

OSPAR Arctic Waters report

Evidence and options for action



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Acknowledgements

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DISCLAIMER

The views expressed in this report are those of the contractor and do not necessarily represent the views of the OSPAR Commission. The report has been co-produced with knowledge and suggestions received from the Arctic Workshop participants and the AOWG.

The OSPAR Arctic Waters report is published by the OSPAR Commission and developed through the Arctic Roadmap (Agreement 2022-01) process.

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l’Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d’Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l’Allemagne, la Belgique, le Danemark, l’Espagne, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède, la Suisse et l’Union européenne.

| List of selected abbreviations and acronyms | |
|---|---|
| For further acronyms, see e.g. a list of commonly used OSPAR acronyms . | |
| AC | Arctic Council |
| ABNJ | Area Beyond National Jurisdiction |
| ACAP | Arctic Council Arctic Contaminants Action Programme |
| AECO | Association of Arctic Expedition Cruise Operators |
| AMAP | Arctic Council Working Group on Arctic Monitoring and Assessment Programme |
| AMOC | Atlantic Meridional Overturning Circulation |
| AOWG | OSPAR Arctic Outcomes Working Group |
| BAT | Best Available Technology |
| BBNJ | Agreement under the United Nations Convention on the Law of the Sea on the Conservation and |
| Agreement | Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction |
| BEP | Best Available Practice |
| CAFF | Arctic Council Working Group on Conservation of Arctic Flora and Fauna |
| CAO | Central Arctic Ocean |
| CBD | Convention on Biological Diversity |
| CBMP | Arctic Council Circumpolar Biodiversity Monitoring Programme |
| CCAMLR | Commission for the Conservation of Antarctic Marine Living Resources |
| CCS | Carbon Capture and Storage |
| CMS | Convention on the Conservation of Migratory Species and Wild Animals |
| EBSA | Ecologically or Biologically Significant Area |
| EGBCM | Arctic Council Expert Group on Black Carbon and Methane |
| EIA | Environmental Impact Assessment |
| EPPR | Arctic Council Working Group Emergency Prevention, Preparedness and Response |
| GBF | CBD Global Biodiversity Framework |
| HOD | Head of Delegation, referring to the OSPAR Commission |
| IAEA | International Atomic Energy Agency |
| ICC | Inuit Circumpolar Council |
| ICES | International Council for the Exploration of the Sea |
| ILO | International Labour Organisation Convention |
| IMO | International Maritime Organisation |
| IPCC | Intergovernmental Panel on Climate Change |
| ISA | International Seabed Authority |
| IWC | International Whaling Commission |
| LME | Large Marine Ecosystem |
| LNG | Liquefied Natural Gas |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MPA | Marine Protected Area |
| NAC | North Atlantic Current |
| NAMMCO | North Atlantic Marine Mammal Commission |
| NASCO | North Atlantic Salmon Conservation Organization |
| NEAES | OSPAR North-East Atlantic Environment Strategy 2030 |
| NEAFC | North-East Atlantic Fisheries Commission |
| NIS | Non-Indigenous Species |
| OECM | Other Effective Area-based Conservation Measure |
| OHC | Organohalogen Compound |
| OSPAR | Commission for the Protection of the Marine Environment of the North-East Atlantic |
| PAME | Arctic Council Working Group on the Protection of the Arctic Marine Environment |
| POP | Persistent Organic Pollutant |
| PSSA | Particularly Sensitive Sea Area |
| QSR | Quality Status Report |
| RFMO | Regional Fisheries Management Organisation |
| SDWG | Arctic Council Working Group Sustainable Development |
| SEA | Strategic Impact Assessment |
| UN | United Nations |
| UNCLOS | UN Convention on the Law of the Sea |
| UNDRIP | UN Declaration on the Rights of Indigenous Peoples |
| UNESCO | UN Educational, Scientific and Cultural Organisation |
| UNFCCC | UN Framework Convention on Climate Change |
| WMO | World Meteorological Organisation |

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Executive Summary

The '*OSPAR Arctic Waters Report: evidence and options for action*' completes one step in the '*OSPAR Roadmap to support achievement of OSPAR objectives in the Arctic*' ([Agreement 2022-01](#)). The aim of this report is to create a common understanding of the status of the marine environment in the OSPAR Arctic Waters (OSPAR Region I) as a basis for identifying options for measures and actions that OSPAR could take in the future. The knowledge in the report has been co-created with participants at a dedicated OSPAR Arctic workshop, including with Indigenous Peoples representatives.

Knowledge is never complete, and due to climate change the pace of change in the Arctic Waters marine environment is so rapid that by the time a status has been described it could already have changed further. An important finding in the report is that time therefore becomes a major obstacle for an effective management response. Climate change mitigation and adaptation measures clearly need to be developed and implemented rapidly. However, generating the scientific and Indigenous Knowledge evidence base is a slow process, after which the process of designing and implementing an action or measure can also be slow. Generating political will to take action in Arctic Waters, while uncertainties in the status of the dynamic and changing ecosystem remain, would be important. This could require exploring new management approaches and steps to allow the management response to address impacts before they occur rather than being reactionary. Collaboration and cooperation with other organisations and authorities, such as the Arctic Council, is fundamental to successful OSPAR work in Arctic Waters.

Having a holistic view of the environment, the drivers of human activities and the pressures they cause, is important to facilitate management response on the most pressing issues. The report presents evidence of ecosystems undergoing rapid and fundamental change, where biodiversity loss could make the functioning of Arctic Waters ecosystems more unpredictable. The rapid loss of sea ice changes the function of associated ecosystems, from a loss of substrate to grow on for ice-algae to a shift in the migratory corridors along the ice edge for large whales. The cold and fresh water from melting glaciers creates cold refuges for eggs and larvae of Arctic fish to mature and hatch, and the areas are important feeding grounds for many breeding colonies of seabirds. The cold meltwater however impacts ocean currents, and there have been observations of changes in currents both within Arctic Waters and in the currents connecting the region to the Wider Atlantic. Assessing the Arctic Waters ecosystem through a regional perspective can help create a wider picture of change, to ensure that a potential creep of biodiversity loss through local change is not overlooked.

There is a need to secure ecosystem connectivity and tackle multiple pressures simultaneously through a holistic ecosystem-based approach to managing human activities in Arctic Waters. Historical human activities have caused pollution and decimation of populations of species that continue to impact Arctic Waters ecosystems today. And new human activities are emerging that could give rise to new and unpredictable pressures.

OSPAR has a unique mandate and competency in the ocean governance framework. It could have a coordinating role in implementing work to protect biodiversity on a regional scale in Arctic Waters to achieve global goals. There are synergies to be found when different organisations bring their competency, resources and knowledge together to address a topic. OSPAR would build on and contribute to the work of other organisations. OSPAR can take legally binding Decisions within Arctic Waters and could also develop soft-law Recommendations that include implementation reporting requirements or other Agreements including guidelines for best practice. These actions can make use of information and recommendations from other entities, such as the Arctic Council. The listed options for actions in Arctic Waters identified a broad range of topics and options. These include developing best practice guidance for human activities and protecting specific Arctic species and habitats or specific ecosystem functions through various measures, including through area-based measures. Future considerations in OSPAR will conclude on the actions to implement under the OSPAR Arctic Roadmap to progress the priorities of the OSPAR North-East Atlantic Environment Strategy 2030.

Récapitulatif

Le rapport OSPAR sur les eaux Arctiques : preuves et options d'action complète une étape de la « Feuille de route OSPAR pour soutenir la réalisation des objectifs d'OSPAR dans l'Arctique » (Accord 2022-01). L'objectif de ce rapport est de créer une compréhension commune de l'état du milieu marin dans les eaux arctiques d'OSPAR (Région I d'OSPAR) en tant que base pour identifier les options de mesures et d'actions qu'OSPAR pourrait prendre à l'avenir. Les connaissances contenues dans le rapport ont été élaborées en collaboration avec les participants à un atelier OSPAR dédié à l'Arctique, y compris avec les représentants des peuples autochtones.

Les connaissances ne sont jamais complètes et, en raison du changement climatique, le rythme des changements du milieu marin des eaux Arctiques est si rapide qu'au moment où un état a été décrit, il peut déjà avoir changé davantage. L'une des conclusions importantes du présent rapport est que le temps devient donc un obstacle majeur à une réponse de gestion efficace. Il est clair que les mesures d'atténuation et d'adaptation au changement climatique doivent être élaborées et mises en œuvre rapidement. Cependant, la création d'une base de données scientifiques et de connaissances autochtones est un processus lent, après quoi le processus de conception et de mise en œuvre d'une action ou d'une mesure peut également être lent. Il serait important de susciter la volonté politique de prendre des mesures dans les eaux Arctiques, alors que des incertitudes subsistent quant à l'état de l'écosystème dynamique et changeant. Cela pourrait nécessiter l'exploration de nouvelles approches et mesures de gestion pour permettre à la gestion de traiter les impacts avant qu'ils ne se produisent plutôt que d'être réactionnaire. La collaboration et la coopération avec d'autres organisations et autorités, telles que le Conseil de l'Arctique, sont fondamentales pour la réussite des travaux d'OSPAR dans les eaux Arctiques.

Il est important d'avoir une vision holistique de l'environnement, des moteurs des activités humaines et des pressions qu'ils exercent, afin de faciliter la gestion des problèmes les plus urgents. Le rapport présente des preuves que les écosystèmes subissent des changements rapides et fondamentaux, et que la perte de biodiversité pourrait rendre le fonctionnement des écosystèmes des eaux Arctiques plus imprévisible. La disparition rapide de la glace de mer modifie la fonction des écosystèmes associés, qu'il s'agisse de la perte de substrat pour la croissance des algues de glace ou de la modification des couloirs de migration le long de la lisière de la glace pour les grandes baleines. L'eau froide et douce provenant de la fonte des glaciers crée des refuges froids où les œufs et les larves des poissons arctiques peuvent mûrir et éclore, et ces zones constituent d'importantes aires d'alimentation pour de nombreuses colonies reproductrices d'oiseaux de mer. Les eaux de fonte froides ont toutefois un impact sur les courants océaniques, et l'on a observé des changements dans les courants à la fois dans les eaux Arctiques et dans les courants qui relient la région à l'Atlantique au large. L'évaluation de l'écosystème des eaux Arctiques dans une perspective régionale peut aider à créer une image plus large du changement, afin de s'assurer que l'on ne néglige pas une perte potentielle de biodiversité due à des changements locaux.

Il est nécessaire d'assurer la connectivité des écosystèmes et de lutter simultanément contre les pressions multiples grâce à une approche holistique fondée sur les écosystèmes pour gérer les activités humaines dans les eaux Arctiques. Les activités humaines historiques ont provoqué la pollution et la décimation de populations d'espèces qui continuent d'avoir un impact sur les écosystèmes des eaux Arctiques aujourd'hui. En outre, de nouvelles activités humaines sont en train d'émerger et pourraient donner lieu à des pressions nouvelles et imprévisibles.

OSPAR a un mandat et des compétences uniques dans le cadre de la gouvernance des océans. Elle pourrait jouer un rôle de coordination dans la mise en œuvre des travaux visant à protéger la biodiversité à l'échelle régionale dans les eaux Arctiques afin d'atteindre les objectifs mondiaux. Des synergies peuvent être trouvées lorsque différentes organisations mettent en commun leurs compétences, leurs ressources et leurs connaissances pour traiter un sujet. OSPAR s'appuiera sur le travail d'autres organisations et y contribuera. OSPAR peut prendre des décisions juridiquement contraignantes dans les eaux Arctiques et pourrait également développer des recommandations non contraignantes qui incluent des exigences de rapport de mise en œuvre ou d'autres accords comprenant des lignes directrices pour les meilleures pratiques. Ces actions peuvent utiliser les informations et les recommandations d'autres entités, telles que le Conseil de l'Arctique. Les options énumérées pour les actions dans les eaux Arctiques ont permis d'identifier un large

éventail de sujets et d'options. Il s'agit notamment de développer des lignes directrices sur les meilleures pratiques pour les activités humaines et de protéger des espèces et des habitats arctiques spécifiques ou des fonctions écosystémiques spécifiques par le biais de diverses mesures, y compris des mesures basées sur les zones. Les considérations futures d'OSPAR se concluront sur les actions à mettre en œuvre dans le cadre de la feuille de route OSPAR pour l'Arctique afin de faire progresser les priorités de la Stratégie OSPAR pour le milieu marin de l'Atlantique du Nord-Est 2030.

1. Introduction

1.1 OSPAR Arctic Waters report Scope and Aim

The *OSPAR Arctic Waters report: Evidence and options for action* (OSPAR Arctic Waters report, the report) is developed for the OSPAR Arctic Outcomes Working Group (AOWG) as part of implementation of the Roadmap to support achievement of OSPAR objectives in the Arctic ([Agreement 2022-01](#)). The report targets an OSPAR expert and policymaker audience, and other interested readers. The Roadmap responds to the commitment in the 2021 OSPAR Ministerial Declaration delivered in Cascais, Portugal, as follows:

“We recognise the unique biodiversity of the Arctic, part of the OSPAR maritime area and commit to protect the Arctic marine environment, including through collaboration with other relevant organisations, such as the Arctic Council and the International Maritime Organisation.”

In keeping with the spirit and goal of the Cascais Declaration regarding the Arctic, it is intended that this work is undertaken in a collaborative and engaged way with other relevant organisations. OSPAR recognises the mandate of several organisations and actors in the Arctic. Collaboration and developing synergies based on the complementarity of mandates is the invitation in working together towards shared goals.

The Arctic Roadmap, including possible future actions and measures, is implemented in support of objectives of the [OSPAR North-East Atlantic Environment Strategy 2030](#) (NEAES 2030), including the objectives related to area-based conservation measures. NEAES 2030 section 4 ‘Our International Engagement’ describes how the work of OSPAR is a contribution towards the United Nations Sustainable Development Goals, European Union instruments objectives, and international ocean issues where OSPAR builds on multi- and bilateral cooperation. OSPAR has established cooperation with relevant Regional Fisheries Management Organisations (RFMOs), the International Maritime Organisation (IMO), the International Seabed Authority (ISA), the International Atomic Energy Agency (IAEA) and the Arctic Council.

OSPAR has welcomed the adoption of the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement), in particular the objective under Part III of the Agreement to conserve and sustainably use areas requiring protection, including through the establishment of a comprehensive system of area-based management tools, with ecologically representative and well-connected networks of marine protected areas. The Convention for Biodiversity (CBD) has adopted a Global Biodiversity Framework (GBF) which describes the global protection goals and targets towards which OSPAR contributes as a regional actor. OSPAR works to contribute to these global goals.

The aim of the *OSPAR Arctic Waters report: Evidence and options for action* is to present evidence of the state of the marine environment in Arctic Waters as well as describe existing human activities and pressures. This is to create a common understanding of the most important changes that are occurring. The report builds on work conducted by other organisations. The evidence forms a basis for identifying options for action under the OSPAR mandate that could be considered in the future work of the OSPAR Commission in implementing the Arctic Roadmap. The report should be viewed as a step in a process rather than as an end product.

