshore wind farms. This is because they need to minimize time spent over water where they get no uplift. There are thus migratory bottlenecks for these species at places with short water crossings between land masses (which are relatively easy to identify and avoid, e.g., The Turkish Straits System, the Strait of Gibraltar, Bab al-Mandab Strait, and the Malacca Strait).

26 Cook et al. 2018
27 King 2019
28 Skov et al. 2018
29 Vanermen and Stienen 2019
30 Peschko et al. 2021
31 Vanermen and Stienen 2019
32 Dierschke et al. 2016
33 Vanermen and Stienen 2019
34 Vanermen and Stienen 2019

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	SUB-GROUP	
Birds	Migratory land birds	• Other migratory species that might encounter offshore wind farms are at lower risk of collision and displacement because: (i) the use of active, flapping flight provides the ability to cross much larger water bodies than soaring birds, and to more readily avoid offshore turbines; (ii) some groups (e.g., geese) are especially averse to risk and may deviate away from wind farms at considerable distance; and (iii) many species migrate on a broad front[35] or they use well-established routes that minimize time spent over water.[36] • However, risks may be increased during poor weather, thereby reducing flight height or visibility, and by bright lighting at night that can attract and dazzle nocturnal migrant passerines and some seabirds.
Bats	Migratory species and those foraging over marine waters	• Although information about bat migration is still relatively limited, some species are known to migrate large distances (up to 4,000 km[37]) and are known to occur seasonally offshore, including in the area of operational wind farms,[38] and to sometimes accumulate in large numbers on stopovers on islands and peninsulas.[39] The intensity of bat migration appears to be highly dependent on low or moderate wind speeds.[40] • Compared to birds, there is little information on flight altitudes during migration due to the difficulties of surveying and measuring these parameters. However, while observed to fly low over the sea, they may also migrate at higher altitudes and potentially within the rotor swept area.[41] • Information on bat collisions with offshore wind turbines is very limited, although bats may be vulnerable as a result of investigative behavior and foraging around the nacelle and rotor blades as is observed at onshore wind energy facilities.[42] • Bats from coastal habitats, especially those that routinely forage over water (e.g., Pond Bat (Myotis dasycneme) in Europe) may also forage over the sea and encounter nearshore wind farms in particular.

35 For example, see Dokter et al. 2011 and Aurbach et al. 2020.
36 See Meyburg et al. 2003 and Bensusan et al. 2007.
37 Hüppop et al. 2019
38 Bach et al. 2017
39 Ahlén et al. 2009; Rydell et al. 2014
40 In Hüppop et al. 2019
41 Hüppop et al. 2019
42 Barclay et al. 2017

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	**SUB-GROUP**	
Fish	Bony and cartilaginous species from different functional groups including benthic, demersal, pelagic, and migratory	• How fish may be affected by offshore wind farms depends on their life stage and the intensity and duration of any effects. Assessment of the potential impacts also needs to consider the existing status of, and pressures upon, fish assemblages.[43] • Risks to fish include: – Habitat losses and gains (e.g., linked to installation of foundations on the seabed, and presence of infrastructure in the water column), and changes in habitat condition (e.g., linked to hydrodynamic changes in the water column linked to turbine infrastructure). – Underwater noise has the potential for lethal, sub-lethal, and behavioral impacts, particularly for groups considered to be hearing specialists, like gadoids and especially clupeids.[44] – Barrier and displacement impacts on migratory fish (e.g., salmonids and eels).[45] – Potential physiological electromagnetic field impacts on fish with electroreceptors (such as sharks, rays, sturgeons, and lampreys)[46], although further study is required. • Construction (and decommissioning) of offshore wind farms may generate acute, short-term effects; although the operational phase may have longer-term impacts, primarily associated with the creation of new hard-substrate habitat (e.g., in the form of turbine foundations and rocky scour protection where there was once soft seabed, or open pelagic environment).[47] • Some fish species are known to benefit from the refuge (especially from restrictions on commercial fishing activity due to the presence of cables and other structures) or reef effects associated with offshore wind farms.[48] Introduced hard substrate is colonized by dense benthic communities (potentially with the risk that these are favored by introduced and non-native species[49]) that then attract benthic and demersal fish species, as well as larger predators.[50] However, the longer-term effects of these trophic changes at the ecosystem level are not yet well understood.[51]

43 Gill and Wilhelmsson 2019
44 For example, Popper 2000; Hawkins and Popper 2017.
45 Gill and Wilhelmsson 2019
46 Gill and Wilhelmsson 2019
47 Gill and Wilhelmsson 2019
48 Hammar et al. 2015
49 Kerckhof et al. 2016
50 Gill and Wilhelmsson 2019
51 As a result of these new communities, there is potential for cascading effects through the food web that ultimately create resources for apex predators, or conversely affect primary production in the surrounding areas (e.g., via a large biomass of colonized filter-feeding bivalves) with associated changes in ecological communities.

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	**SUB-GROUP**	
Marine mammals	Cetaceans and pinnipeds	• Different species of marine mammals are likely to naturally occur in all offshore wind farms.[52] Underwater noise impacts associated with construction (and decommissioning) are potentially severe but typically short-lived. Operation and maintenance impacts are likely to act over the lifetime of the project, especially link to ecosytem change.[53] • Marine mammals are potentially at risk of: – Habitat change that may include areas used for foraging, resting, breeding, or socializing. – Disturbance and physiological damage by underwater noise (including behavioral, sub-lethal, or even lethal effects). – Barrier and displacement effects (e.g., on local and residential species or on migrating species). – Effects and impacts associated with vessel traffic (noise and vessel strike). • Piling, or pile driving, is currently the most widely used installation method for foundations, which generates substantial levels of low-frequency impulsive noise that propagates over large distances and theoretically may be heard over tens of kilometers by sensitive species.[54] Potential impact is generally assessed in terms of potential hearing damage, from permanent threshold shift closer to the source, to temporary threshold shift further away. • Large cetaceans (whales) are most at risk from vessel collision, but all species of marine mammals are potentially at risk,[55] with the threat not limited to faster-moving vessels.[56] Vessel movements and related noise may also disturb and displace marine mammals, including pinnipeds at haul-out sites above water. • Marine mammals may be attracted to the new benthic and fish communities associated with introduced hard substrates, and thereby benefit from the reef effects associated with offshore wind farms.[57] • Impacts on marine mammals may be associated with particular seasons (e.g., breeding and migration), or have more permanent impacts for local resident populations.

52 Nehls et al. 2019
53 Nehls et al. 2019
54 Nehls et al. 2019
55 Cates et al. 2017
56 Kelley et al. 2020
57 Russel et al. 2024

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	SUB-GROUP	
Sea turtles		• The potential impacts of offshore wind farms on sea turtles are currently poorly known, largely because of the geographical focus of large-scale development to date. However, impacts are likely to include: − Habitat disturbance, especially when breeding and nesting,[58] which might be related to the export cable landfall. − Underwater noise.[59] − Vessel strike (when surfacing). − Physiological electromagnetic impacts. • Turtles may also be attracted to the new benthic and fish communities associated with introduced hard substrates, and thereby potentially benefit from any reef effects of offshore wind farms.
Natural habitats		• Natural habitats are defined as "areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition."[60] Many marine, intertidal, and coastal habitats are likely to meet this definition. Some will also provide important ecosystem services. Natural habitats may also support communities of species (e.g., benthic communities) not specifically captured in this table, but which may be themselves threatened or range-restricted. Thus, it is important to understand habitat conservation importance when determining the significance of the potential impacts of offshore wind farms. • Examples of natural habitats to consider include: − Habitats of conservation importance, and those potentially more sensitive to impacts, such as sandbanks, oyster beds, wetlands, seagrass beds, mangroves, intertidal habitats, rocky outcrops, coral, and chalk reefs. − Threatened and/or unique ecosystems such as those listed on the IUCN Red List of Threatened Ecosystems,[61] or otherwise identified as high priorities for conservation in national or regional planning. • Key impacts on natural habitats include habitat loss, degradation, fragmentation, and transformation associated with the physical presence of offshore wind farm infrastructure. Introduction of invasive alien species (e.g., via construction vessels, ballast water, and materials) is also a risk. • At construction, the relatively small footprint of turbines, and their wide spacing, means the area of original seabed affected is generally very small, with little habitat loss for the original fauna. In the intertidal and coastal zones, where the offshore wind farm export cable makes landfall, and where grid connection facilities could be constructed, habitat loss has the potential to be more significant, especially for sensitive habitats of conservation significance (e.g., coral reef, mangroves, or seagrass habitat). Habitat loss during decommissioning will depend on the methods used at that stage.