The OSPAR Arctic Waters report is a concise high-level document, which brings together over 200 different sources of information that were submitted to the OSPAR Arctic Outcomes Working Group through an agreed process in the spring of 2023 (see [ANNEX 2: The source material](#)). The systematically acquired knowledge and scientific information presented in the [OSPAR Quality Status Report 2023](#) (QSR 2023) was used as a starting point. Where the source material identified differences to the QSR 2023 findings, this has been highlighted in

the report. All the rich detail of the source material cannot be reflected in the report, and the original material will remain valid and important to inform the future work of the OSPAR Commission.

The spatial scope of this OSPAR Arctic Waters report is the Arctic Waters (OSPAR Region I) in the OSPAR Maritime Area (Figure 1). There is no one single geographical definition for the Arctic either in OSPAR or in other intergovernmental organisations (see *ANNEX 3: Various maps* for some examples). The focus of this report is on information for Arctic Waters, when information is more location specific the place name is referred to, or if the information is more broadly applicable to the polar region it is referred to as the Arctic region.



Figure 1. Map of the OSPAR Maritime Area and the different OSPAR Regions. The OSPAR Arctic Waters report focuses on information for Arctic Waters (Region I).

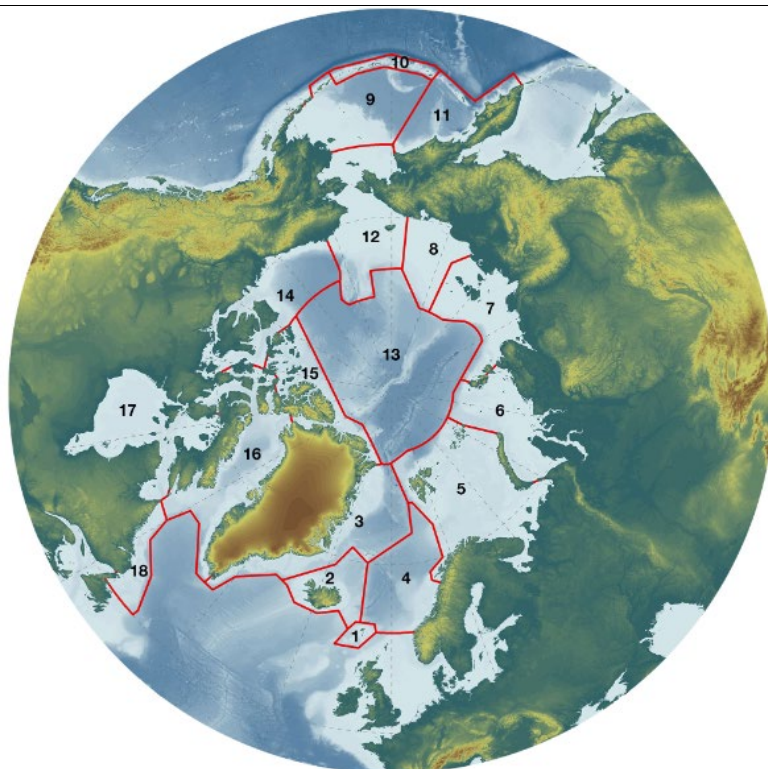
The report includes key messages that highlight key issues described in the chapters. The report identifies options for action based on the issues described in the text as ‘OSPAR could...’ sentences. These options are also summarised in section 8. *Options for action*.

1.2 Recognising and building on work by the Arctic Council

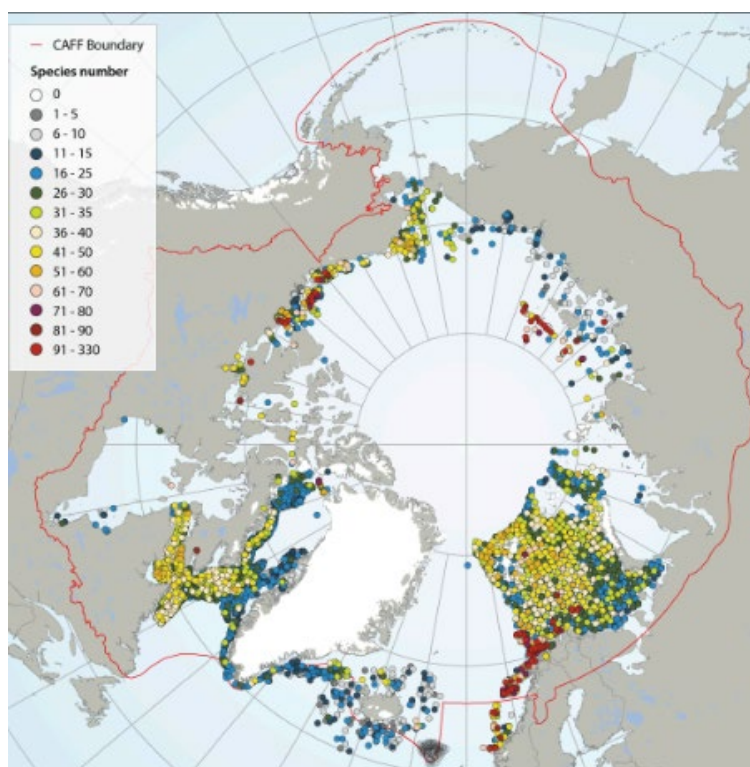
The Arctic Council is the leading intergovernmental forum for promoting cooperation in the Arctic. Formally established in 1996 through the political Ottawa declaration, the forum is a platform where the eight Member States and six Permanent Participants representing Indigenous Peoples come together to cooperate on issues of sustainable development and environmental protection of the Arctic. The Arctic Council produces high quality guidelines, assessments and recommendations. As a forum, the Arctic Council does not have a mandate to implement or enforce these outputs. Military security is explicitly written out of the mandate in the Ottawa declaration.

The overarching objectives of the Arctic Council are set out in the [Arctic Council Strategic Plan 2021-2030](#). Activities are primarily conducted through six Working Groups and an expert group, which also develop action plans on specific topics and oversee delivery of outputs through projects sponsored by one or more Arctic states. For an overview of some of the key Strategic Action Plans, Working Groups and projects see *ANNEX 4: Recognising and building on work by the Arctic Council, other organisations and Multilateral Environmental Agreements*.

The Arctic Council works to identify ways for states to strengthen governance to achieve desired environmental, economic and socio-cultural outcomes through a cooperative, coordinated and integrated approach to managing human activities (PAME 2013a). As an example in the marine environment, the Guidelines for Ecosystem Based Management (PAME 2019b) have identified the geographic extent of the Arctic ecosystems as Large Marine Ecosystems (PAME 2013b), and the marine ecosystem components are monitored through the Circumpolar Biodiversity Monitoring Program (CAFF 2021a), and this type of information has been used to identify areas sensitive to shipping impacts and ecologically and biologically sensitive areas (Figure 2).



Large Marine Ecosystems (LME). Copied from (PAME 2013b)



Benthic sampling stations, number of species. Copied from (CAFF 2017)

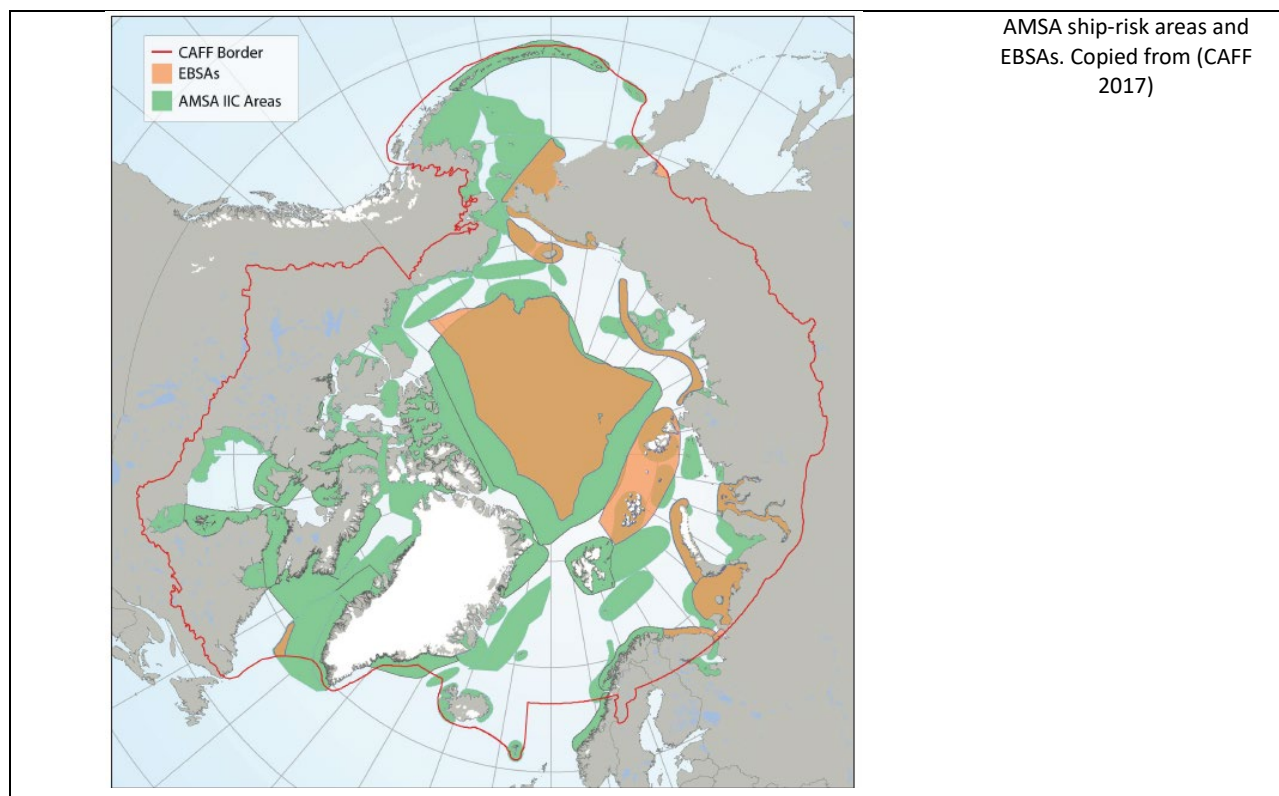


Figure 2. The Arctic Council has defined Large Marine Ecosystems (top), undertakes a Circumpolar Monitoring Programme that collates all data on benthic habitats (middle) and has identified areas at risk from shipping activities and EBSAs (bottom).

OSPAR is an Observer to the Arctic Council since 2017. The Arctic Council Working Group Arctic Monitoring and Assessment Programme (AMAP) has been an Observer to OSPAR since the early 1990s. Institutional cooperation is already ongoing on several topics of mutual interest, creating synergies through the complementarity of mandates and sharing of best available knowledge and practice. Closer communication between the organisations could identify the best means to take forward work, and it could be explored if the OSPAR mandate would allow progressing the implementation of some of the Arctic Council recommendations.

OSPAR could invite Arctic Council Working Groups that are not yet OSPAR Observers to apply for Observer status to facilitate future cooperation.

OSPAR could take an active role, through its Contracting Parties, as Observer to the Arctic Council and its relevant Working Groups.

OSPAR could carry out a comprehensive review of Arctic Council strategic objectives to identify shared priorities and synergies in ongoing work, by inviting Arctic Council Working Groups to share a list of priority recommendations for consideration.

OSPAR could explore if the OSPAR mandate could be used to progress priorities and recommendations of the Arctic Council.

1.3 Recognising and building on work by other organisations

Ocean governance, in general, is complex as there are many organisations operating in the ocean space. Organisations mandates can overlap spatially, mandates can be very specific or cover broad topic areas. This report does not provide a comprehensive overview of all relevant actors and stakeholders in Arctic Waters, nor is it a comprehensive overview of ocean governance and mandates of all relevant organisations. For an indicative list of actors and multilateral environmental agreements of relevance see *ANNEX 4: Recognising and building on work by the Arctic Council, other organisations and Multilateral Environmental Agreements*.

Coordination and collaboration between organisations are prerequisites for a holistic understanding and management response to any marine environment. The amount of information that is constantly created by all actors is so large that it becomes challenging to grasp and to maintain an overview of the most important aspects. This can make it difficult to use the information to create knowledge about the most relevant actions for an organisation to take in response. It is important to actively share information about ongoing work, to build on best practices, and make best use of lessons learned from previous experiences.

OSPAR and the North-East Atlantic Fisheries Commission (NEAFC) have established the Collective Arrangement ([see OSPAR Agreement 2014-09](#)) as a forum for coordination and cooperation among organisations with a mandate in areas beyond national jurisdiction. The Collective Arrangement is set up as a multilateral forum, and other organisations are regularly invited as guests and are welcomed to join the agreement to exchange information and discuss potential management responses.

OSPAR could explore OSPARs unique mandate to convene and coordinate actors in Arctic Waters through an instrument such as the Collective Arrangement.

1.4 The importance and use of Indigenous Knowledge

In seeking to apply a holistic ecosystem-based approach to managing human activities in the Arctic Waters, the OSPAR Commission will inform its decisions on possible measures and actions by using the best available scientific information and, importantly, Indigenous Knowledge sources and local knowledge. The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) is a basis for engagement. The declaration affirms the right of Indigenous Peoples to engage in the governance related to the area they inhabit and the resources of this land (Inuit 2022). Another foundational basis for cooperation is the Indigenous and Tribal Peoples Convention the International Labour Organisation Convention No. 169 (ILO169). Indigenous Peoples need to be involved in the creation of regulations that impact their lives and land use, there is a reluctance among Indigenous Peoples to take on any regulations developed externally.

For the purposes of this OSPAR Arctic Waters report, traditional knowledge is a broad term capturing both Indigenous Knowledge held by Indigenous Peoples and local knowledge held by communities of people living in the area. The OSPAR Commission has not agreed on guidelines for using traditional knowledge in its decision-making process. However individual OSPAR Contracting Parties may have carried out engagement with Indigenous Peoples and local communities nationally and internationally. This is the case for several Contracting Parties to the Convention. There are no official national guidelines or guidance in place in the concerned states for the use of Indigenous Knowledge, however projects have been implemented where good practices have been developed and applied. In Norway, for example, projects have cooperated with the government to ensure that Indigenous Peoples are present when the process of resolving a problem begins, and in Finland the government has initiated annual meetings with the Saami Parliament to discuss problems and solutions over a couple of days. Indigenous Peoples themselves have developed guidelines to ensure their right to maintain, control, protect and develop the Indigenous Knowledge they hold (Inuit Circumpolar Council 2021). Indigenous Peoples seek to engage in all decisions that impact their daily lives and assert their collective rights to engage in governance, including in the development of policy recommendations and decisions at international level (Inuit Circumpolar Council 2021).

Indigenous Knowledge, having been acquired and passed down over numerous generations within and between communities of people, provides important real-world insights that can warrant further investigation, research or other action. For example, Indigenous Knowledge can describe observed migratory patterns of a species which can inform the design of a monitoring network (Huntington and Noongwook 2013). Indigenous Knowledge can also help detect change when current experience differs from the handed down traditions. A classic example from Sapmi is young Sámi saying that they have never experienced a 'normal winter' as described by their elders (Saami Council 2023). Indigenous Knowledge holders have shared that it is difficult to create new Indigenous Knowledge that would respond to the rapidly progressing environmental impacts due to climate change since slow bureaucratic processes and regulations may restrict the possibility to carry out an activity differently, for example shifting hunting practices or changing land use.

The use of Indigenous Knowledge should take place through a dialogue with the knowledge holders to establish an engagement and a participatory process that recognises the needs of the Indigenous Peoples

and provides a genuine opportunity to influence decisions (Arctic Council 2019)(see also Box 1). It can be helpful to understand the use of Indigenous Knowledge as a collaborative concept where different types of knowledge on stewardship of the environment are blended in a long-term process (Whyte 2013). Creating location specific information could be a need for Indigenous Peoples, whereas policy users may require information on a wider scale and a broader range of topics. Thus, it can be helpful to specify the demography of the knowledge holders and users early in a process to ensure produced outputs serve all required purposes (Alexander, Provencher, et al. 2019).

BOX 1: Some of ICC’s recommendations for achieving ethical and equitable engagement with Indigenous Peoples

Excerpt from synthesis report (Inuit Circumpolar Council 2021)

Meetings, communications, and other forms of engagement should be structured in culturally appropriate ways to emphasize values and cooperation by all involved. This may include:

- It is more important to be good at listening than to be good at speaking.
- We share information through storytelling, and the storyteller should not be interrupted before they are finished.
- Everyone has something to share, so coming to the table with humility, respect, and an unpretentious attitude allows space for mutual learning.
- Key values such as listening influence how discussions occur.
- We value cooperation and conflict avoidance, so we may express opposition with silence, and this should not be interpreted incorrectly as agreement.
- We make decisions based on consensus, which requires extraordinary patience and takes the time to hear the views of all participants while actively moving forward in decision making.
- We expect others to come with honesty and trust and to help and volunteer so that the work we pursue can be completed.
- We may expect or require longer discussion periods, in face-to-face formats that focus on discussion rather than presentations to allow for open dialog.
- Sharing food is an important value and cultural practice and may be considered respectful and appropriate during some engagement activities.
- Inclusion and learning is important, so meetings may require language interpreters, the inclusion of appropriate dialects, and the translation of materials available in multiple formats such as written documents, visuals, and audio.

A common concern raised by Inuit communities on governance, is that policy and management actions move forward without understanding Inuit governance structures and fail to engage these structures for proper access to communities, lands, and waters (Inuit Circumpolar Council 2021).

“We call upon people coming into Inuit Nunaat to respect our knowledge, governance systems, and values and to behave according to them. This includes taking responsibility and building their own capacity to recognize prevailing power dynamics and leave them at the door, take the time to understand, to listen to us, learn and be humble. Before any work can start, a relationship needs to be established and trust needs to be built to allow for a meaningful partnership to develop over time.” (Inuit 2022).

A good example of an holistic approach, where information is blended, comes from the Government of Canada and the Haida Nation in setting the direction of the Archipelago Management Board in a management plan that covers everything from mountaintop to seafloor as a single interconnected ecosystem in line with cultural values of the Indigenous Peoples (Council of the Haida Nation and Government of Canada 2018). The management plan shows good practice in co-developing management and respectful stewardship of the environment. The guiding principles of the management plan are based on ethics and values from Haida law and align with the ecosystem-based management approach (Table 1) (Council of the Haida Nation and Government of Canada 2018).

Table 1. How Indigenous Knowledge principles align with ecosystem-based management principles and inform the Management Plan of Gwaii Haanas. (Reproduced from (Council of the Haida Nation and Government of Canada 2018).)

| Haida law guiding principles | Ecosystem-based management principles |
|------------------------------|---------------------------------------|
| Yahguudang – Respect | Precautionary approach |

| | |
|---|-----------------------------|
| 'La guu ga kanhllns – Responsibility | Inclusive and participatory |
| Gina 'waadluxan gud ad kwaagid— | Integrated management |
| Interconnectedness | |
| Giid tlljuus—Balance | Sustainable use |
| Gina k'aadang.nga gii uu tll k'anguudang— | Adaptive management |
| Seeking Wise Counsel | |
| Isda ad dii gii isda—Giving and Receiving | Equitable sharing |

Information that has been compiled based on scientific information and Indigenous Knowledge should be peer reviewed by representatives of both communities. The OSPAR Arctic Waters report was reviewed through an OSPAR workshop in October 2023 that engaged Indigenous Peoples (*ANNEX 1: List of Participants for the OSPAR Arctic Workshop*). OSPAR could in the future include appropriate reciprocity to Indigenous Peoples in exchange for the Indigenous Knowledge provided; for example, by sharing the co-created knowledge and by engaging in good governance when taking further steps to implement management measures for the Arctic marine environment in Arctic Waters (OSPAR Region I) that will also benefit the Indigenous Peoples communities.

OSPAR applies the FAIR principles¹ to data and open access to all publications under the CC-BY 4.0 licence. If applied to sensitive Indigenous Knowledge without modification, this approach could disregard historical and ongoing injustices and imbalances of power, however, guidelines and approaches have been developed to address these issues (Proloux, et al. 2021). Examples of relevant initiatives from the Arctic region include ELOKA- Exchange for Local Observations and Knowledge of the Arctic (CIRES 2023) and the Arctic Council ACAP working groups ongoing project Circumpolar Local Environmental Observer (CLEO) initiative (ACAP 2023). It is critical that values and processes are appropriately designed and respected to ensure that the Indigenous Knowledge does not become detached from its context, especially if non-written sources are used (Proloux, et al. 2021). Indigenous Knowledge can be represented as digital data products (see for example Figure 8) that retain the context and narrative of the observations as event information, drawn from the various methods by which it was collected (Proloux, et al. 2021). Indigenous Peoples have also developed community level approaches for sharing information using digital platforms, for example the Alaskan Community Observation Network for Adaptation and Security (CONAS) (Aleut International Association 2023).

OSPAR could explore Indigenous Peoples participation in the work of the Commission, for example through national delegations, by inviting organisations representing the relevant Indigenous Peoples to become Observers, or through other means.

OSPAR could develop regional guidelines for consultation and engagement with Indigenous Peoples, and explore different ways of ensuring that future engagement of Indigenous Peoples is appropriately resourced, noting that capacity issues can be helped through funding but this may not be sufficient.

OSPAR could develop working procedures or guidelines for blending different types of information, ensuring that Indigenous Knowledge is stored and used appropriately, to co-create knowledge and improve ocean literacy, which could ensure that local needs are communicated in ways to influence global debates as well as facilitating implementation or regional and global policies on a local scale.

¹ FAIR principles as outlined in European Open Science Cloud Declaration 2017, see <https://www.go-fair.org/fair-principles/>

2. The social landscape

Key Message:

- **Local, regional and global societal drivers are not necessarily aligned and the challenge for the management response is to balance these needs in Arctic Waters.**
- **Management actions under the OSPAR mandate to protect the marine environment have direct implications for food security and income generation for Arctic Indigenous Peoples**

2.1 Societal needs as drivers

There are local, regional and global societal needs associated with the Arctic Waters marine environment. Meeting all the needs require creating equity in the decision-making process and careful management of all the resources providing ecosystem services. The Arctic region is characterised by large areas that have been relatively little impacted by human industrial activities and development. This vast region is characterised by high human vulnerability to environmental and social pressures, and therefore societies in the Arctic region are sensitive to climate change impacts (Saami Council 2023). Societies in the Arctic region are connected to the global population through trade and other social and economic interactions. In the past 50 years the global human population has doubled, which has created a general driver for provisioning more energy and materials (IPBES 2019).

The Arctic Waters (OSPAR Region I) is sparsely populated by humans (2.6 million) (OSPAR 2023a) a significant proportion of whom are represented in the OSPAR Commission by the Kingdom of Denmark, Finland, Iceland, Norway, and Sweden. Arctic peoples' social drivers are the same as societies in other regions, including societal well-being, energy and food security, housing and infrastructure, economic development, and national security.

BOX 2: Policy relevant conclusions from Arctic Council Human Development Report
Excerpt from (Stefanson Arctic Institute 2004)

Arctic societies have a well-deserved reputation for resilience in the face of change. But today they are facing an unprecedented combination of rapid and stressful changes involving environmental processes (e.g. the impacts of climate change), cultural developments (e.g. the erosion of indigenous languages), economic changes (e.g. the emergence of narrowly based mixed economies), industrial developments (e.g. the growing role of multinational corporations engaged in the extraction of natural resources), and political changes (e.g. the devolution of political authority).

The issues that dominate the Arctic agenda today typically involve institutional issues or matters of governance.

Arctic economies generate a substantial share of their income through resource extraction. Extraction of non-renewable resources from the ground should conceptually be seen as a loss in wealth rather than income generation (Glomsrød, et al. 2021). Income generation in Arctic societies can be achieved through ecosystem services. The value of Arctic wilderness, northern lights, rich biological resources and traditional living generates income through tourism and harvesting of renewable resources (Glomsrød, et al. 2021). Monetisation of ecosystems through the ecosystem service framework however gives rise to some concern and resistance, as turning nature into a commodity could have side-effects that are not yet well known, or could exacerbate existing inequalities between actors when policy trade-offs are considered (CAFF 2015d). Allocation of fishing or hunting rights may create tensions between groups and result in debates about relative value, or inherently uneven comparisons could arise between the value of an extractive industry compared to intrinsic value of Arctic ecosystems (CAFF 2013). The framework can perhaps be most usefully applied by describing the many uses and functions of a particular resource, and supporting a comparison of values without introducing a price. For example, marine mammals can provide provisioning services in terms of food, clothing and other materials, plus provisioning services through energy and biomass transfer within the ecosystem, as well as marine cultural ecosystem services underpinning tourism activities.

Local and global perceptions of the societal needs and drivers can differ, and result in groups feeling misunderstood or marginalised if their approach to using a resource is not seen as balanced with the use of other ecosystem services a resource can provide. Conservation of iconic species, such as marine mammals, often stimulates societal debate, driving public pressure in political debates and public demand for action (OSPAR 2023j). Greenlanders represented through the Kingdom of Denmark have for example felt that their lifestyle and traditions are misunderstood in the EU, showcased as an EU ban on seal products in the internal markets (later lifted through a special provision²), or a lack of EU support for proposals by Greenland and Faroe Islands to increase Aboriginal Subsistence Whaling catch limits for certain species at the International Whaling Commission (Eritja 2017b).

The work carried out under the mandate of the OSPAR Convention on conservation of specific species and more broadly to protect the marine environment, has a direct link to food-security of Indigenous Peoples in Arctic Waters. Protecting a species that is used for food, as well as protecting its environment by managing human activities that could harm the species, contributes to food-security in the long term. It should be recognized that these management actions could have negative implications in terms of food-security in the short term. A respectful approach that balances the different societal goals is a foundation for good conservation outcomes. While social welfare is not a focus within the OSPAR mandate, work carried out under the convention to protect the environment and support a transition towards more reliable and sustainable human activity practices can result in improved welfare for Arctic societies in the future. The Convention on Biodiversity (CBD) Global Biodiversity Framework (GBF) is broad and inclusive of social aspects which could become a route by which to consider welfare.

Building climate-proof economic and social systems, through management responses that ensure sustainable ecosystems, will create resilience against extreme events such as floods and storms (OSPAR 2023p). To achieve this, policies are needed to generate and distribute energy, to ensure sufficient access to all communities, and to move away from greenhouse gas emitting sources by expanding renewable energy development to combat climate change (OSPAR 2023p). The increasing global demand for secure supplies of minerals, including to support a transition to renewable energy with associated increased energy storage requirements, is a key driver for increased demand for resources such as copper, cobalt, nickel, lithium, silver and rare earth elements. Such drivers could result in more intensive exploration and aggregate extraction activities in Arctic Waters, including from areas opening up due to reductions in sea ice cover or from the seabed (OSPAR 2023b). In the Arctic region, work to facilitate responsible business and economic development, including business for extractive industries such as mining, oil and gas exploration but also service sectors such as tourism, is done for example through the Arctic Economic Council.

Spatial decoupling of production and consumption through global trade has decoupled benefits and negative impacts from extractive activities, resulting in global social inequity which can further exacerbate negative impacts on ecosystems (IPBES 2019). Non-Arctic societies have interests in Arctic resources to combat climate change but are also concerned by climate change events in the Arctic region causing wide-spread impacts such as sea level rise or impacts on global food security. It would therefore be important to consider and manage societal drivers also in non-Arctic areas, so that a green transition ensures equity and social justice both within and between regions.

The social and cultural impacts on Arctic Indigenous Peoples communities from various extractive activities could include increased drives for urbanisation, altering landscapes and traditional activities such as hunting (Eritja 2017b). The global urbanisation trend can already be seen in the Arctic region with a decline in rural populations, possibly a sign of a decreasing attractiveness of a lifestyle due to a reduction or absence of traditional practices (PAME 2013a). Increasing globalisation coupled with climate change could create industrial interests in expanding activities such as aquaculture for example in Greenland. It is important to clarify the role of Indigenous Peoples and the appropriate forums for their interaction in decision making regarding offshore activities (Eritja 2017b). This is also applicable to other local communities inhabiting the Arctic region.

² EC No 1007/2009 which came into effect in 2013 and allows seal products resulting from hunting by Indigenous Peoples in Greenland, the provision was later extended to allow comparable products from other countries such as Canada.

Stability and security are needed for all communities to thrive. And while security issues appear high on many national agendas, the equally important need to ensure stability by implementing commitments to protect the environment is hampered by a lack of political will in making sufficient funding available. Maintaining viable societies in the Arctic region, linked to the global community, is foundational. This will require ensuring equity in access to the benefits from Arctic nature, while protecting nature from excessive global exploitation. A societal discussion on financial interests and the lack of funding for environmental management, particularly in countries with industrial activities, may need to be elevated.

OSPAR could consider conservation economy, which suggests working towards more regional economies that are more self-sufficient and resilient as well as less depleting of natural resources, as a framework in its work on economic and social analysis, when considering social impacts of measures and actions.

OSPAR could explore linkages with the Arctic Economic Council to progress economic and social analysis for human activities of shared interests.

2.2 Indigenous Peoples

Indigenous Peoples homelands cut across nation-state borders. The Indigenous Peoples living in the OSPAR Maritime Area are the Sámi³ and the Inuit⁴, both within Arctic Waters (OSPAR Region I). Indigenous Peoples' wish to sustain their identity and culture has resulted, among other things, in the establishment of governance mechanisms to pursue local needs and interests through the Sámi Parliaments in Fennoscandia and the self-government of Greenland (PAME 2013a). These sub-national governance instruments and institutions reflect Indigenous Knowledge and sustainable management practices at a local level, with the Greenlandic self-governance stretching to most areas of governance (PAME 2013a). An example of how the sub-national governance structures can implement local measures was the Sámi Parliaments involvement in developing measures, approved by the Norwegian Parliament, to establish a local fjord advisory board to allocate additional cod quota for Sámi, and for other residents in Coast Sámi areas (PAME 2013a). Indigenous Peoples may have more interest in work on coastal drivers, compared to at-sea or industrial drivers linked to the work of OSPAR Commission, as these have a direct link to everyday activities such as coastal subsistence fishing.