58 NOAA Fisheries 2017
59 Samuel et al. 2005; Inger et al. 2009
60 IFC 2012b
61 IUCN-CEM 2022

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	SUB-GROUP	
LPAs, IRAs, and other designated areas of biodiversity importance		– KBAs are the most important places in the world for species and their habitat. The KBA designation approach builds on the experience of Important Bird and Biodiversity Areas,[69] AZEs (the most important sites for preventing global species extinctions), Important Plant Areas, Prime Butterfly Areas, and KBAs for freshwater and marine species. The KBA standard[70] harmonizes these existing approaches with a set of eleven criteria for identifying KBAs. – Ramsar sites are rare or unique wetland types, and sites of international importance for conserving biological diversity. The definition of wetland is broad,[71] including all lakes and rivers, underground aquifers, swamps and marshes, wet grasslands, peatlands, oases, estuaries, deltas and tidal flats, mangroves and other coastal areas, coral reefs, and all human-made sites such as fish ponds, rice paddies, reservoirs, and salt pans. Marine habitat types could be at risk from offshore installations and cabling, and non-marine wetland habitat types from export cable landfall and/or the shore-based transmission infrastructure for offshore wind farms. • To align with IFC Performance Standard 6,[72] development within LPAs and IRAs must align with requirements for natural and critical habitats and: (i) be legally permitted; (ii) be consistent with any recognized management plans for the area; (iii) involve consultation with key relevant stakeholders; and (iv) promote and enhance the conservation aims and effective management of the area. Achieving these requirements could potentially be incompatible with offshore wind development. Importantly, development in some LPAs and IRAs may not be acceptable for financing[73], including UNESCO Natural and Mixed World Heritage Sites and sites that fit AZE criteria.[74] • Other areas designated due to their ecological importance in the marine realm include EBSAs and IMMAs. They can range from relatively small-scale areas within national boundaries to much broader areas that span national borders (or extend into marine areas beyond national jurisdiction). While such areas are not legally protected or formally categorized according to the IUCN protected area system, alignment with international lending standards will depend on the biodiversity attributes for which they are designated. • Country-specific protected area designations that do not align with the LPA definition (above) may also exist. • The potential impacts of offshore wind development on LPAs, IRAs, and other types of area designated for ecological importance are related to the biodiversity attributes for which they are designated (see above in this table). Hence, the nature of any impacts and the risk to biodiversity is variable. Impacts could potentially undermine the objectives of protected area designation.[75] For example, coastal KBAs and Ramsar sites designated for important congregations of birds may be at risk of disturbance associated with export cable landfall. Offshore wind development within an IMMA may present a risk to seasonally migrating/breeding marine mammals.

69 The KBA program is the successor to and extension of BirdLife International's successful Important Bird Area approach, expanding to include all biodiversity whilst remaining closely aligned with standards already implemented in IBAs.
70 IUCN 2016
71 Ramsar 2024
72 IFC 2012b
73 See IFC 2019
74 Criteria can be found at zeroextinction.org
75 Note that IUCN World Conservation Congress Recommendation 2016-102, 'Protected areas and other areas important for biodiversity in relation to environmentally damaging industrial activities and infrastructure development' effectively asks governments, relevant authorities, companies, public sector bodies, and financial institutions to recognize all protected areas (LPAs, as defined above) and KBAs as 'no go' for industrial development. See IUCN 2016.

BIODIVERSITY ATTRIBUTE		SUMMARY OF POTENTIAL IMPACTS ON BIODIVERSITY ATTRIBUTES ASSOCIATED WITH OFFSHORE WIND
GROUP	**SUB-GROUP**	
Natural Habitats		• Natural habitat degradation can arise from construction activity (e.g., sediment resuspension and deposition) and the presence of the operational wind farm resulting in hydrodynamic changes, seabed scour, and patterns of upwelling and downwelling.[62] The potential significance of these impacts is related to the prevailing physical processes (e.g., currents and tidal excursion) (see Annex 6.2). • Natural habitats could be affected by ecosystem change through: − The introduction of new hard substrate and its subsequent colonization by new benthic communities. − Attraction of higher trophic level species (the artificial reef effect).[63] − The exclusion of destructive types of commercial fishing (e.g., trawling) that otherwise damage natural habitats (refuge effect). • Reef and refuge effects create the potential for positive effects on (or in) some natural habitats (depending, for example, on the sustainability of any associated fishing activity).
LPAs, IRAs, and other designated areas of biodiversity importance		• LPAs are defined by IUCN (and in WBG standards) as "any clearly defined geographical space recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values." [64] This definition is expanded by six categories as defined in the IUCN Protected Area Categories System: Ia) strict nature reserve; Ib) wilderness area; II) national park; III) natural monument or feature; IV) habitat/species management area; V) protected landscape or seascape; and VI) protected areas with sustainable use of natural resources.[65] Areas proposed by governments for such designation may also be considered as LPAs. The level of protection afforded to each of these protected area types, and the activities permitted within them, varies. • IRAs are sites of recognized importance to biodiversity conservation, though they are not always legally protected. WB and IFC standards define IRAs as: − Performance Standard 6[66]: UNESCO Natural World Heritage Sites, UNESCO Man and the Biosphere Reserves, Key Biodiversity Areas, and wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention). − WB Environmental and Social Standard 6[67]: areas of high biodiversity value including World Heritage Natural Sites, Biosphere Reserves, Ramsar Wetlands of International Importance, KBAs, Important Bird Areas (IBAs), and Alliance for Zero Extinction (AZE) Sites, among others. • More detail on sites defined as IRAs: − UNESCO Natural World Heritage Sites are sites of outstanding universal value, for example because they contain the most important and significant natural habitats for in-situ conservation of biological diversity, including threatened species.[68] − UNESCO Man and the Biosphere Reserves are for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity.

62 Broström et al. 2019
63 Danheim et al. 2019
64 Dudley 2008; IFC 2012
65 Dudley 2008
66 IFC 2012b
67 World Bank 2016b
68 One of ten criteria used to identify outstanding universal value.

Annex 3.2: Social Attributes and Potential Impacts and Outcomes of Offshore Wind Development

This Annex summarizes the social attributes that could be susceptible to impacts of offshore wind development and provides a definition for each group. It also summarizes the potential impacts of offshore wind development in terms of outcomes on affected people and assets.

These social attribute groups are not exhaustive and not intended to restrict the identification of the social attributes of the highest potential sensitivity to offshore wind development in an implementing country. The list of attributes should be tailored to the particular country context. Lessons learned from offshore wind development to date indicate that aspects of social wellbeing can be sensitive to the construction and operation of offshore wind energy facilities and that addressing social concerns too late in the process has led to opposition to wind developments[76] and negative social outcomes.[77] There is limited knowledge about the effects and implications of offshore wind development for social attributes, and the outcomes of development are strongly influenced by context, the vulnerability of the coastal communities, as well as social factors such as place attachment, sense of identity, dependence on marine natural resource livelihoods, and perception of risks.[78] The potential effects on local communities are not yet fully understood[79] but they could represent significant, complex, and adverse implications for their livelihoods, wellbeing, resilience, and social cohesion.

76 McKeegan and Torres 2021

77 It may also be necessary to consider those who live and work in non-coastal municipalities adjacent to coastal ones, for example where that community has a relationship with the marine environment.

78 Esteves et al. 2017

79 Stelzenmüller et al. 2020

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
COASTAL COMMUNITIES		
Coastal municipalities	Municipalities that border the marine area (i.e., where land and marine water meet). Municipalities without such a border are non-coastal. It may be necessary to consider non-coastal municipalities adjacent to coastal ones, for example where that community has a relationship with the marine environment. Depending on the national context, other relevant local administrative units could be used to identify and define coastal communities.	Coastal communities' livelihoods, values, and way of life are typically closely linked to activities and landscapes at the coast and sea. These aspects may be particularly vulnerable to the risks posed by offshore wind development. Coastal communities are at potential risk of physical and economic displacement related to the land required for onshore infrastructure, e.g., cable landing points, onshore grid connections, cable routes, and substations. There may also be health and safety hazards related to marine navigation.[80] There is a risk of increased social and economic vulnerability arising from reduced income, food security, and wellbeing. Coastal communities may experience increased community conflict due to wind farm developments.[81] There may also be socioeconomic benefits associated with offshore wind farm development, for example in terms of opportunities for jobs, training, and economic benefits, and in terms of championing GIIP with respect to ethnic diversity, gender balance, and equality across the workforce.[82]
Indigenous Peoples	Indigenous Peoples within the SenMap area[83] are defined in line with IFC Performance Standard 7. The term "Indigenous Peoples" (or as they may be referred to in the national context using an alternative terminology[84]) is used to refer exclusively to a distinct social and cultural group possessing the following characteristics in varying degrees: • Self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others; • Collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources in these habitats and territories; • Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture; or • A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.	Offshore wind development, and related coastal activities, may disproportionally impact Indigenous Peoples due to the close connection between natural resources and Indigenous Peoples' livelihoods, food security, and cultural heritage. This may include the loss or revocation of land and sea rights, the loss of or reduced access to common or individual land and natural resources, including fisheries, and/or the destruction of, or restricted access to, historical areas, features of worship or cultural heritage. Impacts on access to fishing resources is particularly significant. This is because, on average, coastal Indigenous Peoples' per capita consumption of seafood is 15 times higher than non-Indigenous country populations.[85] Compared to other coastal communities, the potential effects on Indigenous Peoples may be exacerbated by pre-existing vulnerabilities. Such vulnerabilities exist due to increasing competition for land and other natural resources, the overexploitation of marine resources by industrial-scale activities, pollution, lack of participation in development, and other initiatives affecting their territories, ways of life and traditional knowledge. In addition, Indigenous Peoples may experience the loss or erosion of skills and heritage, including traditional ceremonies, livelihoods, and techniques related to the coastal and marine environment.

80 McKeegan and Torres 2021
81 Avila-Calera 2017 and selected cases from the Global Atlas of Environmental Justice 2024.
82 World Bank Group 2021a
83 See Task 1.1 for guidance related to defining the sensitivity mapping area.
84 Also referred as "indigenous ethnic minorities," "aboriginals," "hill tribes," "vulnerable and marginalized groups," "minority nationalities," "scheduled tribes," "first nations," or "tribal groups."
85 Cisneros-Montemayor et al. 2016

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
FISHERIES & AQUACULTURE[86]		
Subsistence fisheries	Subsistence fisheries refers to activities undertaken by fishing households whose capture is predominantly (>50 percent) consumed by their own household with no major transaction occurring at the marketplace.	The majority of households estimated to engage in subsistence fishing are found in lower and lower-middle income countries.[87] Subsistence fishing provides a critical source of food and nutrition and can serve as a safety net for vulnerable households in coastal environments, particularly during crisis or times of hardship.[88] The potential impacts of offshore wind development on subsistence fisheries include exclusion from and displacement from fisheries or landing sites. These may lead to increased operational costs (e.g., increased travel time, fuel costs, etc.) and decreased productivity (reduced catch per unit of effort), potentially resulting in reduced food and nutrition security and reduced wellbeing. Increasing climate change induced stressors may compound these impacts and further undermine the resilience of subsistence fishing households.
Commercial fisheries	Commercial fisheries include households where at least one member engages in market-oriented activities spanning the entire fishery value chain, from pre-harvest through harvest to post-harvest activities (such as processing and trading), with the primary objective of generating cash revenues. Commercial fisheries can be categorized into two main groups: (i) artisanal and small-scale, and (ii) semi-industrial and industrial.	The potential impacts of offshore wind on both small and industrial-scale commercial fisheries largely mirror one another but are different in scale. There is limited information on the socioeconomic impacts of offshore wind developments on industrial fisheries in emerging market countries.[89] Based on evidence largely from Europe, there may be a modification of fleet or fishing method (e.g., to target different species or areas), leading to increased cost and decreased catch.

86 These is no agreed, international definition for the various sub-sectors of fisheries and aquaculture. Moreover, there is often some degree of overlap between them. Small-scale fisheries may include those activities that are commercial in nature and aimed at generating cash revenue as well as activities for which the capture is primarily consumed at the household level. The SenMap Lead should refer to the relevant national legal and regulatory frameworks in the implementing country as these instruments may include definitions for operational designations.

87 An October 2023 study published in Nature Food estimated this to be 60 percent (Virdin et al. 2023).

88 Virdin et al. 2023

89 Current knowledge about the potential impact of offshore wind on industrial fisheries is mostly from Europe and is largely related to ecological impacts. There is a knowledge gap regarding economic and social ones (Stelzenmüller et al. 2020).

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
Commercial fisheries	• **Artisanal and small-scale fisheries** Small-scale fisheries typically involve fishing households (as opposed to commercial companies), using a relatively small amount of capital and energy and relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption. In practice, definition varies between countries, e.g., from gleaning[90] or a one-man canoe to more than 20-meter trawlers, seiners, or long-liners. Small-scale fisheries captures can be traded for local consumption or export. They are sometimes referred to as artisanal fisheries.[91] • **Semi-industrial and industrial fisheries** Semi-industrial and industrial fisheries typically have a higher level of technology, investment, and impact. Typically, these fisheries use larger, mechanized boats equipped with technology capable of efficient, very large catches. Boats may stay out on fishing trips anywhere from a few days to several months. It includes purse seiners, trawlers, long-liners, and others. Although a clear boundary to the definition does not exist, these are generally established in national legal frameworks.[92]	Key socioeconomic impacts of offshore wind on commercial fisheries could include exclusion from and displacement of fishers from fisheries[93] both of which could have wider impacts beyond the scale of an individual project footprint. Unpublished impact assessments of offshore wind in emerging economies have documented concerns related to the wind farm siting and safety exclusion zones. These include the permanent and/or temporary loss of, or restricted access to, fishing grounds and gleaning areas. There may also be changes or restrictions to navigation routes and rules for fishing boats. The potential effects of these impacts on both groups of fishers and the associated communities are similar. There may be increased social and economic vulnerability arising from loss of jobs and informal livelihoods associated with industrial fishing,[94] reduced food security, and reduced wellbeing. The resulting unemployed workforce may emigrate, leading to increased vulnerability of both migrants and family members that stay behind. These impacts may also increase conflict arising from increased competition for resources, leading to unsustainable resource use and reduced income per fleet,[95] and increased expenditure for fishers. Reduced income and revenue from fishing and activities related to fishing, and from shore-based gleaning, may lead to increased poverty and food insecurity. Gleaning activities are performed mostly by women and children worldwide,[96] and there are gendered impacts associated with loss of financial independence, food security, and social status (see Box 3). There may be increased competition for available resources.[97] A loss of skills, heritage, and ways of life may also be experienced by affected communities.

90 Gleaning is a fishing method used in shallow coastal, estuarine, and freshwaters waters or in habitats exposed during low tide. Other terms may be used for this type of fishing, such as "gathering" or "collecting." Both women and men glean, but in many countries and regions gleaning is mostly done by women and children. Gleaners walk in the shallow water or on the exposed land, and pick up the snails, shells, sea cucumbers, urchins, seaweed, and fish. Gleaning often occurs during the day but can also happen at night with flashlights or lanterns. This definition is from genderaquafish.org. For more information on gender roles in fisheries and aquaculture and further details on gleaning, see https://genderaquafish.org/stories/gleaning.htm.

91 FAO 2014

92 World Fisheries Trust 2008

93 European Commission 2021

94 Most jobs related to industrial fisheries and aquaculture are unskilled and semi-skilled. Employability and livelihood diversification opportunities of these persons in other sectors in the same location is likely to be very limited.

95 The fishing effort is a measure of the amount of fishing. Typically, a surrogate is used that relates to a given combination of inputs into the fishing activity, such as the number of hours or days spent fishing, numbers of hooks used (in long- line fishing), kilometers of nets used, etc. The European Union defines fishing effort as fleet capacity [tonnage and engine power (kW)] x days at sea (EU 2017, 14).

96 For further information, see https://genderaquafish.org/stories/gleaning.htm.

97 Mee 2006

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
Aquaculture	Aquaculture refers to farming of aquatic organisms including finfish, mollusks, crustaceans, and seaweed. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, or protection from predators. Farming also implies individual or corporate ownership of the stock being cultivated; the planning, development, and operation of aquaculture systems, sites, facilities and practices; and the production and transport. It is generally aimed at generating cash revenues and may include both small-scale (or artisanal) and industrial aquaculture oriented for profit. Aquaculture offers a variety of socioeconomic benefits through the supply of highly nutritious foods and commercially valuable products, providing jobs and creating income, especially in remote areas. However, it may also have negative social and environmental impacts where sustainable practices are not used. Many semi-skilled and unskilled jobs related to aquaculture have large, positive socioeconomic effect in coastal communities with traditionally high unemployment rates.[98] Globally, at least 20 percent of direct jobs are female.[99] When post-harvest operations data are included, it is estimated that globally one in two workers in the sector is a woman.[100] • **Artisanal and small-scale aquaculture** As with fisheries, there is no universal definition for artisanal and small-scale aquaculture, but it refers to small-scale production usually managed at family level.[101] • **Industrial aquaculture** Industrial aquaculture refers to large-scale, inland, coastal, and offshore farming systems.	The potential effects on the associated communities are generally expected to be the same as those above for fishing. However, unskilled and semi-skilled jobs directly and indirectly related to aquaculture are difficult to replace because it requires there to be another locally-based industry that is labor intensive. The risks associated with small-scale aquaculture are similar to those for artisanal and small-scale fisheries (see above). Farming areas and aquaculture activities are typically impacted where offshore wind infrastructure is located within or close to these areas. Aquaculture activities can be permanently or temporarily displaced, leading to loss of income and livelihoods. Those activities located close to offshore wind development could be impacted by increased turbidity[102] and impacts on water quality during construction. The risks associated with industrial aquaculture are similar to those for artisanal and small-scale aquaculture and fishing but differ in terms of scale.