Indigenous Peoples communities in the Arctic have a relatively close relationship with the environment, with many societal links and drivers. Their cultural identity can be directly linked to the marine environment; for example the "Coast Sámi" are Sámi people who live on the coast and in fjords and rely on fisheries for their main income, and there are many Inuit whose lives are concentrated along the coast due to inland areas being made up of solid ice and of low productivity (PAME 2013a). It should also be recognised that many Indigenous Peoples communities have undergone huge changes in the last decades due to state regulations and full incorporation in the global market economy.

Arctic Indigenous Peoples have unique food systems, where locally sourced foods are more prevalent than in other communities, and where subsistence livelihoods, including reindeer herding, fishing, hunting, gathering and trapping, provide foods but also economic, cultural and spiritual connections to the environment as a basis for cultural identity (Saami Council 2023). Obtaining traditional foods can be an activity that strengthens family and generational bonds in the community by passing down Indigenous Knowledge (PAME 2021f).

"In the Sámi cosmology, humans are seen as part of nature, not above other forms of life, where maintaining harmony within the ecosystem is the core value. Guiding principles are modesty – taking only what is needed – and respect, towards other beings both as individuals and as populations. This reciprocal relationship with nature is a key value which binds people to their environment, history and heritage. While benefiting from the gifts of nature, it also brings a responsibility to maintain a balance within the ecosystem and to safeguard the healthy environment as a foundation of all life." (Saami Council 2023)

As the Arctic region warms due to climate change, increasing changes in the environment occur simultaneously with the increasing intensity of new economic activities which threatens many facets of Arctic livelihoods, in particular for the Indigenous Peoples (Saami Council 2023). For example, a potentially expanding aquaculture industry into warming waters of the Arctic region could bring economic benefits to

³ For more general information see for example <https://www.saamicouncil.net/en/home/>

⁴ For more general information see for example <https://www.inuitcircumpolar.com/>

some coastal states or communities but may e.g. damage the seabed and push Arctic species further northwards, which could have negative impacts on other communities (Saami Council 2023). Indigenous Peoples are more dependent on what is available locally, and local deterioration in environmental conditions could result in an increasing need to import for example foods which would increase the cost of living and complicate continuing traditional practices and lifestyles.

The Sámi culture and society are impacted by climate change, impacting livelihoods in traditional areas which contributes to outmigration to more urban areas (Saami Council 2023). If less time is spent on the lands and in connection with nature, the Sámi, and other Indigenous Peoples, report negative impacts on mental well-being, with depressive symptoms, substance abuse and family violence, whereas more time spent on the lands is associated with positive mental well-being, seen as increased self-worth and expression of cultural traditions (Saami Council 2023). Sámi youth experience stress and worry from the threats to the natural environment and conflicts with new industries in the region, which may negatively impact cultural traditions and livelihoods in the future (Saami Council 2023). This is expressed for example as:

“There is a big risk that many more will suffer from mental illness if it continues like this. At the same time as there are more and tougher conflicts about the pastures. For example, the so-called “green” transition threatens to take the remaining (industrially) untouched lands. Within my reindeer herding community, two new copper mines and wind farms are being planned, and the forestry is going hard on the last remaining trees. When the reindeer are in places where they don’t usually stay during the winters, there are conflicts with other land users such as the tourism industry but also with cabin owners, etc. The social climate becomes harsher and even more polarized where reindeer herding is pitted against climate change; for us who represent reindeer herding, the threats to us personally are increasing, and racism gains new wings.”– reindeer herder in northern Sápmi (Saami Council 2023).

In the marine environment, Indigenous Peoples are equally connected to biodiversity and the physical environment. This includes a connection to areas beyond national jurisdiction (ABNJ) through i.a. the links in ocean currents and migrating species, which means that any unsustainable use of marine biodiversity in these areas could have a direct impact on Indigenous Peoples livelihoods (Tugend 2021). High seas ice-edge ecosystems provide important feeding areas for fish which are utilised by Indigenous Peoples in coastal areas, creating a clear link to biodiversity in areas beyond national jurisdiction, as noted during the CBD Arctic EBSA workshop (CBD 2014). It is therefore considered that as conservation strategies for biodiversity in areas beyond national jurisdiction are developed the states should underpin the necessary measures with scientific information and Indigenous Knowledge and implementing the measures to ensure rights of Indigenous Peoples (Tugend 2021). Such conservation strategies should take into account existing strategies such as the Arctic Council CBMP and CAFF biodiversity action plan (see ANNEX 4: *Recognising and building on work by the Arctic Council, other organisations and Multilateral Environmental Agreements*). Conservation strategies and actions could be addressed through the implementation of the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement) which was adopted in June 2023. Other relevant instruments could be the NAMMCO Agreement and the Agreement on the Conservation of Polar Bears.

OSPAR could identify the main areas of work of interest for Indigenous Peoples as an important step to ensure that engagement is relevant and reflects local needs, which may differ from focus areas of international negotiations.

OSPAR could co-create a narrative with Indigenous Peoples on how marine environment protection actions to increase ecosystem resilience can improve the livelihoods of Indigenous Peoples.

OSPAR could explore OSPARs role as a regional legal entity in supporting the implementation of the BBNJ Agreement within the Arctic Waters, taking into account the rights and needs of Indigenous Peoples.

3. Human activities in Arctic Waters

Key Message:

- The projected increase in intensity of shipping, extraction of oil and gas and tourism activities are bigger than what OSPAR has previously identified.
- Aquaculture has increased rapidly in Arctic Waters and exerts strong pressures locally.
- Tourism and port activities supporting shipping are examples of activities that exert strong pressures locally which can be a concern to Arctic communities.
- Deep-seabed mining and geoengineering activities could exert strong pressures in the future.
- Several human activities not regularly considered by OSPAR are suggested to be important to assess in Arctic Waters.
- Arctic Waters is a vast area, and human activities are often localised and therefore spatial tools to understand the intensity and potential overlap of several activities could be useful.
- The OSPAR mandate to assess human activities and their impacts and bring the information to the attention of other competent authorities is important in addition to developing guidelines for best practice on activities within its own competency.

OSPAR applies an ecosystem-based approach to ensuring that human activities in the marine environment of the North-East Atlantic are sustainable; meaning that human activities are the aspect to manage or the “levers to pull” in this approach. Human activities are already managed through sector-specific legislation as well as holistic management plans. However, where human activities continue to negatively impact biodiversity and ecosystem functioning in the Arctic Waters, there is a need to consider further management responses.

The OSPAR QSR 2023 focussed on eight human activities (Table 2), the co-creation of knowledge for the OSPAR Arctic Waters report identified a number of other human activities of relevance, such as military activities, scientific research, land-use change and forestry, waste-handling and freshwater resource management. Extractive activities are a significant component of the economic activity in the Arctic Waters, with tourism being an example of a different source of economic activity. Overall, the services sector does not appear to be as important in generating revenue as in more temperate regions. Commercial activities, such as petroleum production in Norwegian waters, and fisheries in Iceland, the Faroe Islands and Norway are significant contributors to the economies in Arctic Waters (OSPAR 2023a). Finfish aquaculture is an important and growing industry, notably in Norway and Iceland, and another growing industry is tourism (OSPAR 2023b). Deep-seabed mining is a potential future activity with environmental impacts that are as of yet not fully understood (OSPAR 2023b), loss and disturbance of benthic habitats through extraction or smothering through re-suspended sediments is an example of expected but not fully understood impacts.

Table 2. Human activity overview table for Arctic Waters (OSPAR 2023b). The co-creation of knowledge in the OSPAR Arctic Waters report has identified more activities and future trends to be more intense or increasing than previously recognised in OSPAR as *comments.

| Main activities | Intensity | Trend since QSR2010 | Trend to 2030 |
|-----------------------|-----------|---------------------|---------------|
| Fishing | H | ↓ | ? |
| Aquaculture | H | ↑ | ↑ |
| Oil/gas production | M | ↔ | ↔* |
| Shipping | M | ↔ | ?** |
| Tourism | L*** | ↑ | ↑ |
| Renewable energy | L | ↑ | ↑ |
| Aggregates extraction | L | ↔ | ?**** |
| Agriculture | L | ↔ | ↔ |

* Several activities have been started in recent years, which could be an indication for an increase.
 ** The Arctic Council Shipping Status Report (2013-2019) (PAME 2020a) shows increasing trends, and the NOAA Arctic Report Card 2022 models predict increasing activity (Berkman, et al. 2022).
 *** Tourism intensity has been high at certain locations in the past decade, for example in Iceland, Svalbard and northern Norway,

*** There are future plans for deep-seabed mining and terrestrial mines in coastal areas suggesting an upward trend

Availability of information on human activities is not uniform across Arctic Waters, and information is currently not available in OSPAR at a sufficient level of detail to allow for comparable regional assessments. Information is missing from Iceland and Greenland while a lot of information from Norway is readily available in the source material. Information was also lacking for the north-eastern most corner of the Arctic Waters, including the White Sea which is important for the wider Arctic region, but it should be noted that Russia is not a Contracting Party to OSPAR. Human activities taking place outside the boundary of Arctic Waters can also exert pressure on the Arctic Waters marine environment.

Climate change has already been found to impact human activities in Arctic Waters (OSPAR 2023p), thus the nature and extent of activities is not fixed in space and time and further changes can be anticipated into the future. Similarly, the cumulative impacts of human activities or new activities with wide-reaching impacts regionally such as deep-seabed mining or offshore wind energy generation are a concern. New policies could create more impacts than policymakers anticipate in light of climate change and wide-reaching and cumulative impacts. Localised assessments, for example using the Environmental Impact Assessment (EIA) framework for single projects are considered accurate, however there could be a need for a more wide-reaching approach using for example Strategic Environmental Assessments (SEA) to understand regional impacts from new policies.

OSPAR could consider improving information sharing practices and consider using alternative sources of information on human activities to improve the understanding of activity intensity and distribution.

OSPAR could compile regionally comparable spatial information data sets about human activity occurrence and intensity as a basis for future assessments.

OSPAR could consider assessing more human activities of relevance specifically in Arctic Waters, for example military activities.

3.1 Extraction of living resources

3.1.1 Fishing

Fishing is an important human activity in Arctic Waters, with many types of fisheries taking place as commercial, recreational and subsistence fishing. Environmental impacts from coastal fishing activities are different from offshore industrial fishing activities. Small scale fishing for subsistence purposes as an activity has much smaller impacts on the environment compared to larger scale commercial fishing activity. In Greenland, 80% of households in small remote settlements have members participating in hunting and/or fishing for subsistence purposes as a necessary supplement to wage income (AMAP 2021a). In Fennoscandia, both indigenous communities and other residents engage in fishing and hunting for their own consumption, with an estimated 25-50% of the population engaging in fishing, and 5-15% in hunting of mainly terrestrial animals (AMAP 2021a).

In the offshore areas of the Arctic region, the number of unique fishing vessels and the distance sailed has increased in 2013-2019 based on vessel monitoring data (PAME 2020a). Commercial fisheries in the Nordic and Barents Sea mainly target cod, saithe, haddock, blue whiting, herring and capelin for which major spawning grounds exist along the continental shelf (OSPAR 2023a). The Barents Sea and Lofoten region are among the most productive sea areas globally, with fisheries data having been systematically collected and analysed since 1864 (ICES 2020c). Fishing is an important human pressure in the Barents Sea and some of the impacts appear to have diminished in recent years (Siwertsson, et al. 2023). Based on current knowledge, snow crab is the only currently exploited wild fishery resource for which Norway has identified the potential to increase the harvest (Norwegian Ministry for Climate and Environment 2020). Currently, no commercial fishing takes place in the Central Arctic Ocean and regulations to prevent unregulated fisheries have been set

out in the international 'Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean'. Most fisheries in the area beyond national jurisdiction are managed by the North-East Atlantic Fisheries Commission (NEAFC), fisheries for tuna and tuna-like species are managed by the International Convention for the Conservation of Tuna (ICCAT).

Projections of climate change and ocean acidification impacts on fishing still contain large uncertainties. Global models predict decreased productivity in the long-term, but possible increase has been modelled for production in the Arctic region (IPCC 2023). There could be job creation in new areas if fish stocks move into more northerly areas but there are also risks to traditional livelihoods as stocks may move out of areas where they are currently harvested (AMAP 2021a). A spatial shift of fish stocks could result in more complex and contentious assessment, allocation of catches and transboundary management of fish stocks (OSPAR 2023p). Northward range expansions are already underway for commercially important fish stocks, for example Atlantic cod (*Gadus morhua*) has expanded northward in the Barents Sea which is believed to have contributed to a decrease in polar cod (*Boreogadus saida*) through predation (CAFF 2017). Norway has identified sustainable harvesting of new species, particularly at lower trophic levels, as an option for the future (Norwegian Ministry for Climate and Environment 2020). Adaptation of fishers' practices and gear could also be required in response to environmental changes, such as the frequency of extreme events (OSPAR 2023p).

Regarding other pressures exerted by the fishing activity, fishing with bottom contacting gear is well known to cause long term structural damage to certain benthic habitats. The physical impact from bottom trawling in the Barents Sea has been assessed as minor overall, but moderate in areas that are trawled frequently (Norwegian Ministry for Climate and Environment 2020). Incidental by-catch can also be a major pressure from this activity, acting on the by-caught species and it can also have a negative impact on the fishing activity itself. Norwegian authorities have registered by-catch of the following marine mammal species over the past 40 years: hooded seal, bearded seal, harbour seal, grey seal, harbour porpoise, humpback whale, minke whale, killer whale, beluga whale, pilot whale (OSPAR 2023j). Harbour porpoise and harbour seal were most commonly by-caught, with by-catch levels of harbour porpoise currently at unsustainable levels (OSPAR 2023j). Iceland requires incidental by-catch of marine mammals to be recorded in fisheries logbooks (OSPAR 2023j)). Observed by-catch rates of 9-19% of harbour seal and 8-24% of grey seal populations in Iceland implies that existing measures may not be sufficient for the protection of these species (OSPAR 2023j).

3.1.2 Hunting

Commercial hunting of seals, whales and polar bears led to the decimation of many populations in the Arctic Waters historically. This is likely to have permanently altered energy flow and the dynamic properties of the ecosystem (OSPAR 2000). Some of the overexploited species, such as fin whale and minke whale, have recovered well (OSPAR 2000), whereas species such as bowhead whale continue to be in poor status and seriously depleted (OSPAR 2023j). The northern right whale was hunted to extinction in Arctic Waters and its former range along the coast of Norway, repatriation (from the West Atlantic) has not taken place. Other species such as walrus and polar bears, although still below historical population sizes are showing positive population trends in the European Arctic (Kovacs, Belikov, et al. 2021a).