98 Buck et al. 2018
99 Buck et al. 2018
100 FAO 2020
101 For further description of the terms ‘artisanal’ and ‘small-scale’, see https://www.fao.org/artisanal-fisheries-aquaculture-2022/about/en/.
102 Vanhellemont and Ruddick 2014

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
Processing	Processing encompasses those resources caught in fisheries or produced through aquaculture that are later prepared (usually inland) for consumption and sale, involving activities including, but not limited to, cleaning, cooking, canning, smoking, salting, drying, or freezing.[103] Processing activities may be required for both industrial and artisanal/small-scale production.	Fisheries and aquaculture have added value as they generate additional employment and income in the form of spin-off and support industries that deal with marketing, supply, product distribution, processing, packaging, etc. Restricting fisheries and aquaculture activities over large areas may lead to the shutdown or reallocation of those support activities, including associated industries and logistics. In these cases, reallocation might be caused by changes in landing sites. Processing activities and facilities may be closed or displaced due to wind farm onshore infrastructure. The potential effects on associated communities are delete related to the impacts on fishing and aquaculture described above. The consequences for coastal communities may be more severe where they are highly dependent on industries related to fishing and aquaculture and where there is limited opportunity for employment in other sectors. As with small-scale fisheries, the potential social outcomes are highly gendered. Workers at fish processing plants are mostly female (approximately 90 percent of all seafood processing workers worldwide) while workers at associated logistics jobs are mostly male.[104]
Cultural heritage		
Tangible MUCH	The concept of MUCH refers to both tangible (submerged or onshore but linked to the marine environment) and intangible heritage.[105] Tangible cultural heritage, as defined in IFC Performance Standard 8 Cultural Heritage [106] includes: movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance.	Offshore wind development may result in the permanent destruction, removal, exposure, damage, burial, or other disturbance of tangible MUCH (e.g., during construction, operation, or decommissioning or because of changed hydrodynamic conditions).[107] Partial or total damage of tangible MUCH is permanent, and the intrinsic vulnerability of a cultural heritage is related to its rarity, value, or cultural and historical importance.[108] As a result, individuals and communities may experience a disrupted sense of place and identity and of social-community relations. There may also be a loss of income and reduced opportunities for education, tourism, and development.

103 This definition is from the FAO Terminology Portal available at https://www.fao.org/faoterm/en/.
104 Castano Isaza et al 2021
105 UNESCO–IOC 2021
106 IFC 2012e
107 Mainstream Renewable Power LTD 2012; Manders 2011; Pater 2020
108 Mainstream Renewable Power LTD 2012

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
Tangible MUCH	Tangible cultural heritage may be located in urban or rural settings and may be above or below land or under the water. It includes underwater and coastal antiquities, coastal archaeological sites, and traditional material cultures such as fishing and marine communities, traditional gear and instruments, boats and ships, lighthouses, unique houses and shelters, and their construction materials. It also includes critical cultural heritage, which consists of one or both of the following types of cultural heritage: (i) the internationally recognized heritage of communities who use, or have used, within living memory the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designation. Legally protected cultural heritage areas include World Heritage Sites and nationally protected areas. The uniqueness of underwater cultural heritage is codified in the 2001 UNESCO Charter as: "All traces of human existence having a cultural, historical, or archaeological character which have been partially or totally underwater, periodically or continuously, for at least 100 years such as: (i) sites, structures, buildings, artifacts, and human remains, together with their archaeological and natural context; (ii) vessels, aircraft, other vehicles, or any part thereof, their cargo or other contents, together with their archaeological and natural context; and (iii) objects of prehistoric character." However, some countries have their own legal definition of underwater cultural heritage which should be applied when implementing the SenMap approach.	To align with IFC standards, developments must meet IFC Performance Standard 8 requirements where applicable, including those for critical cultural heritage. Where areas are legally protected cultural heritage areas, developments must also comply with defined national or local cultural heritage regulations or the protected area management plans; involve consultation with key relevant stakeholders; and promote and enhance the conservation aims and effective management of the area. Where a wind farm project may significantly impact on critical cultural heritage that is essential to the identity and/or cultural, ceremonial, or spiritual aspects of Indigenous Peoples lives, priority will be given to the avoidance of such impacts. Where significant project impacts on critical cultural heritage are unavoidable, the project proponent must obtain the Free Prior and Informed Consent of the affected communities of Indigenous Peoples. Achieving these requirements could potentially be incompatible with offshore wind development. When conducting the sensitivity scoring, the SenMap Lead should be aware of exclusion areas that are recognized by governments and/or IFIs where development may not be acceptable for financing, such as UNESCO Natural and Mixed World Heritage Sites.[109]

109 IFC 2019

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
Intangible MUCH	Intangible cultural heritage, as defined in IFC Performance Standard 8,[110] includes practices, representations, expressions, knowledge, and skills—as well as the instruments, objects, artifacts, and cultural spaces associated therewith— that communities and groups recognize as part of their cultural heritage, as transmitted from generation to generation and constantly recreated by them in response to their environment, their interaction with nature, and their history. Intangible MUCH attributes encompass the unique ethos and identity of places such as fishing villages, the skills to build boats and ships, and other traditional work-related techniques. Coastal sites, activities and features of coastal culture, and tradition considered meaningful for its inhabitants and visitors are also intangible heritage. The marine cultural land and seascape and its signatures of past human behavior and activities are also embedded in this social attribute.	Offshore wind development may result in impacts to intangible MUCH if traditional activities and practices are prevented or disrupted by development (e.g., through an exclusion zone), and may ultimately lead to the loss or erosion of features of coastal culture. The suspension of a traditional activity may result in the loss of the traditional knowledge and skills related to it (e.g., skills to build traditional fishing gear and boats). There may also be impacts on the ability of individuals and/or communities to appreciate meaningful places due to the visual impact of wind turbines. Similar to tangible MUCH, communities and individuals may experience a disrupted sense of place, identity, and social relations due to these impacts, especially if they have a strong cultural identity connected to the coastal landscape and lifestyle. These connections can be gender specific (see Box 3). Conflict and opposition to offshore wind projects may arise due to potential changes in use and enjoyment of meaningful places.[111]
RECREATION & TOURISM		
Water sports **Natural tourist attractions** **Recreation and tourism infrastructure and housing**	Recreation and tourism attributes capture the relationship between locals, seasonal residents and tourists, and the people and places they enjoy, particularly in the coastal environment. Coastal tourists travel to the coastal zone for parts of the day, for weekends, for short vacations, and for prolonged stays. Most coastal tourism takes place along the shore and in the water immediately adjacent to the shoreline. Coastal tourism destinations fall along an urban-rural continuum from major cities and ports known for their cultural, historical, and economic significance, to relatively isolated and pristine coastlines valued for their natural beauty, flora, and fauna.[112]	Offshore wind development may cause a permanent loss of, or reduced access to, water sports areas or navigation routes for recreational and tourist boats (e.g., due to wind farm infrastructure and/or exclusion zones). Consequently, communities and individuals may lose income due to the reduced number of visitors and users and there may be a decline in (or cessation of) sporting activities and events. This may result in increased social and economic vulnerability arising from loss of jobs and/or informal livelihoods associated with water sports tourism and recreation, including negative effects on small and medium-sized enterprises. With these changes, there may be a reduced sense of place and identity for permanent and seasonal residents.

110 IFC 2012e

111 The Windpark Noordoostpolder project near the former island of Urk, The Netherlands, is an example. The residents of Urk experienced a variety of negative impacts associated with the wind farm, including a reduction in the aesthetic quality of their landscape and impacts on their community identification and place attachment. The project reduced leisure and recreation opportunities. Now part of the mainland, Urk is a former island and retains a strong independent identity and a sense of 'islandness'. The windfarm project generated strong feelings and has mobilized community action against the project. See Langborek and Vanclay 2012.

112 Miller and Hadley 2005

SOCIAL ATTRIBUTE	DEFINITION	SUMMARY OF POTENTIAL IMPACTS AND OUTCOMES ASSOCIATED WITH OFFSHORE WIND
Water sports **Natural tourist attractions** **Recreation and tourism infrastructure and housing**	Water sports include activities that take place on or under the water, including surfing, snorkeling and diving, windsurfing, recreational fishing, boating, and sailing. Natural tourist attractions include tourist beaches, important or attractive land and seascapes, animal watching (e.g., birds, dolphins, and whales), and any other nature-based attractions. Recreation and tourism infrastructure and housing captures the facilities and dedicated infrastructure that support recreation and tourism, such as hotels, cruise ship terminals, ports and marinas, coastal promenades, camping areas, theme parks, restaurants, shops, and markets. It also includes residents' living environment in terms of viewshed and real estate value.	Due to wind farm infrastructure, there may be a direct loss of natural tourist attractions or lost or restricted access to them. There is a risk that offshore wind may bring changes to valued biodiversity and ecosystems enjoyed by visitors and residents, impact the natural beauty and quality of the coastline, and erode the value of "unspoiled" nature.[113] Offshore wind development may reduce—or be perceived to reduce—the attractiveness of the area affecting the numbers of visitors and causing visual impacts on seascapes and coastal landscapes.[114] It may also offer an opportunity to create new destinations for recreational activities. Residents and property owners may be displaced due to the siting of onshore infrastructure (e.g., onshore grid facilities). It is noted that although negative effects on local property values due to visual impacts and proximity of wind project infrastructure is often raised as a stakeholder concern, there are very few studies addressing this topic. Where property value impacts of offshore wind projects have been studied, the evidence does not show an effect.[115]

113 McKeegan and Torres 2021

114 A 2017 study, published in *Marine Policy*, of a theoretical windfarm on the Catalan coast of Spain estimated a significant seasonal welfare loss due to tourists seeking Catalan beaches without offshore wind farms (Voltaire et al. 2017). For further reading on offshore wind and tourism, see the case studies on the Netherlands, Germany and Estonia here: https://maritime-spatial-planning.ec.europa.eu/sector-information/tourism-and-offshore-wind

115 A 2018 large-scale analysis from Denmark did not a significant effect on property prices when turbines are in view from a property or nearest beach. See Jensen et al. 2018.