Only a few marine mammal species are currently subject to what is classified as commercial harvests, but traditional and subsistence hunts occur for virtually all species occurring in Arctic Waters. The ongoing Norwegian commercial hunt for minke whale has remained stable at approximately 500 whales taken annually (Norwegian Ministry for Climate and Environment 2020). Iceland has allowed limited hunting quotas for both fin- and minke whale in recent decades (OSPAR 2023j). Hunting was suspended in Iceland for some time while a working group evaluated and proposed methods for reducing irregularities during hunting of fin whales in order to improve the animal welfare aspect, the autumn 2023 hunt was carried out following stricter requirements for hunting equipment and methods that will be evaluated at the end of the hunting season (Ministry of Food, Agriculture and Fisheries 2023).

The only seal species currently hunted at commercial levels within Arctic Waters is the harp seal. Hunting quotas are calculated for harp seals by the ICES working group WGHARP for both the White Sea and Greenland Sea populations. In recent years the numbers of seals taken are well below assigned quotas (ICES 2020h). Hooded seals became protected from commercial harvest in 2008 because overexploitation over a

period of many decades had depressed the population by approximately 90%; despite this protection the population has not shown signs of recovery (ICES 2023b). Hunting of seals along the Norwegian coast is allowed under licences which restrict the number, time and place in which grey- and harbour seals can be taken (OSPAR 2023j), as well as other species such as ringed seals that are permitted in the sport-hunt occasionally. Seasonal closures to protect the breeding period and the time when shot seals would sink have been implemented in Svalbard for ringed- and bearded seal hunts (OSPAR 2023j). Iceland had a programme of granting a premium on the killing of seals in the 1980s, but this has been abandoned a long time ago, and hunting of seals is banned since 2019 unless a licence is granted by the Directorate of Fisheries meeting the strict requirements relating to grounds on limited and traditional utilisation, which has resulted in minimal hunting in recent years (pers. comm. Iceland HOD).

In Greenland, subsistence hunting activities are seasonally driven with ringed seals and polar bears hunted on long trips on sea ice, while summer hunting takes place along the ice edges or from motorboats in the fjord systems (Flora, et al. 2019). In East Greenland ringed seals dominate the traditional hunters' catch, with 5 000 – 10 000 animals taken annually (NAMMCO 2022), followed by bearded seal, arctic char, black guillemot, walrus, polar bear and narwhal (Flora, et al. 2019). Small numbers of other species are also taken. For example, hooded seals are also taken in the Greenland hunt, with numbers ranging from a few to some hundreds; although most of these animals are likely from the Northwest Atlantic stock, some might also be from the Greenland Sea stock which is classified as Endangered in the Norwegian Red List of 2021. The marine mammal meat is used as food for humans and sled dogs, and the national tannery purchases many of the skins (Ugarte, et al. 2020). The skin of bearded seals is tough compared to other seals, and therefore used to make soles of traditional kamiks (Inuit footwear) and the whips used to guide sled dogs (Ugarte, et al. 2020). Harbour seal skins are coveted in Greenland since they have been traditionally used to make the women's national costume; however, due to a population decline of harbour seals, hunting has been banned since 2010 (Ugarte, et al. 2020).

Narwhal mattak (skin and blubber) is an expensive delicacy, giving Greenlanders a high motivation to hunt for this species, with a yearly take of approximately 450 animals (Ugarte, et al. 2020). The east Greenland narwhal population has diminished, and in 2019 the scientific council of the North Atlantic Marine Mammal Commission (NAMMCO) recommended a complete stop of hunting, however, a quota of 50 animals was set for 2020, 40 for 2021 and 30 for 2022 (ICES 2020h). The International Whaling Commission (IWC) has expressed concern regarding the sustainability of small cetacean hunts in Greenland, recognising an imminent risk of extirpation of narwhal in southeast Greenland, and recommended that Greenland follow the scientific recommendations from NAMMCO and the Canada and Greenland Joint Commission on narwhal and beluga (CNB) on sustainable removals (IWC 2023). The sudden appearance of white whales on the south-east coast of Greenland in the last few years stimulated a spontaneous hunt, and an issuing of a technical quota of 30 beluga for the period of 2023-2027 in east Greenland (pers. comm. Kingdom of Denmark). The source population of these animals is currently unknown as the species does not normally occur in east Greenland.

Compared to hunts in east Greenland in the 1980s, the hunts monitored in 2017 and 2018 took place over smaller spatial areas, which is explained by a smaller number of hunters, quotas being filled close to the settlements and less land-fast ice, which restricts dog sledge mobility and access (Flora, et al. 2019). The reduction of sea ice has also brought more polar bears closer to settlements, increasing the number of bears killed in order to protect humans (CAFF 2017), the self-defence takes are deducted from the overall regional quotas. The east Greenland Scoresby Sound (Ittoqqortoormiit) polar bear project has been running since 1983, providing long-term datasets of persistent organic pollutant levels in polar bears and ringed seals through ongoing collaborations with full-time Inuit hunters (AMAP 2021c). The researchers and hunters are in contact year-round to exchange mutually relevant information related to hunts, contamination exposure data and human and wildlife health issues (AMAP 2021c).

Marine mammal hunting has strong traditional foundations also in the Faroes Islands. Virtually all species residing in the islands or visiting the region are subjected to harvest. The main species involved in the Faroes drive-fisheries are long-finned pilot whales (*Globicephala melas*) and white-sided dolphins (*Lagenorhynchus acutus*). Catches are variable, ranging from small numbers up to 1 500 animals of each species annually (NAMMCO 2022). Smaller harvests also take place for grey seals (*Halichoerus grypus*), common bottlenosed

dolphins (*Tursiops truncatus*), Risso's dolphin (*Grampus griseus*), white-beaked dolphins (*Lagenorhynchus albirostris*), northern bottlenosed whales (*Hyperoodon ampullatus*) and killer whales (*Orcina orca*).

3.1.3 Kelp harvesting and cultivation

Kelp are large macroalgae that can form dense forests along rocky coasts. Macroalgae are harvested commercially as a source of alginates that are used for example in the food- and cosmetics industry. Kelp harvesting can result in preferred habitats for fish species being removed or overharvesting of a kelp bed and loss of the habitat, a sort of underwater deforestation.

There has been a strong interest in macroalgae cultivation along the Norwegian coast since 2012, including in Finnmark (Norwegian Ministry for Climate and Environment 2020). Sugar kelp (*Saccharina latissima*) and dabberlocks (*Alaria esculenta*) are the main species used for cultivation, however aquaculture licences have been issued for over 30 different macroalgae species (Norwegian Ministry for Climate and Environment 2020). This emerging ocean industry is in a developmental phase and, while initial feedback from companies has been positive, it will require more knowledge to be generated on topics such as food safety, environmental impacts and technological developments before it is commercially viable (Norwegian Ministry for Climate and Environment 2020).

3.1.4 Bioprospecting

Marine bioprospecting is an emerging ocean industry. The activity includes collection of marine biodiversity that is analysed for compounds and/or genetic code that could be useful in an economic application. The focus of marine bioprospecting in the future is expected to be on organisms of deep oceans in areas beyond national jurisdiction (Bekiari 2023). The activity is of particular relevance in the Arctic region where many organisms have developed adaptations to extreme environmental conditions (Norwegian Ministry for Climate and Environment 2020). These adaptations could be the source of unique genes or molecules of commercial development interest, for example in the pharmaceutical industry. Cold-adapted enzymes have already been discovered and are being produced and sold commercially (Norwegian Ministry for Climate and Environment 2020).

Prospecting activities are systematic but currently do not include extensive harvesting of marine biodiversity. In cases where bioprospecting requires extensive harvesting of organisms, there is a risk of harm to targeted locations and habitats (Bekiari 2023). Sampling methods applied in marine bioprospecting are often similar to those applied in marine scientific research and can result in cooperative ventures, the difference is that bioprospecting aims to develop profitable products whereas scientific research aims to expand scientific knowledge (Bekiari 2023). Bioprospecting causes direct disturbance and mortality to species or secondary pressures through changes in water flow, alteration of community structure or biological contamination through introduction of non-indigenous species (Bekiari 2023).

Bioprospecting for the pharmaceutical industry could be guided by information on organisms used for medicinal purposes by Indigenous Peoples, in which case issues with appropriation of information could arise (Bekiari 2023). There is no explicit legal framework in existence to govern Indigenous Peoples' participation in benefit-sharing by industry from Arctic region bioprospecting (Eritja 2017a). However, the adoption in June 2023 of the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement) puts in place a legal framework for benefit sharing from extraction of marine genetic resources in areas beyond national jurisdiction. Resource management, biodiversity protection and benefit sharing for resources within national jurisdiction are regulated under the CBD and the Nagoya Protocol.

OSPAR could consider the need to develop a code of conduct for bioprospecting activities, in particular if activities are carried out jointly with scientific research activities which could warrant, for example, developing an Annex to OSPAR Agreement 2008-1 on the code of conduct for deep-sea and high seas scientific research.

OSPAR could discuss whether a measure on benefit sharing from bioprospecting in Arctic Waters is needed, in particular clarifying how the BBNJ Agreement would support the Indigenous Peoples participation.

3.2 Aquaculture

Aquaculture has increased significantly over the past decade and is one of the most marked changes in industrial activity across the entire OSPAR Maritime Area (OSPAR 2023a). Norway is the largest aquaculture producer, with a 1.35 Mt production of mainly salmon in 2018 to a value of € 6.7 billion, and the Faroe Islands another big salmon producer (OSPAR 2023b). Aquaculture production has increased approximately 10-fold since 2015 in Iceland, with current production of mostly salmon and trout at 50 000 t and an export value of 49 billion ISK in 2022 (Statistics Iceland 2023). Intensity of the activity across the vast Arctic Waters Region is not reflective of potential local impacts, including impacts on Indigenous Peoples and local communities.

The growth in industrial aquaculture has been linked to a significant increase in waterborne nutrient input in Arctic Waters, however due to technical reasons it has not yet been possible to assess whether this increase in nutrients is giving rise to eutrophication effects (OSPAR 2023a). Other pressures from this human activity, such as impacts on the environment from the use of pesticides and antibiotics, have decreased historically through the introduction of effective vaccines to eliminate bacterial disease (OSPAR 2000), however in light of climate change potentially giving rise to new pests or diseases this conclusion may need to be re-visited. Climate change impacts could again increase the incidence of diseases, harmful algal blooms or parasites, as well as introducing an increased risk from microbial pathogens (OSPAR 2023p). There is still a lack of knowledge on how medicine applied to treat lice at salmon farms may impact the wider ecosystem, in some areas de-lice agents have been found to result in moderate environmental impacts on non-target species (Grefsrud, et al. 2023). The chemical treatments at salmon farms could be a threat to shrimp in the surrounding open water area. Spread of lice from aquaculture farms are a threat both to Atlantic salmon and Arctic trout (Grefsrud, et al. 2023). Overall, there appears to be a lack of knowledge in fully assessing the impact of nutrients, particulate organic matter, copper and de-lice agents from aquaculture activities on vulnerable habitat types such as cold-water coral reefs/gardens, eelgrass beds and kelp forests.

Aquaculture facilities for salmon farming are often placed in fjords at locations with strong currents, but for example in Norway the coastal and fjord areas have not been systematically mapped and therefore aquaculture facilities placement could overlap with sensitive benthic habitats that form in such locations (Kutti and Husa 2020). Indigenous Knowledge recognises such locations as good fishing spots with diverse and abundant benthic habitat communities, including for example cold-water corals, and the locations as spawning grounds for wild cod. Indigenous Knowledge and scientific research have shown that coastal cod returns to a lesser degree to old spawning areas if salmon farms are located in the fjords. Placement of aquaculture facilities at such location exerts a disturbance pressure and is a threat to coastal cod (Mearrasiida 2015, Grefsrud, et al. 2022). The current level of knowledge on the holistic impacts on fjord ecosystems from aquaculture facilities is insufficient to fully describe or manage the pressures (Kutti and Husa 2020, Grefsrud, et al. 2023).

Indigenous Peoples and fishermen from local communities have expressed concern and called for more investigations into the risk of residues from aquaculture facilities being carried by currents and negatively impacting locations at a distance. Some long-term studies of impacts from salmon aquaculture on fjord ecosystems have been carried out (Brkljacic, et al. 2022), however these are considered insufficient to holistically assess the full impacts on the complex ecosystems of the fjord area.

Escaped farmed salmon pose a threat to the genetic integrity of wild salmon populations. Increased storminess due to climate change could result in a higher risk of spread of non-indigenous species from aquaculture facilities (OSPAR 2023p). The number of cod farms are on the rise, and there is a higher risk of contact between farmed cod and threatened coastal cod populations coming into contact across the nets of the farming facilities. Also, farmed cod has been known to spawn in captivity which poses a risk of genetic contamination of wild coastal cod populations.

Aquaculture production could extend further north under climate change scenarios whereby ocean temperature would increase sufficiently to allow for higher growth rates of certain finfish (OSPAR 2023p). Aquaculture production is increasing along the coast and in the fjords of northern Norway, marking the direction of travel as Norway aims to increase aquaculture production severalfold by 2050 (OSPAR 2023b).

OSPAR could assess cumulative impacts from all pressures from aquaculture, to clarify the local impacts on fjord ecosystems in a holistic manner.

OSPAR could work to improve the coverage and spatial resolution of sensitive benthic habitat maps as a basis for spatial assessment of aquaculture impacts in areas of overlap.

OSPAR could assess the risk on the genetic integrity of wild salmon and cod populations from climate change impacts, including from a potentially increasing occurrence of escapes from aquaculture facilities due to increased storm frequency.

3.3 Extraction of oil and gas

Petroleum activities started in the Barents Sea in the 1980s and have to date resulted in 162 exploration and appraisal wells drilled, 101 of which were begun in 2005 or later (OSPAR 2023b). Oil and gas products can be expected to be used as fuels still for some time, while a global transition towards other energy sources progresses at different paces for different countries. A detailed description of the development of national regulation for oil and gas prospecting and licensing has been prepared by PAME (PAME 2021d).

Exploration for oil recently took place in north-east Greenland. The five oil exploration licence blocks have since been given up (Clausen, et al. 2022). The Government of Greenland announced a moratorium on exploration in 2021. Oil companies operating in Greenland are obliged to contribute to environmental knowledge creation to inform the Strategic Environment Impact Assessment (SEA) (Boertmann, Blockey and Mosbech 2020), and the information could for example inform response activities to accidental oil spills (see Atlases in Clausen, et al. 2022, Johansen, et al. 2022). The Icelandic government has declared a policy of no exploration and of not granting extraction licenses for hydrocarbons in Icelandic waters, which has been put forward as a legislative proposal that has not yet been adopted by the Icelandic Parliament (pers. comm. Iceland HOD). Three previously issued exploration licenses have been withdrawn. There are five structures of potential oil and gas exploration interest in the Faroese area (PAME 2021d), but no plans for activity (OSPAR 2023c).

Norway has two producing fields in the Barents Sea (PAME 2021d) and 21 in the Norwegian Sea (norskpetroleum.no). The fields Snøhvit (on-stream in 2007) and Goliat (on-stream 2016) are currently in production, with the Johan Castberg field under development and production to start in 2024 (OSPAR 2023c). The Johan Castberg field will be the northernmost offshore development, and this is reflected in the development plans which include drift ice observation procedures, and procedures for production halts if drift ice is detected to be approaching the floating production platforms (Norwegian Ministry for Climate and Environment 2020). The Norwegian waters of the Barents Sea where petroleum activities take place are on average ice-free year-round and water temperatures are comparable to the Norwegian Sea (OSPAR 2023b). Gas infrastructure was established in the Norwegian Sea in the 1990s with Haltenpipe in 1996 and Åsgard Transport in 2000. The Polarled gas pipeline from the Aasta Hansteen field was in operation from 2018 (OSPAR 2023c). Gas from Snøhvit is transported by pipeline to Hammerfest where liquified natural gas (LNG) is produced and shipped (PAME 2021d). Norway has carried out environmental impact assessments (EIA) for the oil and gas exploration activities in the Barents Sea, including assessing impacts on Indigenous Peoples and local communities (PAME 2021d). There is a demand from European countries for Norwegian oil and gas products.

Across the OSPAR Maritime Area a downward trend in emissions and discharges from oil and gas activities has been described between QSR 2010 and QSR 2023 (OSPAR 2023c). Oil and gas production are long-lasting activities that carry with them a risk of permanent effects on the environment, such as pollution from accidental oil spills, discharge of produced water, or displacement of marine mammals due to underwater noise. There are ongoing studies to clarify whether Arctic region ecosystems and organisms are more sensitive to hydrocarbon-related pollution compared to other areas, with initial results from laboratory exposure studies showing a significant variability of responses depending on the type of oil, dispersants and environmental factors (ICES 2020b). North-East Greenland shelf break sediments contained light alkyl-PAHs at detectable concentrations, suggesting some form of limited oil exposure, whereas none were detected in shelf sediments (Johnsen, et al. 2019).

3.4 Shipping

Shipping is the human activity giving rise to the widest set of pressures in Arctic Waters, from underwater noise, disturbance from light, ship strikes with marine mammals, to pollution from operations and accidents to socioeconomic impacts for coastal communities. The International Maritime Organisation (IMO) has adopted the Polar Code to manage shipping in the high Arctic (see section 7.1.4 *Managing shipping*). Protecting the Arctic marine environment from shipping impacts is good for all parties and stakeholders concerned, including the sea farers. Shipping, including cruise tourism, meet societal drivers from trade, commerce, and recreation (OSPAR 2023a). Global shipping is predicted to increase based on future scenario analyses (OSPAR 2023b). If climate change results in continued sea ice losses, shipping could increase across pan-Arctic trade routes (OSPAR 2023b). Climate change impacts on shipping remain uncertain; factors such as the length of the Arctic shipping season and the economic viability of trans-Arctic routes will influence how significant an increase will be seen (OSPAR 2023p).

Increases in shipping activity in the Arctic region has already been observed (PAME 2020a). Concerns have been expressed regarding potential impacts, for example on noise sensitive Arctic marine mammals which depend on sound for communication and in some cases also navigation (Reeves, et al. 2014). To track the predicted changes in circumpolar shipping activity, the PAME Arctic Ship Traffic Data portal was launched in 2019 to collect circumpolar ship traffic information (PAME 2023b). Different types of shipping are tracked: *destinational transport* where a ship sails to the Arctic for an activity and then sails south again; *intra-Arctic transport* where a ship stays within the Arctic and connects two states; *trans-Arctic transport* where a ship sails from the Atlantic to the Pacific; and *cabotage* where a ship sails between two ports of the same state (PAME 2020a). There has been a 25% increase in the number of unique vessels entering the Arctic region and a 75% increase in the distance sailed by all ship types in the period 2013-2019 (PAME 2020a). Fishing vessels made up the majority in the increase of new vessels and distance sailed (PAME 2020a).

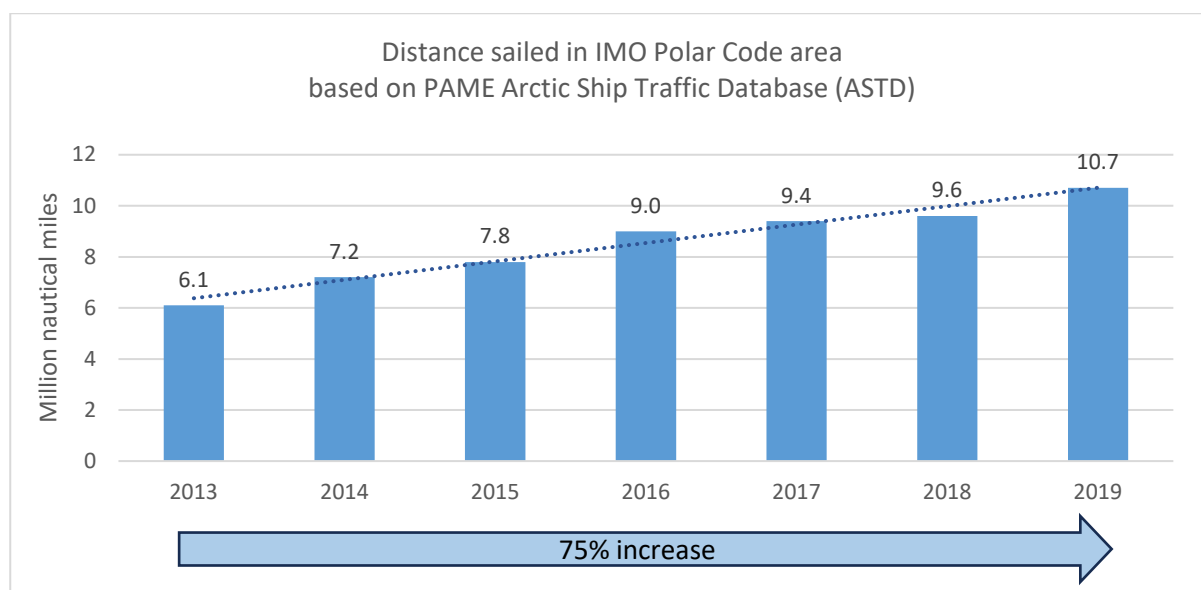


Figure 3. Distance sailed in Arctic Polar Code area in million nautical miles based on information from the PAME Arctic Ship Traffic Database (ASTD). Reproduced from (PAME 2020a).

Approximately a third of the global ice-breaker fleet operated within the Central Arctic Ocean high seas area in the period 2009-2013 (Berkman, et al. 2021). Ice breaking has many impacts. Sea ice does not re-form in the same way after having been broken which can have impacts on the ice associated biota, but also pose safety risks and impact traditional land use and thus impact Indigenous Peoples food security. Ice-breaker channels concentrate ship traffic, which can contribute to higher concentrations of pollutants in these surface waters for example from oily discharges or discharges from ship scrubbers (exhaust gas cleaning systems) containing hazardous substances such as heavy metals.

Climate change is known to increase navigational risks in the Arctic region, due to increasingly mobile sea-ice and poor hydrographic charting of newly opened areas, and limited weather, water, ice and climate data

services (Constable, et al. 2022). Floating ice is recognised as a major hazard in Arctic region shipping, and meteorological predictions are still provided at a general scale (PAME 2013a). The World Meteorological Organisation (WMO) and the International Maritime Organisation (IMO) cooperate to provide mariners in the Arctic region with weather, wave and ice warnings and forecasts and navigation alerts to the same standards as in other oceans, which extends the global maritime distress safety system (PAME 2013a). Obtaining daily minimum temperatures when some areas are not covered by meteorological data is a challenge, to alleviate the situation ships have been proposed to carry out ship-based observations of ice properties and weather (Prior 2022).

Shipping accidents in the Arctic region are a concern, and groundings are a continued risk to the marine environment as there is a risk of pollution or wreckage. The passenger vessel *Akademik Ioffe* ran aground in August 2018 on an uncharted shoal 78 nautical miles north-west of Kugaaruk, Nunavut, which is an example of the consequences for poor coverage of hydrographic data in the Arctic and the Master of the ship relying on old charts with incomplete bathymetric data (Prior 2022). In 2023 there were several groundings of cruise ships and research vessels in the Arctic region, for example the *MS Isbjorn 2* grounding in May, the *Mikhail Somov* grounding in July, and the *Ocean Explorer* in September (pers. comm. Robin des Bois). Given the long distance for search and rescue operators to travel and the insufficient resource availability in terms of tug-boats that could refloat ships, pollution risks from groundings and other ship accidents are particularly high in the Arctic region. The legally binding 'Agreement on Cooperation on marine Oil Pollution Preparedness and Response' between Arctic states aims to increase cooperation between countries in tackling this challenge by setting out monitoring activities to identify oil pollution and procedures for requests of assistance in case of oil pollution incidents. The Arctic Council Working Group EPPR maintains the operational guidelines for the Agreement. Oil spills in Arctic Waters from acute pollution events or longer-term operational spills are a concern and the long-term impacts on the marine environment need continued monitoring.

Maritime disasters are often attributable to human error, but there should not be an assumption made that autonomous vessels would be free from disasters. Future developments could include development in autonomous ship technology that could allow for more aerodynamic structural design, more optimisation in routing and energy efficiency which in turn could result in environmental impacts being reduced by enabling longer distances to be travelled using electric propulsion (Norwegian Ministry for Climate and Environment 2020). Norway has already amended national legislation to allow for navigation of autonomous ships in coastal waters without the use of a pilot (Norwegian Ministry for Climate and Environment 2020).

The use of heavy fuel oils has been identified, and worked on, by the Arctic Council as the most significant pressure exerted by ships in the Arctic region (Comer, et al. 2017). Heavy fuel oil is typically used in large vessels' big engines, while smaller vessels use other fuel types such as marine diesel. In 2019 the vessels in the IMO Polar Code area that used heavy fuel oil were dredging vessels, refrigerated cargo, container ships, chemical tankers, general cargo ships, oil tankers, LNG tankers, passenger ships and bulk carriers (PAME 2020b). The top three emitters of black carbon were fishing vessels (25%), general cargo vessels (19%) and service vessels (12%) (Comer, et al. 2017). The Government of Greenland has supported a ban on the use and transport of heavy fuel oil in the Arctic region. A future shift towards using alternative fuels in the Arctic region will bring new challenges for combatting spills and protecting the environment. The IMO has implemented a cap on sulphur content in ship fuels to 0.5% from a previous 3.5% outside designated emission control areas from 1 January 2020 under MARPOL, which can be met by ships by using low-sulphur fuels such as distillates or by installing scrubbers to remove sulphur oxide from the exhausts enabling ships to continue using heavy fuel oils. A joint project 'New Low Sulphur Fuels, Fate and Behaviour in Cold Water Conditions' by PAME and EPPR explores some of these issues to address the knowledge gap of how low sulphur fuels behaving in cold Arctic waters (PAME 2020b). The currently insufficient network of distribution points in the Arctic of these new types of fuel is one issue that would need to be addressed and would potentially include construction of new port facilities. This would also be a consideration if fuels such as natural gas or electrification of ships would become more wide-spread in the Arctic region.

Port infrastructure development and associated coastal development have strong impacts on local coastal communities. These shipping associated activities can result in disturbance to species in a local environment or localised pollution and can increase the need for dredging activities for navigational purposes with potential benthic habitats disturbance impacts through resuspension of sediments.

OSPAR could contribute to strengthening the knowledge base on pollution levels in ice-breaker channels, including from ship scrubber emissions.

OSPAR could contribute to understanding the risk of interactions between ships and migratory species in Arctic Waters, in particular south of the IMO Polar Code boundary.

3.5 Tourism

Tourism has previously been considered a minor pressure in Arctic Waters (OSPAR 2000), however the activity has increased in recent years and future projections foresee a further increase in particular for expedition cruises (OSPAR 2023b). Tourism is a more intensive activity that exerts more pressures on the Arctic Waters marine environment than previously recognised in OSPAR. Tourism to Svalbard and Greenland require particular attention to ensure the activity remains at a sustainable level and does not exert pressure on the environment. Tourism has created employment in Svalbard, but not at the same degree in Greenland. One option to increase employment opportunities could be to invite Indigenous Peoples and local communities to navigate or guide in their local areas.

Tourists are attracted to ice edges, natural features such as glaciers, and to the wildlife associated with these habitats. Marine mammals can be directly impacted by tourism activities through disturbance at moulting sites for seals, disturbance to sea bird breeding sites, and disturbance to marine mammals including polar bears other than at moulting sites, or collisions between whales and whale-watching boats (OSPAR 2023j). Increasing numbers of tourists could increase the number of encounters with polar bears, and potentially increase the number shot in self-defence. There are also other pressures to be managed from increased tourism, such as discharges from the cruise ships or littering, or disturbance from the noise of helicopters. Arctic tourism includes a large number of different activities from ice-diving to kayaking in the marine environment, and many other activities that can take place on the coast such as skiing, ice climbing or visiting Indigenous Peoples communities. In addition to managing pressures on species and habitats, it is important to consider cultural heritage issues for which the United Nations Educational, Scientific and Cultural Organisation (UNESCO) heritage reports can provide useful insights. Climate change impacts could further reduce or make sea ice and snow cover more unpredictable, which could impact tourism activities, and create risks and hazards; for example floe edge tours to calving glaciers (Constable, et al. 2022).

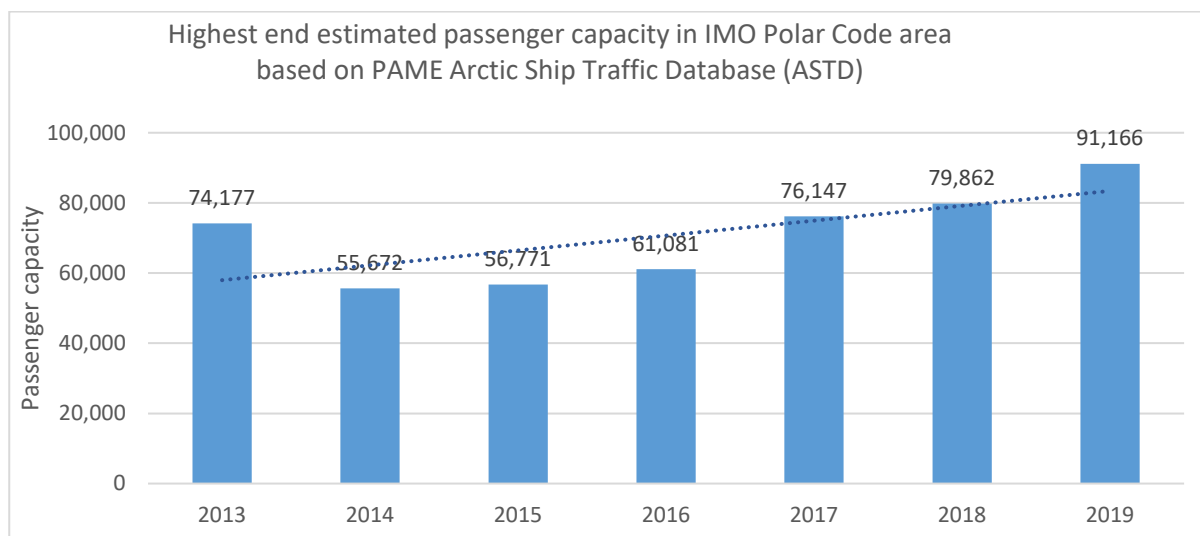


Figure 4. The highest end estimate of passenger capacity of cruise ships in the Polar Code area (total number of passengers and crew) based tourism vessel ship tracking data and numbers the vessels are certified to carry. (Recreated from (PAME 2021e)).