Annex 4: High-level Steps for Setting up a Geodatabase

The SenMap approach is driven by spatial data. The volume of E&S data and information for consideration could be very large and variable in terms of type, quality, and utility. A robust process for data handling, management, and quality assurance will be essential. It is recommended that a geodatabase is established to centralize E&S data, facilitate consistency in data handling and management, and provide the basis for sensitivity mapping in Step 4. Note that it may be appropriate to use, follow, or integrate with existing government mechanisms or systems for handling and managing spatial data. The geodatabase should be designed according to GIIP to store, query, and manipulate geographic information and spatial data.[116] It should be set up and managed by an appropriately experienced GIS specialist familiar with good practice protocols. Consideration can be given to enabling visualization and supporting collaborative data sharing and access (e.g., via online spatial mapping environments).

In summary, steps to establish a geodatabase based on GIIP are as follows:

- Identify the preferred geospatial platform (e.g., commercial packages like ArcGIS (https://www.esri.com/en-us/arcgis/about-arcgis/overview), or open-source alternatives such as QGIS (https://qgis.org/en/site/)).
- Collate data and define the geodatabase.
- Establish permissions for data use and confirm any access limitations.
- Compile data, standardize it to a national-level coordinate system, and apply a consistent metadata standard to describe all the data layers.
  - Note that some large countries (e.g., Brazil) have more than one coordinate system, which will require additional attention during spatial analyses.
  - Metadata standards are used to describe the data using the properties of digital data, such as information on extent, quality, spatial, and temporal aspects (e.g., INSPIRE (https://inspire.ec.europa.eu/id/document/tg/metadata-iso19139), Federal Geographic Data Committee (https://www.fgdc.gov/metadata/geospatial-metadata-standards), or International Organization for Standardization (https://www.iso.org/standard/53798.html)).

116 Ehler and Douvere 2009; Nylén et al. 2019

- Develop a geodatabase structure for the geospatial layers, for example by data model (e.g., raster and vector), scale (e.g., global, national), data source, or feature dataset (e.g., species, habitats, coastal communities, and artisanal fisheries).
- Consider data sharing and access, for example by leveraging web-based data portals for visualization or online mapping platforms for participatory and collaborative mapping (see also Section 7.3).
    - An online portal could be designed to engage stakeholders and facilitate collaboration between various parties. All the available datasets can be visualized together, which can support the identification of data gaps (e.g., ArcGIS (https://www.esri.com/en-us/arcgis/about-arcgis/overview) or open source alternatives like MapServer (https://mapserver.org/), GeoTools (https://geotools.org/)), or SeaSketch https://www.seasketch.org/).

Annex 5: Example Guidance and Tools for Sensitivity Mapping

This Annex provides example guidance and tools for sensitivity mapping. Most of the available guidance is focused on environmental, ecological, and/or biodiversity sensitivity, with some references to socioeconomic sensitivity in various sources. This likely reflects the better availability of spatial biodiversity data compared to spatial data for social attributes. Examples of guidance include:

- **The European Union's Wildlife Sensitivity Mapping Manual** (2020): This interactive manual is a compendium of the information necessary to develop wildlife sensitivity mapping approaches to inform renewable energy deployment. It includes extensive references to other supporting documents and sources. The manual notes that wildlife sensitivity mapping is a key instrument in mitigating renewable energy impacts on protected species and habitats and that it is most appropriate as part of strategic planning at the regional and national scale. The manual provides an overview of wildlife sensitivity mapping, and steps for wildlife sensitivity map development (including compiling and preparing datasets, developing a scoring system, mapping resources, identifying transmission and constraints, and GISpresentation). It notes that most wildlife sensitivity mapping approaches provide a gradient of sensitivity (i.e., a scale), and that factors enhancing sensitivity generally fall into these categories: (i) species characteristics including migratory behavior, behavioral traits, and morphology; (ii) habitat characteristics like fragility and habitat-species associations; (iii) conservation status; and (iv) population dynamics such as life history traits and proportion of the global, regional, and/or national population potentially affected. The manual gives a theoretical example of a sensitivity scoring system, where species are scored in relation to their sensitivity to a form of renewable energy on a scale of Low/None, Medium, High, Very High, and Extremely High. The spatial distribution of the species is then fitted to a grid system. Within each grid square, the scores of those species present are summed to give an overall score for each grid cell, and therefore a rudimentary sensitivity map.[117] The manual includes a review of 24 wildlife sensitivity mapping exercises, with key observations including: (i) most examples are for wind energy; (ii) there is no single, universal approach to sensitivity mapping—rather, each is a "custom-made response to specific regional circumstances;" and (iii) most approaches emphasize that sensitivity maps do not negate the need for more substantive site-level assessment.

117 European Commission 2020, 13–29

- **Sensitivity Mapping: Accelerating offshore wind expansion and protecting nature** (2023): BirdLife Europe and Central Asia and the Renewables Grid Initiative have produced a short video explainer that outlines how sensitivity maps are a powerful tool for protecting nature while facilitating the necessary rapid transition to renewable energy.
- **Mapping Environmentally Sensitive Assets** (MESA) (2020): The United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC) MESA tool is a step-by-step protocol for developing an environmental sensitivity atlas based on a standardized methodology that was developed following a review of existing methods. It can be applied for a variety of uses including strategic planning and project management. The process involves identifying pressures (impacts) and ecological assets (such as protected areas), prioritizing assets, and producing an atlas that can be integrated into decision-making. The protocol uses GIS to produce the sensitivity atlas. It does not include socioeconomic assets, but it does note that these should be considered side-by-side with (not aggregated with) ecological assets in the decision-making process. An explanatory video introduction to sensitivity mapping and the MESA tool is also available.[118]
- **Environmental sensitivity mapping for oil and gas development: A high-level review of methodologies** (2019): While aimed at oil and gas development, this non-exhaustive review of sensitivity mapping approaches is more broadly applicable. It aims to provide guidance when selecting sensitivity mapping methods under different data availability scenarios and based on differing user capacities. The review notes that multiple approaches to environmental sensitivity mapping are described in the literature, often with similar stages but adapted to local contexts. It includes factsheets outlining the technical capacity and data requirements of several sensitivity mapping approaches, with a step-by-step summary of the respective methods. The review discusses the inclusion of socioeconomic activities (e.g., tourism and aquaculture) in sensitivity mapping, based on stakeholder consultation to identify priorities. The review notes that "the identification and mapping of sensitive biodiversity or socioeconomic assets should be a simple and exploratory process, with the aim of understanding the range and location of assets that may be affected by a given pressure. This first stage of developing a sensitivity map results in a combined map of potentially sensitive assets."[119]

Related to offshore wind in particular, the most prominent and credible examples of tools available are focused on birds and the potential for collision or displacement linked to offshore wind infrastructure. These include the following:

- **AVISTEP**, the Avian Sensitivity Tool for Energy Planning (2023), has been developed by BirdLife International to identify where renewable energy could impact birds and should therefore be avoided, and to ensure that facilities are developed in the most appropriate locations. AVISTEP provides a detailed spatial assessment of avian

118 Visit https://www.youtube.com/watch?v=ggF-j4l-6zE
119 NEA and UNEP-WCMC 2019, 7–9

sensitivity in relation to different types of renewable energy infrastructure (offshore wind, onshore wind, photovoltaic solar, and overhead power lines (transition and distribution)). Importantly, the assessments are precautionary and intended to provide an awareness of the at-risk bird species that could be present in an area, and what species composition might mean for renewable energy development. The tool is intended to inform, rather than replace, subsequent site-level evaluation. AVISTEP provides "spatial heat maps" (color-coded grid cells) that depict potential avian sensitivity. Each 5km x 5km grid cell has a sensitivity score, represented as Low, Moderate, High, or Very High sensitivity. AVISTEP suggests that High sensitivity areas may be unsuitable for development, and Very High sensitivity areas are likely to be unsuitable, and that mitigation measures will be required in both. The tool is supported by an instructional video and a Technical Manual and Supplementary Material detailing how sensitivity scores are calculated.[120] To date, AVISTEP supports four countries: India, Nepal, Thailand, and Vietnam.

- **Seabird Mapping and Sensitivity Tool** (SeaMaST) (2014/2019): SeaMaST is a GIS tool providing evidence of the use of sea areas by seabirds and inshore waterbirds in English territorial waters. The tool is grid-based (3km x 3km), and takes a quantitative, more complex approach than others outlined herein, calculating Species-specific Sensitivity Indices and producing maps for seabirds relevant to English waters. The methodology is publicly available[121] and considered relevant for assessment in other countries requiring management of marine areas for seabirds.
- **Soaring Bird Sensitivity Mapping Tool** (2014) is a planning tool for wind energy and other sectors, developed by the Migratory Soaring Birds Project—a partnership of BirdLife International, United Nations Development Programm, and Global Environment Facility, supported by several national independent organizations working together for soaring birds. The tool is designed to provide developers, planning authorities, and other interested stakeholders access to information on the distribution of soaring bird species along the Rift Valley and Red Sea flyway. This is the second most important flyway in the world for migratory soaring birds, using this corridor to move between breeding grounds in Europe and West Asia and wintering areas in Africa each year. The tool can help inform decisions on the safe siting of new developments like wind farms, ensuring that negative impacts on this important migration route are minimized. The Soaring Bird Sensitivity Mapping Tool uses six color-coded sensitivity categories: Unknown, Potential, Medium, High, Very High, and Outstanding. It is not a grid-based tool—users can define a location or area of interest and the tool generates an assessment (capturing species, IBAs, other protected areas, observations, and satellite tracks) with a summary of the sensitivity in one of these six categories. The tool is supported by an instructional guidance video.[122]

120 Serratosa and Allinson 2022
121 Bradbury et al. 2014
122 https://www.youtube.com/watch?v=nN_7kYwTzic

Annex 6: Supporting Information for Desk-based Data Collation, Screening, and Preliminary Sensitivity Scoring

This Annex summarizes existing datasets that can be consulted as part of desk-based data collation and screening. It also summarizes non-biodiversity information that could potentially be useful for understanding biodiversity in the SenMap area and informing the SenMap process.

Annex 6.1: Summary of Example Global Biodiversity Datasets

This table provides an overview of global biodiversity spatial datasets with global or regional coverage. These can be reviewed alongside country-level and local datasets, where available, to determine an initial list of biodiversity attributes likely to be most sensitive to the potential impacts of offshore wind.

BIODIVERSITY	DATASETS	OWNER/SOURCE
Birds	Atlas of Seabirds at Sea (AS@S)	National Research Foundation/South African Environmental Observation Network, BirdLife South Africa
	eBird	Cornell University Lab of Ornithology
	International Seabird Tracking Database	Birdlife International
Fish	FishBase	Froese, R. and D. Pauly. Editors. 2023. FishBase. Current version (10/2023)
LPA/IRA–marine mammals	IMMAs	Marine Mammal Protected Areas Task Force
LPA/IRA–multiple features	KBAs (also included in the IBAT–see below)	BirdLife International
	EBSAs	Secretariat of the Convention on Biological Diversity
	Natural and Mixed World Heritage Sites (also included in WDPA–see below)	IUCN
	Particularly Sensitive Sea Areas	International Maritime Organization
	WDPA–Protected Planet	IUCN, UNEP-WCMC
Natural habitat–benthic	Global Distribution of Seamounts and Knolls	Yesson et al. (2011).

BIODIVERSITY	DATASETS	OWNER/SOURCE
Natural habitat–corals	Global Distribution of Coral Reefs	UNEP-WCMC, WorldFish Centre, WRI, TNC (2018).
	Global Distribution of Cold-water Corals	Breiwald et al. (2017).
	Global Distributions of Habitat Suitability for Cold-water Octocorals	Yesson et al. (2012).
Natural habitat–ecoregions	Marine Ecoregions of the World	TNC (2019).
	Terrestrial Ecoregions	TNC (2021).
Natural habitat–intertidal	Global Distribution of Tidal Flat Ecosystems	Murray et al. (2019).
Natural habitat–landcover	Copernicus Land Cover (Climate Data Store)	European Space Agency
	Copernicus Global Land Service Global Land Cover	Buchhorn et al. (2020).
Natural habitat–mangroves	Global Distribution of Modelled Mangrove Biomass	Hutchison et al. (2014).
	Global Mangrove Watch v2.0	Global Mangrove Watch
	Global Mangrove Distribution, Aboveground Biomass, and Canopy Height	Simard et al. (2019).
	A Global Biophysical Typology of Mangroves	Worthington et al. (2020).
Natural habitat–multiple features	Global Ecosystem Typology	Keith et al. (eds.) (2020).
Natural habitat–seagrass	A Modelled Global Distribution of the Seagrass Biome	Jayathilake and Costello (2018).
	Global Distribution of Seagrasses	UNEP-WCMC and Short FT (2017).
Species–multiple	Aquamaps	Joint project of FishBase and SealifeBase
	GBIF	GBIF
	IUCN Red List of Threatened Species (Red List)	IUCN
	Movebank	Max Planck Institute of Animal Behavior, the North Carolina Museum of Natural Sciences, and the University of Konstanz
	Migratory Connectivity in the Ocean	Marine Geospatial Ecology Lab at Duke University
	Ocean Biogeographic Information System (OBIS)	OBIS
	SeaLifeBase	Palomares and Pauly. Editors. (2020).
	State of the World's Sea Turtles	Kot et al. (2018).
	Seaturtle.org	http://www.seaturtle.org
	Tagging of Pelagic Predators (TOPP)	TOPP
Other–Critical habitat	Critical habitat Layer	UNEP-WCMC (2017).

BIODIVERSITY	DATASETS		OWNER/SOURCE
Other—multiple datasets	Integrated Biodiversity Assessment Tool (IBAT) (Note—IBAT includes the IUCN Red List, WDPA, and KBA data)		IBAT Alliance
Example non-biodiversity datasets that may complement sensitivity mapping*	Bathymetry	General Bathymetric Chart of the Ocean (GEBCO)	GEBCO Compilation Group.
	Deadzones	Deadzones	Diaz and Rosenberg (2008).
	Geomorphology	World Seafloor Geomorphology	GRID Arendal (2019).
	Wind resource	Global Wind Atlas	Technical University of Denmark and World Bank Group, (2021).
	Physical processes	E.g.: Global Ocean Currents Database (Sun, 2018); OSCAR surface currents.	
	Remote sensing	E.g.: NASA Earth Observations Ocean datasets; Sea surface temperature; Sea surface salinity (both European Space Agency); Ocean colour (Ocean Colour Climate Change Initiative).	

*This list is not exhaustive. The utility of such datasets should be discussed with relevant stakeholders.

Annex 6.2: Other Data that Could Inform Sensitivity Scoring and Mapping for Biodiversity Attributes

Some types of non-biodiversity information could potentially be useful for understanding biodiversity in the SenMap area. For example, bathymetric data is often a key defining variable in species and habitat distribution, and dynamic physical processes (e.g., currents, fronts, upwellings, tidal rips and eddies, and river discharges) can contribute to biological diversity and productivity.

Waves, tides, and currents are the major physical processes acting in the ocean. They configure shorelines and the coastal zone, and influence seabed topography. They can be both constructive (e.g., depositional) and destructive (e.g., erosional). Thus, physical processes also influence species, habitats, and protected areas. Such features may underpin or contribute significantly to the distribution of biodiversity attributes (e.g., coral reefs, or specifically designated protected seabird colonies, see Annex 3.1). Physical processes are themselves potentially affected by offshore wind development and are considered in their own right in terms of engineering and design. The available evidence from the project-level is as follows.[123]

- ***Modification of tidal currents***: Offshore wind farms can decrease flows in the wake of a structure or accelerate the flows around the edges of the wind farm.
- ***Modification of the local wave regime***: All offshore structures modify the local wave regime to some extent, and all structures will be impacted by the local wave regime. The effect is primarily near-field, normally a reduction of wave height in the lee of structures.
- ***Sediment transport impacts***: including sediment plumes (resuspension or remobilization caused by installation activities), and deposition and erosion or scour associated with water flows around offshore structures. The extent of plumes depends on sediment type, grain-size distribution, and hydrodynamic regime. The impact of these plumes on local habitats has not been routinely determined, but they can be transported over large distances and potentially impact filter-feeding species, primary production, and the ability of visual predators to locate prey. Most research suggests that changes to sediment dynamics associated with offshore wind farms will be local, but the combined effects of multiple large wind farms could alter net sediment transport and deposition, affecting shorelines and bathymetry. Stronger currents may lead to stronger far-field effects.

123 A detailed synthesis of the available evidence of project-level offshore wind impacts on physical processes can be found in Rees and Judd (2019). At present, there is not enough evidence to conclude on the potential cumulative physical effects of multiple offshore wind farms.

At the seascape scale, physical processes combine with the distribution of biodiversity (species and ecosystems) and the ecological processes, patterns, features, and functions that are necessary for maintaining biodiversity[124] to give rise to effects at the ecosystem level. All these types of information are important for understanding the environmental context in which offshore wind development is planned. However, compared to the investigation of potential impacts on individual species or groups of species (e.g., from the site level), the complex potential effects of offshore wind farms at the ecosystem level are more difficult to define and are currently poorly understood.[125] They include, for example:

- ***Changes in atmosphere-ocean dynamics***[126] (e.g., through wind-wake eddies from turbines): these may have far-field effects much larger than the footprint of the wind farm, including effects on productivity and the subsequent implications for trophic systems (e.g., offshore windfarm-induced upwelling leading to increased fish production which attracts other fauna, potentially benefitting the fishing industry). Conversely, increased primary productivity could bring adverse effects including eutrophication, potential for toxic algal blooms, and increased near-seabed areas with low oxygen levels.
- ***Artificial reef effects***, where offshore wind farm infrastructure introduces new hard substrate habitats that are colonized, providing prey for other mobile species.[127] As a result of these new communities, there is potential for cascading effects through the food web that ultimately create resources for apex predators, or conversely affect primary production in the surrounding areas (e.g., via a large biomass of colonized filter-feeding bivalves) with associated changes in ecological communities.