Cruise tourism to the Arctic region (calculated for the IMO Polar Code area) has increased over time when assessed as the capacity of cruise vessels (Figure 4) and is due to both an increase in the number of vessels and the increasing size of vessels (PAME 2021e). Arctic region cruise tourism brings potential revenue to local communities; however adverse effects on these communities have also been reported, with impacts on local culture, hunting and fishing as well as crowding, and the majority of the revenues benefitting foreign-based individuals or corporations (AMAP 2021a).

OSPAR could contribute to identifying marine areas that are particularly sensitive to pressures from tourism due to their ecological features.

3.6 Renewable energy generation

Offshore wind power is an emerging and fast-growing ocean industry, where production costs are currently higher and risk management more complex compared to land-based wind power (Norwegian Ministry for Climate and Environment 2020). There are currently fewer offshore wind installations and a smaller capacity in Arctic Waters compared to other OSPAR Regions (OSPAR 2023b). Other types of offshore renewable energy installations, such as floating offshore wind-, tidal- or wave energy installations, are largely at an experimental stage across the OSPAR Maritime Area (OSPAR 2023b).

OSPAR is undertaking further work on exploring potential environmental impacts from windfarm developments, with a focus on temperate regions where the development pressure is most intensive (OSPAR 2023b). The impacts on benthic habitats and for example migratory species such as seabirds from the construction and operation of offshore wind farms is not sufficiently understood. Arctic Waters particularities for offshore windfarm impacts could relate to sea ice habitats or migratory corridors of ice associated animals.

Terrestrial renewable energy generation activities can also impact the marine environment, coastal placement of wind-farms could for example result in disturbance of marine species such as seabirds. Hydropower dams could result in hydrological changes in coastal ecosystems due to changes in freshwater discharges.

Electrification of oil and gas extraction activities has been proposed as a means of reducing the environmental impact, however this would demand more renewable electricity than is currently available. Generating the needed electricity through offshore wind farms would require large fields to be established that would also have an impact on the marine environment. Electrification and generation of renewable energy are also foreseen to significantly increase the demand for lithium, platinum and other rare earth metals which could result in countries bordering the Arctic looking to meet this demand by exploit existing deposits, including in the deep seabed.

Construction of offshore wind energy developments would require more cables being placed on the seafloor. The main impacts from power-cables come from the physical structure itself including any protective structures, often providing an artificial hard substrate that can facilitate the spread of non-indigenous species. It is not likely to be a significant pressure, compared to the energy-generating facilities. Power-cables could also create electromagnetic fields or heat radiation which could potentially impact some sensitive marine species.

OSPAR could contribute to the knowledgebase of impacts from windfarm development and operations on the Arctic Waters.

3.7 Aggregate extraction and mining

Aggregate extraction has been very limited in coastal areas of Arctic Waters to date; however, the extraction of minerals from the seabed is an emerging industry (Norwegian Ministry for Climate and Environment 2020). Aggregate extraction and mining include removal of marine sands or other minerals from the seabed which can be completed using various techniques such as dredges or explosives. Such activities can cause direct damage and loss to seabed habitats, for example seagrass beds that tend to grow in sandy coastal areas, or through disturbance from pollution and resuspension of sediments in deep-water ecosystems.

Dredging for navigational purposes is not considered under this activity, however with predicted increases in ship traffic in Arctic Waters this could become an issue to consider in the future.

3.7.1. Deep-seabed mining

To date, no deep seabed mining projects exist as functioning operations in Arctic Waters. However, the Government of Norway is in the process of opening areas for exploration on the continental shelf within Arctic Waters, and initiated an opening process for offshore mineral activity in 2020 (OSPAR 2023b). The opening area under consideration is known to hold sulfide- and manganese crusts (Det Kongelige Olje- og energidepartementet 2023).

Deep-seabed mining activities could target sites with polymetallic crusts or inactive hydrothermal vents in Arctic Waters (Figure 5). The general pressures exerted by the activity on deep-sea ecosystems are known, however there are many unknowns on the specific environmental impacts in Arctic Waters as well as globally. Some of the potential pressures from deep-seabed mining include hazardous substances pollution, dispersal of sediment plumes at different water depths impacting wide areas around the mining site and underwater noise. A need to consider how the knowledge gaps should be addressed has been identified in OSPAR, in order to ensure that the general obligations and agreed measures and approaches under the OSPAR Convention are upheld, including i.a. the application of the precautionary principle, the polluter pays principle, BAT/BEP and the ecosystem approach (OSPAR, 2021).

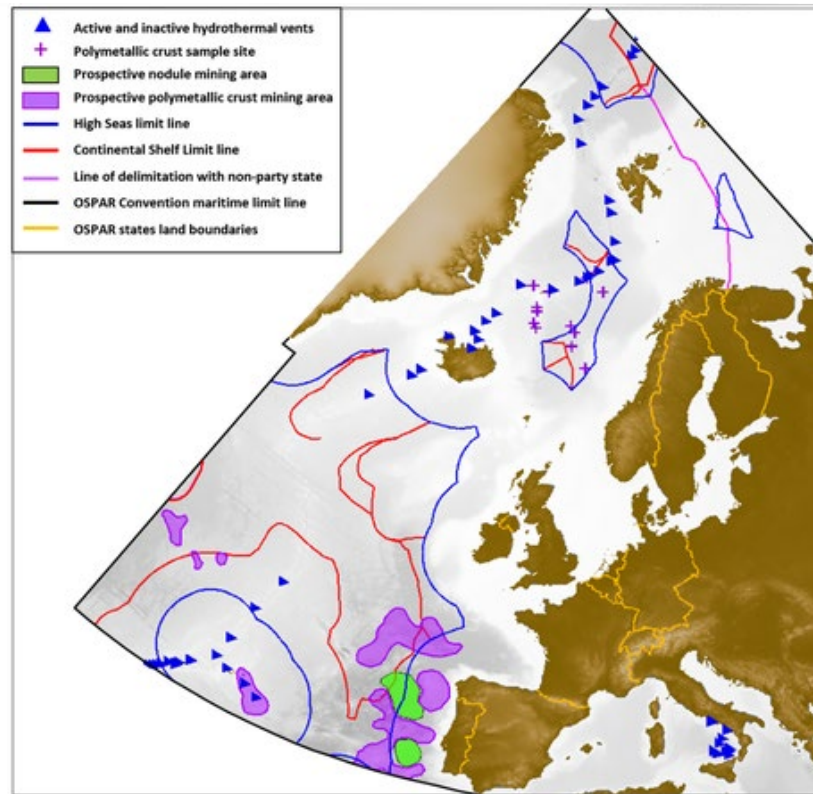


Figure 5. Compilation of confirmed and potential metallic deep seabed mineral deposits (OSPAR 2023b).

OSPAR could continue work to create a knowledgebase on deep-sea ecosystem impacts from deep-seabed mining activities and, as a priority, focus on describing impacts on deep-sea ecosystems in the Arctic Waters.

3.7.2. Coastal mining and deposition of mine-tailings in the sea

Some coastal mining operations in Arctic Waters, operational or planned for example in Norway and Greenland, sometimes employ methods of disposal into the ocean of waste rock or mine tailings, made up of crushed stone and process chemicals (Godin and Daitch 2023). The mine tailings from titanium oxide and copper mines include heavy metal and disposal of the tailings can give rise to pollution effects. Disposal into fjord systems can give rise to concern of the disposal having the potential to alter the fjord bathymetry as well as pollute the ecosystem, which would influence the potential for other uses of the sea area (Godin and Daitch 2023). Industrial mines in the coastal area could also contribute to the issue of coastal erosion.

3.8 Agriculture

Agricultural activities occur at low intensity in Arctic Waters (OSPAR 2023b). However, animal husbandry is an important component of the cultural lives and activities of Indigenous Peoples (Saami Council 2023). The OSPAR Commission mainly focuses on agriculture activities regarding the management of runoff of pollutants and nutrients into the marine environment. There is no evidence provided of Indigenous Peoples' animal husbandry impacting the marine environment directly. However, it may be an important activity to consider

at this stage, linked to potential conflicting land use interests and to local and regional use of natural resources.

3.9 Military activities

Military activities could lead to pressures being exerted on the Arctic Waters marine environment. Vessel traffic associated with military exercises take place outside conventional shipping routes (PAME 2019c) giving rise to underwater noise at locations which may be quiet at other times. Military vessel traffic that could be of particular concern as a source of underwater noise include ice breaking activities or vessels that give rise to high-volume underwater noise or vessels moving at very high speeds making it more difficult for animals to avoid the source of noise or potential ship strikes. The use of mid-level military sonars has been associated with lethal impacts on beaked whales in non-Arctic areas (PAME 2019c). The contribution of military sonars to ambient underwater noise is not known (PAME 2019c).

Tracking of military activities in 2020-2023 have noted exercises and training, deployments, missile tests, naval incidents, air defence operations and air policing in Arctic Waters (CSIS 2023). Currently military activities are not believed to have major impacts at the scale of the Arctic Waters, however information on these activities have not been included in regular environmental assessments. Indigenous Knowledge holders have expressed concern at the OSPAR Arctic workshop regarding the placement of military practice areas in fjords, which could give rise to underwater noise and disturbance to fish and marine mammals which in turn could affect food security of local communities.

OSPAR could consider inviting noise from military activities to be included in national data reporting, with a view to minimise negative environmental impacts from the activities.

OSPAR could consider bringing marine environment impact information to the attention of militaries with a view of mitigating negative impacts, for example related to underwater noise or activities at locations with sensitive ecosystems.

3.10 Scientific research

Marine scientific research is a prerequisite and integral component of the OSPAR ecosystem-based management approach to human activities. Scientific research creates the fundamental knowledge needed on the complex marine ecosystem and on the impacts human activities are having. While research activities have the potential to disturb species and habitats it is not currently believed to cause major pressures on Arctic Waters regional scale.

Scientific research activities in the marine environment can be conducted through a number of different means, and there could be negative impacts on the studied ecosystem. Research may for example require invasive sampling techniques, or the mere presence of researchers could cause disturbance to species. Research vessels could cause similar pressures to cruise tourism vessels. Scientific research activities can impact Indigenous Peoples and local communities, and it would be important to consider benefit sharing and sharing of results and outcomes if research has been carried out in areas relevant to these groups.

OSPAR could explore if it could have a coordination and facilitation role for research activities in Arctic Waters by all its Contracting Parties, including by non-Arctic states.

3.11 Land-use change and forestry

Sustainable land-use and urban planning are assessed globally as feasible management actions with a high level of synergies with mitigation actions (IPCC 2023). The conversion of forests into agricultural land, i.e. land-use change, is a globally significant historical and ongoing source of CO₂ emissions to the atmosphere (IPCC 2023). Land-use change also changes the albedo and evapotranspiration of the land, which is a further climate change impact. Deforestation due to forest industry activities has many impacts on ecosystems and biodiversity, including links to the ocean for example through run off. However, forestry practices and land use management can also impact the incidence of forest fires. Forest fires, for example in mainland Europe, is a significant source of black carbon that negatively affects the properties of snow and ice when transported atmospherically into the Arctic region.

3.12 Waste handling and waste-water management

Waste handling and waste-water management is non-existent or deficient in some coastal Arctic communities which can result in pollution and litter entering the marine environment (PAME 2019a). Litter may also escape from communities or industries further inland in the Arctic (PAME 2019a). Dumping sites of waste that are not well managed can be source of methane emissions into the atmosphere, with climate change impacts. Insufficient waste-water management can introduce pathogens and excess nutrients into the marine environment.

3.13 Freshwater resource management

Predicted climate change impacts on freshwater resources in the Arctic region include an overall increase and higher variability in annual precipitation, which could impact the reliability of freshwater resources through a fluctuation between floods and droughts (Instanes, et al. 2016). A reliable freshwater source is important for many uses in society, including domestic water use. Freshwater management in industrial operations, such as mining or oil and gas extraction, is an important consideration in minimising the overall environmental impact of the activities.

3.14 Geoengineering

Geoengineering is mainly seen as a potential future human activity in Arctic Waters. Continuing and increasing climate change impacts could create strong political will to implement geoengineering activities. Currently some pilot projects are underway, including carbon capture and storage, whereas future plans include a larger number and different types of geoengineering activities. Potential geoengineering activities in the Arctic region could include marine albedo enhancement to slow down the ice melt, ocean alkalization to combat ocean acidification, increasing the amount of biomass sinking towards the seafloor and carbon capture and storage. A rapid assessment of some measures concluded that there are unknowns remaining for example in sea ice albedo modification measures, whereas the potential for relevant impacts by managing fishing practices to elicit a food-web response is thought to be low (Alfthan, et al. 2023).

3.14.1 Carbon capture and storage

There are different mechanisms and technologies available for carbon capture and storage (CCS). For example, injecting CO₂ into sediments that mimic Svalbard environmental conditions have resulted in the formation of CO₂ hydrate in laboratory conditions (Almenningen, et al. 2020). There is a risk of CO₂ leakage in CCS activities, which may have negative effects on the marine environment if a leakage were to occur (OSPAR 2023b). Care is needed to ensure that measures intended to sequester carbon do not exacerbate the ocean acidification challenge, for example through the potential leakage from storage sites (OSPAR 2023a).

A full-scale CCS-project has been in operation since 2007 in Norway. Natural gas from the Snøhvit field is transported by pipeline to the Hammerfest LNG processing facility. CO₂ in the well stream from the Snøhvit Field is separated at the LNG-plant and returned to the Stø reservoir at the field for permanent geological storage. Annually, approximately 0.7 million ton of CO₂ is captured and stored.