The types of non-biodiversity information that could be available are potentially diverse, including for example bathymetry charts and charts representing physical processes and features (e.g., hydrographic charts showing the direction of prevailing currents). Specialists and those familiar with a country's maritime area are likely to be able to identify areas where such features exist or prevail. Such information could potentially be useful to inform sensitivity scoring (see Section 3.4),[128] on the advice of specialist stakeholders.

124 IFC Performance Standard 6 advocates an ecosystem approach to understanding the environment in which large-scale and complex projects are located (see IFC 2012b).
125 Perrow et al. 2019
126 See Broström et al. 2019
127 Dannheim et al. 2019
128 Or to consider alongside E&S sensitivity maps and maps of technical constraints, to inform spatial planning—see Chapter 7.

Annex 6.3 Summary of Example Global Social Datasets and National Data Sources

This table provides an overview of social spatial data, global datasets, and national data sources. This type of information should be reviewed alongside non-spatial sources (e.g., research reports and other existing literature) to determine an initial list of social attributes likely to be most sensitive to the potential impacts of offshore wind.

SOCIAL ATTRIBUTE	SPATIAL DATA	RELEVANT GLOBAL DATASET	EXAMPLE NATIONAL DATA SOURCES
Coastal communities	**Coastal municipalities** • Administrative limits of municipalities (or administrative unit) within the SenMap area • Related data also include the following: – World Bank's Global Subnational Atlas of Poverty https://maps.worldbank.org/datasets – Sustainable Development Goals (SDG) data and statistics SDG Data Alliance https://www.sdg.org/pages/about-us – Open SDG DataHub https://unstats-undesa.opendata.arcgis.com/ **Indigenous Peoples** • Location of Indigenous Peoples within the SenMap area • Territories with recognized rights by Indigenous Peoples	• Mapping Ocean Wealth Explorer: Coasts at Risk – https://maps.oceanwealth.org/ • Food and Agriculture Organization of the United Nations (FAO): The State of Food Security and Nutrition in the World (2023) and related data – https://data.apps.fao.org – https://www.fao.org/3/cc3017en/online/cc3017en.html – EM-DAT: The International Disaster Database https://www.emdat.be/ – Natural Disasters https://ourworldindata.org/natural-disasters • Natural Hazards Viewer – https://www.ncei.noaa.gov/maps/hazards/?layers=0 • Tsunami Ready Communities – https://tsunamireadyviewer.ioc-tsunami.org/ • Indigenous Peoples – Native Land Digital https://native-land.ca – Landmark: Global Platform of Indigenous and Community Lands http://www.landmarkmap.org – Indigenous Navigator https://indigenousnavigator.org/ – Landex: Global Land Governance Index https://www.landexglobal.org/ • Minority Rights Group International – https://minorityrights.org/about-us/ – https://peoplesunderthreat.org/	• National census • Regional and municipal planning authorities and population databases and registries • Hurricanes, typhoons, tsunamis, and earthquakes databases • Social vulnerability indexes • Climate change vulnerability indices and assessments

SOCIAL ATTRIBUTE	SPATIAL DATA	RELEVANT GLOBAL DATASET	EXAMPLE NATIONAL DATA SOURCES
Fisheries and aquacultures	**Commercial fisheries** • Artisanal and small-scale fisheries − Artisanal and small-scale fishing zones legally established − Key fishing areas for artisanal and small-scale fishers for each species or group of species − Landing sites, including fishing harbors • Semi-industrial and industrial fisheries − Key fishing grounds for national industrial fishing fleet for each species or group of species − Fishing areas (concessions) for international operators for each species or group of species − Landing sites, including fishing harbors **Artisanal and small-scale aquaculture** • Artisanal and small-scale aquaculture zones legally established • Key aquaculture sites for each species or group of species **Industrial aquaculture** • Aquaculture areas (concessions) for each species or group of species • Aquaculture farms (structures) for each species or group of species • Landing sites **Processing** • Processing facilities **Tangible MUCH** • Wrecks (e.g., shipwrecks) • Sunken ruins and cities • Underwater museums • Coastal maritime museums • Other coastal and offshore sites related to tangible MUCH	• Global Fishing Watch − https://globalfishingwatch.org/map-and-data/ • Ocean Health Index − http://www.oceanhealthindex.org/ • FAO − Fisheries and Aquaculture Geographic Information https://www.fao.org/fishery/en/geoinfo • Fisheries GeoNetwork platform − https://www.fao.org/fishery/geonetwork/srv/eng/catalog.search#/home • Fisheries and Aquaculture Statistical Collections − https://www.fao.org/fishery/en/fishstat − https://www.fao.org/fishery/en/collection/aquaculture • Fisheries and Aquaculture Country Profiles − https://www.fao.org/fishery/en/facp/search • FishStatj—Software for Fishery and Aquaculture Statistical Time Series − https://www.fao.org/fishery/en/statistics/software/fishstatj − Yearbooks of Fishery and Aquaculture Statistics − https://www.fao.org/cwp-on-fishery-statistics/handbook/tools-and-resources/list-of-fao-yearbooks-of-fishery-statistics/en/	• National fisheries and aquaculture authorities' databases and registries • Fisheries and aquaculture certification schemes • Studies from other offshore and coastal economic activities that include fisheries characterization

SOCIAL ATTRIBUTE	SPATIAL DATA	RELEVANT GLOBAL DATASET	EXAMPLE NATIONAL DATA SOURCES
Cultural heritage	**Intangible MUCH** • Cultural sites and areas related to intangible MUCH • Protected areas related to IUCN Protected Area Category V, Protected Landscape/Seascape **Water sports** • Key surfing sites and areas, including reserves[129] • Key snorkeling and diving sites and areas • Key recreational fishing sites and areas • Other key water sport sites and areas	• UNESCO World Heritage list – https://whc.unesco.org/en/list/ • Wreck site database – https://www.wrecksite.eu/	• Regional and national databases on MUCH • Nautical charts
Recreation and tourism	**Natural tourist attractions** • Nationally and internationally known seascapes • Main tourist beaches • Animal watching sites, areas, and routes (e.g., birds, cetaceans) • Other sites and areas of nature-based tourism **Recreation and tourism infrastructure** • Key recreational and touristic centers and dedicated infrastructures (marinas, cruise ship terminals, promenades, exhibition centers, thematic parks, camping areas) • Areas with concentrations of vacation homes • Key areas with hotels, tourism, restaurants, and other tourism related services	• Mapping Ocean Wealth Explorer: Recreation and Tourism – https://maps.oceanwealth.org/ • World Surf Spots Map – https://surfing-waves.com/atlas.html • WannaSurf Surf Spot Atlas – https://www.wannasurf.com/ • Dive sites – https://dive.site/ • Marina Map: Portal Site for Boating – https://www.marinamap.com/search/	• Water sports, diving, snorkeling, fishing, and sailing maps, charts, and atlases • Specialized social media accounts and websites

129 World Surfing Reserves (WSR) represent a global network of designated surfing reserves that are managed, implemented, and protected by local communities. WSRs serves as a model standard for preserving wave breaks and their surrounding areas by recognizing and protecting key environmental, cultural, and economic attributes in coastal communities. For more information, see https://www.savethewaves.org/protected-areas/

Annex 7: Supporting Information for Primary Data Collection

This Annex provides an overview of the survey techniques that can be used to collect data for the biodiversity attributes. It is not exhaustive but rather designed to give a sense of the potentially appropriate approaches to biodiversity field survey. In practice, the approaches selected should always be informed by GIIP and involve appropriately qualified personnel.

Annex 7.1: Key Survey Methods for Biodiversity Attributes

This table summarizes a suite of key survey methods and target biodiversity attributes[130] and gives an indication of the relative cost per unit survey effort (in qualitative terms).

Key:[131]

✔ Method usually applicable

+ Method often applicable

Method sometimes applicable

n/a Method generally not applicable

130 Note that the platforms summarized here broadly address the biodiversity attributes for which protected areas could be designated, but it is not anticipated that surveys to inform early sensitivity mapping will require specific or detailed field assessment of existing or candidate protected area status. The spatial designation itself is likely to be sufficient for sensitivity scoring/mapping at this stage

131 The key used here is based on the approach used in Sutherland 2006. This handbook covers the principles of sampling and provides detailed insight into methods and approaches suitable for plants, invertebrates, fish, amphibians, reptiles, birds, and mammals

SURVEY METHOD	BIRDS[132]	BATS	FISH	MARINE MAMMALS		SEA TURTLES	NATURAL HABITATS	INDICATIVE RELATIVE COST PER UNIT SURVEY EFFORT	COST-EFFECTIVE FOR BROAD-SCALE COVERAGE? (Y/N)
				CETACEANS	PINNIPEDS				
Digital aerial survey (e.g., camera array—still images or continuous video) or unmanned aerial vehicles	✔	n/a	+	✔	n/a	+	#	**Moderate:** Cheaper and greater spatial coverage in shorter time compared to boats. Potential for simultaneous observations of marine mammals, turtles, and large fish. Potentially higher equipment costs compared to other methods, with time-consuming post-processing requirements.	Y
Boat-based direct visual observations	✔	n/a	+	✔	n/a	+	n/a	**High:** Expensive per survey unit because of slow boat speed. However, potential for simultaneous observations of marine mammals, turtles, and large fish, and for deployment of towed hydroacoustic arrays for detecting (unseen) cetaceans.	N
Visual scan from vantage point (coast, nearshore, landfall location, offshore met mast, etc.).	✔	+	n/a	#	#	#	n/a	**Low:** Relatively inexpensive. Best used alongside radar and camera methods. Application restricted to coastal areas.	N
Direct observations at key onshore sites and haul-out sites	✔	n/a	n/a	n/a	✔	✔	✔	**Low:** Relatively inexpensive. Application restricted to coastal areas. Could be combined with tagging and/or tissue sampling.	N
Underwater observations (subsea camera—drop down, towed, remotely operated—or divers)	n/a	n/a	#	#	n/a	n/a	✔	**Low-Moderate:** Relatively inexpensive for diver observations. Variable costs for subsea camera equipment. Can be combined with vessel-based visual observations (e.g., for birds). Can be combined with environmental DNA (eDNA) sampling.	N

132 A recent review of radar (2D and 3D), camera, accelerometer, acoustic equipment, and large-scale telemetry for bird and bat monitoring at the project level has been completed by DHI and Ørsted in their Bat and Bird Monitoring guidance (Skov 2023).

SURVEY METHOD	BIRDS[132]	BATS	FISH	MARINE MAMMALS		SEA TURTLES	NATURAL HABITATS	INDICATIVE RELATIVE COST PER UNIT SURVEY EFFORT	COST-EFFECTIVE FOR BROAD-SCALE COVERAGE? (Y/N)
				CETACEANS	PINNIPEDS				
Radar, camera, and thermal imaging (e.g., continuous sampling from fixed onshore or offshore location)	✔	+	n/a	n/a	n/a	n/a	n/a	**Low:** Relatively inexpensive equipment. Can cover a relatively large area and sample at night. Can be mounted alongside remote acoustic monitoring equipment. Especially suitable for monitoring intensity of migration (including small songbirds). Same equipment can be used for birds and bats. Radar best linked to visual scans—difficult to separate bats from small birds and from large insects—visual observation is required to confirm. No species identification. Abundance cannot be determined.	Y (multiple radar stations)
Infrared imaging (e.g., night vision goggles and scopes, near-IR video cameras, and thermal video cameras)	n/a	✔	n/a	n/a	n/a	n/a	n/a	**High:** Expensive both in terms of equipment cost and data analysis. Can be paired with radar to identify and track moving targets, but no species identification and only small survey area. Additional light source may be required.	N
Tagging, telemetry, and tracking	✔	✔	+	✔	✔	+	n/a	**Moderate:** Variable equipment costs, but potentially broad-scale and long-term coverage. Remote sampling of species determines key areas of use and some elements of behavior. All weather conditions sampled. Potential to combine with visual tracking. Potential to combine with tissue sampling. However, high deployment effort, and sampling limited to a few individuals. Possible deleterious effects of tag attachment (e.g., welfare issues and biased data). Some GPS systems require individual recapture (e.g., bats) to retrieve data.	Potentially, depending on species

SURVEY METHOD	BIRDS[132]	BATS	FISH	MARINE MAMMALS		SEA TURTLES	NATURAL HABITATS	INDICATIVE RELATIVE COST PER UNIT SURVEY EFFORT	COST-EFFECTIVE FOR BROAD-SCALE COVERAGE? (Y/N)
				CETACEANS	PINNIPEDS				
Acoustic (hand-held or static)	**n/a**	✔	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**Low:** Relatively inexpensive. Flexible deployment options. Potential to be conducted at night from same vessel used for diurnal visual survey birds and marine mammals. However, limited range of detection (<100m). Abundance cannot be determined.	N
Hydroacoustic methods (e.g., echosounding, towed hydrophone array, passive acoustic monitoring, sidescan sonar)	**n/a**	**n/a**	✔	✔	**n/a**	**n/a**	✔	**Moderate-High:** Equipment costs variable. Expensive per survey unit because of slow boat speed. However, potential for simultaneous visual observations of birds, marine mammals, turtles, and large fish.	Potentially, depending on equipment and method
Active fish capture (trawling—multiple gear types)	**n/a**	**n/a**	✔	**n/a**	**n/a**	**n/a**	**n/a**	**Low-Moderate:** Variable equipment costs. Can be done at night. Boat speeds and gear type potentially affect cost per unit survey effort. Cannot be combined with simultaneous observations (e.g., of marine mammals, birds) because of potential attraction to fishing activity.	N
Passive fish capture (gill nets, traps, pots, hook and line, etc.)	**n/a**	**n/a**	✔	**n/a**	**n/a**	**n/a**	**n/a**	**Low-Moderate:** Variable equipment costs. Can be done at night. Potential for equipment loss. Equipment deployment and recovery potentially affects cost per unit survey effort. Cannot be combined with simultaneous observations (e.g., of marine mammals, birds) because of potential attraction to fishing activity.	N

SURVEY METHOD	BIRDS[132]	BATS	FISH	MARINE MAMMALS		SEA TURTLES	NATURAL HABITATS	INDICATIVE RELATIVE COST PER UNIT SURVEY EFFORT	COST-EFFECTIVE FOR BROAD-SCALE COVERAGE? (Y/N)
				CETACEANS	PINNIPEDS				
eDNA	✔	✔	✔	✔	✔	✔	✔ (associated characteristic communities)	**Moderate–High:** Particularly useful for aquatic species. Can quickly determine species presence. Complements traditional survey methods. However, potentially expensive per survey unit depending on sampling location and slow boat speeds for sampling, and variable cost of laboratory analysis, depending on: (i) sensitivity required (e.g., identifying broad species groups versus families); and (ii) the extent to which the DNA sequences of sampled species are already captured in genetic reference databases.[133] Abundance cannot be determined. Risk that sample does not originate in sampling area (risk is greater in smaller study areas).	Y
Physical sampling (e.g., grab sampling)	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	✔	**Low–Moderate:** Useful for confirming or verifying habitat types (e.g., observed via camera or in geophysical data). Relatively inexpensive for equipment and sample collection. Variable costs for sample analyses, if required. Can be combined with other vessel-based survey.	N

133 When a DNA sequence is not available in the reference database, capture and identity verification is necessary to obtain a tissue sample for sequencing and future reference. This has cost implications and may require permits for sampling and specialist laboratory analysis (The Biodiversity Consultancy and NatureMetrics 2021).

Annex 7.2: Biodiversity data collection—further reading

Birds

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Acronyms

AZE – Alliance for Zero Extinction
BCC – Benguela Current Convention
BOEM – Bureau of Ocean Energy Management
CBD – Convention on Biological Diversity
CIA – Cumulative Impact Assessment
CR – Critically Endangered
CSO – Civil Society Organization
DoE – Department of Energy
E&S – Environmental and Social
EBSA – Ecologically and Biologically Sensitive Areas
eDNA – environmental DNA
EN – Endangered
ESIA –Environmental and Social Impact Assessment
FAO – Food and Agriculture Organization of the United Nations
GBIF – Global Biodiversity Information Facility
GEBCO – General Bathymetric Chart of the Ocean
GIIP – Good International Industry Practice
GIS – Geographic Information Systems
GRID – Green, Resilient, and Inclusive Development
GWEC – Global Wind Energy Council
IAP2 – International Association for Public Participation
IBA – Important Bird Area
IBAT – Integrated Biodiversity Assessment Tool
IBRD – International Bank for Reconstruction and Development
IFC – International Finance Corporation
IFI – International Financial Institution
IMMA – Important Marine Mammal Areas
IOC – Intergovernmental Oceanographic Commission
IPBES – Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IUCN – International Union for Conservation of Nature
KBA – Key Biodiversity Area
LCOE – Levelized Cost of Energy
MESA – Mapping Environmentally Sensitive Assets
MUCH – Maritime and Underwater Cultural Heritage
MSP – Marine Spatial Planning
NGO – Non-Governmental Organization
NOC – National Oceanography Centre

OBIS – Ocean Biogeographic Information System

PPGIS – public participation geographic information system

SDG – Sustainable Development Goals

SeaMaST – Seabird Mapping and Sensitivity Tool

SenMap – Integrated Environmental and Social Sensitivity Mapping—Guidance for Early Offshore Wind Spatial Planning

SESA – Strategic Environmental and Social Assessment

TOPP – Tagging of Pelagic Predators

UNCLOS – United Nations Convention on the Law of the Sea

UNEP-WCMC – United Nations Environment Programme—World Conservation Monitoring Centre

UNESCO – United Nations Educational, Scientific and Cultural Organization

UNFCCC – United Nations Framework Convention on Climate Change

WBG – World Bank Group

WDPA – World Database of Protected Area

WEF – World Economic Forum

WSR – World Surfing Reserve

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