4. Pressures on the Arctic Waters marine environment

Key Message:

- **Climate change is the most significant pressure in Arctic Waters and exacerbates other existing pressures.**
- **Underwater noise is a more significant pressure than previously recognised in OSPAR.**
- **A small number of non-indigenous species have expanded their range rapidly in Arctic Waters with significant impacts on the marine environment, and the spread could expand further north due to climate change.**
- **Hazardous substances continue to be a concern in Arctic Waters, with high concentrations observed in top predators due to biomagnification.**
- **Black carbon and microlitter particle emissions could result in changes in sea ice properties.**
- **Many pressures stem from human activities taking place outside the Arctic, underlining the importance of OSPAR communication and engagement with other organisations through its mandate to protect Arctic Waters.**

An Indigenous Knowledge holder perspective on pressures on the marine environment, shared at the OSPAR Arctic workshop, comes from seeing a Norrland fjord system change over a 70-year period to having less fish and more macroalgae. In the fjord, aquaculture, hydropower plant energy generation and fishing activities have exerted various pressures that are now being exacerbated by climate change. But isolating what part of the change is due to climate change and what is due to a single aquaculture installation, that could be more easily managed in a local context, is very difficult. Rather than looking at one pressure, such as eutrophication and all human activities that contribute, it could be relevant to look at the spatial cumulation of all different pressures exerted by a single activity type, such as aquaculture.

Assessing cumulative impacts from human activities is ongoing work in OSPAR and other organisations, for example ICES, PAME or the Baltic Marine Environment Protection Commission (HELCOM). Different frameworks have been developed and their application is often limited by the lack of regionally comparable datasets. The importance of considering cumulation, spatially and/or per pressure, is recognised however not addressed in the report due to the complexity of the issue. An indication of the complexity is described as linkages between human activities contributing to one pressure (Table 3).

Table 3. Linkage between the main pressures and human activities considered in the OSPAR Arctic Waters report. The table does not describe all linkages comprehensively nor in order of magnitude of the contribution.

| Pressure | Contributing Human activity |
|------------------------|---|
| Climate change | Extraction of living resources, Aquaculture, Extraction of oil and gas, Shipping, Tourism, Renewable energy generation, Aggregate extraction and mining, Agriculture, Military activities, Scientific research, Land-use change and forestry, Waste handling and waste-water management |
| Underwater noise | Aquaculture, Extraction of oil and gas, Shipping, Tourism, Renewable energy generation, Aggregate extraction and mining, Military activities, Scientific research |
| Non-indigenous species | Aquaculture, Extraction of oil and gas, Tourism, Shipping |
| Hazardous substances | Aquaculture, Extraction of oil and gas, Shipping, Aggregate extraction and mining, Military activities, Agriculture, Forestry, Freshwater and waste-water management, Waste handling |
| Eutrophication | Aquaculture, Forestry, Waste handling and waste-water management |
| Radioactive substances | Extraction of oil and gas |

| | |
|--------------------------------------|--|
| Marine litter | Extraction of living resources, Aquaculture, Extraction of oil and gas, Shipping, Tourism, Renewable energy generation, Aggregate extraction and mining, Agriculture, Military activities, Waste handling and waste-water management |
| Mortality and disturbance to species | Extraction of living resources, Extraction of oil and gas, Agriculture, Shipping, Tourism, Renewable energy generation, Military activities, Scientific research, Land-use change and forestry |

OSPAR could assess cumulative pressures in Arctic Waters and trial different assessment approaches depending on data-availability.

4.1 Climate change

Human activities resulting in greenhouse gas (GHG) emissions cause global climate change. Climate change arises due to carbon emissions causing an imbalance in the global carbon-cycle and together with other GHG emission, such as methane, the gases trap heat in the atmosphere. Since the heating gives rise to many impacts, and heat is also directly absorbed by the oceans, climate change is both a direct and an indirect pressure on the marine environment.

Observations of the global surface temperature has already reached 1.1°C above 1850-1900 levels in the period 2011-2020, and during this period the temperature above the world oceans increased by 0.88 °C (IPCC 2023). It is virtually certain that the global ocean has warmed over the past decades and it is likely that the rate of heating is increasing, as is the intensity of marine heat waves (IPCC 2019). The Arctic region is affected by climate change at one of the highest rates and largest magnitudes of impact of any region globally (Constable, et al. 2022). Arctic amplification refers to this phenomenon of the region heating faster than other regions, it is attributed to ice melt and is most strongly observed in seasons when the Central Arctic Ocean is not ice covered. Arctic air temperature (at 2 m height) has increased three times more than the global average temperature in the period 1971-2019 (AMAP 2021a). In the same period precipitation has increased, observed as a 25% increase in rainfall, with regional differences, and no overall trend for snowfall (AMAP 2021a).

The Arctic region is predicted to become profoundly different by 2050 under all warming scenarios with high confidence (Constable, et al. 2022). Regardless of the GHG emission scenario, all models predict that the strongest warming will occur in the centre of the Arctic Ocean where the temperature is influenced by sea ice occurrence (AMAP 2021a). Based on model predictions, a sea ice free summer could possibly occur as early as the 2040s or between 2060 and 2100 (AMAP 2021a). Indigenous Knowledge holders in Sápmi have already observed that the snow season has shortened by 10-14 days over the past 30-60 years and at the same time there has been an overall trend towards stronger winds (Saami Council 2023).

Temperature extremes have already resulted in unprecedented environmental impacts in the Arctic region, such as the first ever observed rainfall at Summit Station in the middle of Greenland on 14 August 2021 (Moon, et al. 2021). Satellite data, used in the Arctic Council Circumpolar Biological Monitoring Programme (CBMP) shows significant land use index changes between 2000 and 2017 in the Arctic region, with similar rates of change for marine and terrestrial parameters (Jenkins, et al. 2020). There is strong evidence for the increased frequency and/or intensity of extreme weather events in the Arctic, including extreme high temperatures, rapid sea-ice loss events and widespread melt of the Greenland ice sheet, which can result in tipping points being reached, resulting in further escalation of change processes (AMAP 2021a). The full impacts of extreme events, cumulative impacts and potential tipping points remain unknown in the Arctic region (AMAP 2021a).

BOX 3: Over 50% of climate tipping points with global repercussions are located in the Arctic
Excerpt from (Alfthan, et al. 2023)

McKay et al. 2022 identify 16 major Global Climate Tipping Points. Nine of these are in the Arctic and northern regions:

- Collapse of the Greenland ice sheet • Abrupt thaw of northern permafrost • Loss of Barents Sea ice • Collapse of Labrador Sea current • Collapse of northern permafrost • Southern dieback of boreal forests • Northern expansion of boreal forests • Collapse of North Atlantic deep-water formation • Collapse of the Arctic winter sea ice

Global consequences of these tipping points include:

- Amplified global warming • Rapidly increasing sea level • Changes in weather patterns and weather extremes • Changes in ocean currents • Ocean acidification, de-oxygenation • Impact on ecosystems (fisheries, wildlife, plants) • Impact on food production • Impact on freshwater supply

Armstrong McKay, D.I., Staal, A., Abrams, J.F., Winkelmann, R., Sakschewski, B., Loriani, S. et al. 2022. Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science*. 377, eabn7950. DOI:10.1126/science.abn7950

Climate change is expected to exacerbate and amplify other pressures exerted on the marine environment in Arctic Waters. The mechanisms for exacerbations from e.g. eutrophication, hazardous substances, radioactive substances and marine litter include; changes in the toxicology of contaminants at warmer temperatures; changes in the pathways of contaminants; and changes in the frequency of weather conditions that lead to episodic inputs of contaminants from land and rivers, and to the remobilisation of historic pollutants (OSPAR 2023p). The fast pace of climate change and the complexity of the interactions between pressures creates uncertainty, which is a challenge for taking timely management actions that rely on a fully explored evidence base.

On a global scale, climate change related extinctions have been estimated at 5% in a scenario of 2 °C of warming and to drastically increase to 16% under a 4.3 °C of warming scenario (IPBES 2019). Arctic biodiversity is in a relatively good state when considered in a global context, however climate change is progressing rapidly and strong impacts are anticipated. Climate change pressures on marine biodiversity can be categorised as resulting in habitat loss, shifts of distributions, changes to species composition and food-webs and changes to life history events (OSPAR 2023p). All of these impacts have been documented in Arctic Waters. The loss of multi-year sea ice is one clear example of loss of habitat, which could result in disappearance of Arctic fish, crab, bird and marine mammal species (Constable, et al. 2022), including possible regional extinction of Arctic endemic seals, whales and polar bears. Global range shifts across marine epipelagic species and benthic species have been 52km (±33 km) and 29(±16 km) respectively (IPCC 2019). Arctic endemic species or migratory species could be driven to extinction if they are driven to move ever northward but eventually finding there is no-where left to go. Climate change can also result in pressures such as disease risk moving into the Arctic, a current example is the spread of avian flu through populations of fulmars and kittiwakes (CAFF 2017). Warmer temperatures in the air and water are likely to increase disease risks, which is likely to be particularly hazardous for naïve Arctic animal populations (Barratclough, et al. 2023).

Climate change has been identified as an important pressure explaining the already observed changes in plankton, benthic communities, seabirds and marine mammals in the Arctic region (CAFF 2017). To understand the impacts on biodiversity it can be helpful to take a food-web approach, however significant uncertainty remains in the understanding and assessment of food-web interactions (OSPAR 2023o). Strong evidence is emerging of significant changes in the trophic structure, for example in the Norwegian sector of the Arctic Barents Sea, where climate change is considered to be a stronger pressure causing food-web change than for example the pressure exerted by fishing activities (OSPAR 2023o).

Changes in temperatures and weather patterns in the Arctic region can impact weather patterns at mid-latitudes, impacting billions of people. However, there is currently no consensus among meteorological experts on the degree to which observed changes in the Arctic region impact severe mid-latitude weather events (AMAP 2021a). Arctic amplification and the climate change impacts that take place in the Arctic region

will be felt far beyond. Thus, non-Arctic states have a direct interest in contributing to mitigating climate change impacts in the Arctic Waters.

In the QSR 2000, OSPAR highlighted the need to improve the scientific basis for linking climatic variability and climate change to the environmental conditions in the Arctic, in order to better understand whether i.a. fishing pressure may coincide with climatically driven variability (OSPAR 2000). Since then, significant progress has been made in OSPAR and in other fora to develop the scientific understanding of climate change impacts. The message of ongoing and increasing change has already been given clear visibility and weight in government policy documents, for example the Norwegian integrated management plans (Norwegian Ministry for Climate and Environment 2020) and in circumpolar conservation and management strategies by Arctic Council working groups CAFF, PAME and AMAP. Climate change can result in a lack of predictability when ecosystems reach tipping points and pressures are exacerbated. There is a threat of inaction from governments since there may be no one clear answer to which action should be taken in the light of these complex interactions.

OSPAR could explore how the speed at which regional management actions can be taken could best support global ocean governance management actions that may take longer to implement, and how to progress management and action in light of the uncertainty of impacts and fast pace of change.

4.1.1 Black carbon

Black carbon forms through incomplete combustion of fossil fuels, biofuels or biomass. It contributes to climate change by absorbing sunlight and heating the atmosphere, and by reducing the albedo of snow and ice surfaces it settles on as it changes the reflective properties and absorbs sunlight. Black carbon is also a significant air quality pollutant with negative impacts on human health. Actions to target reduction of black carbon are typically included in national air quality policies or policies to address short-lived climate pollutants, rather than in climate change policies aimed at reducing carbon emissions (EGBMC 2021).

Arctic states have reduced their black carbon emissions by 20% in the period 2013-2018 and are on track to reach the target of reducing emissions by 25-33% compared to 2013 levels by 2025 (EGBMC 2021). The main sources of black carbon emissions among Arctic states are mobile and stationary diesel-powered engines, oil and gas operations, residential combustion activity and agricultural practices of burning waste (EGBMC 2021). Imported coal is still used for energy in some Arctic communities, and sufficient support for a just transition to cleaner energy sources would be needed. Atmospheric transportation of black carbon from tundra- and forest fires is a significant source for the Arctic region and is predicted to increase in intensity and frequency due to climate change (EGBMC 2021).

Heavy fuel oil use in shipping has been estimated to have contributed approximately two thirds of black carbon emissions in the Arctic in 2015 (Comer, et al. 2017). Within the IMO Polar Code area, the top three emitters are fishing vessels, general cargo vessels and service vessels (Comer, et al. 2017). However, it is noteworthy that only 17 % of black carbon shipping emissions in the wider Arctic region occurred within the Polar Code area and that significant emissions were seen around Iceland, Norway and Faroe Islands, with the top three emitters in the wider Arctic region being ferry ro-pax vessels, fishing vessels and general cargo vessels (Comer, et al. 2017). It could furthermore be noted that black carbon can be transported from emissions sources far from the Arctic region.

OSPAR could contribute to creating a knowledgebase on the significance of black carbon emissions from shipping as well as oil and gas operations in Arctic Waters.

4.1.2 Ocean acidification

Ocean acidification takes place due to increasing concentrations of CO₂ in the atmosphere from human activity emissions of carbon. Higher atmospheric concentrations result in higher CO₂ uptake in the ocean. As this happens the water acidifies and its chemical properties change, creating a pressure on the marine environment.

The food-webs of the Arctic region are comparatively short, which could result in ocean acidification having a rapid and widespread impact across all compartments of the ecosystem (Moon, et al. 2021). For example, ocean acidification may directly impact larval stages of molluscs upon which walrus prefer to prey. Non-

calcifying macroalgae such as kelp may see beneficial impacts from ocean acidification with increased growth, whereas calcifying macroalgae and corals may not be able to form their skeletal structures, and this could result in changes in habitat composition with further species being impacted (AMAP 2018a).

The ocean in the Arctic region is acidifying faster than the global ocean, but there are regional differences (Moon, et al. 2021). The Greenland and Iceland Seas have shown significant acidification of waters down to 200 m depth since the 1980s (AMAP 2018a). However, acidification has not yet been observed in the Barents Sea, although the area around Svalbard and the Arctic Ocean is the area where the largest changes in ocean acidification are expected over the coming decades (Norwegian Ministry for Climate and Environment 2020). The Central Arctic Ocean is modelled to become more acidic as sea ice decreases, since this would increase CO₂ uptake (AMAP 2018a). Deep waters in the Arctic are acidifying which has resulted in the aragonite saturation depth shoaling at a rate of 4 m/year, from the current ca 1 700 m depth (AMAP 2018a). This impacts for example deep-sea corals.

Model predictions indicate an increasing rate of change in terms of ocean acidification in the Arctic region in the coming century (AMAP 2018a). There are still many unknowns regarding ocean acidification in the Arctic. To improve the understanding of i.a. seasonal changes and regional differences in ocean acidification in the Arctic region a high frequency, long-term monitoring programme would be needed (AMAP 2018a).

OSPAR could contribute to the development of an ocean acidification monitoring programme in Arctic Waters.

4.1.3 Methane in the seabed

Gas hydrates occur at high pressure and low temperature and form ice-like structures made up of a hydrogen-bonded water lattice with trapped gas molecules, typically dominated by methane and often referred to as natural gas. Release of the trapped gas, for example as methane emissions into the atmosphere, would contribute to climate change. There is substantial evidence for hydrate occurrence in offshore Greenland, offshore west Svalbard, the Barents Sea and the mid-Norwegian margin (Minshull, et al. 2020). Natural gas hydrate has been suggested as a transitional fuel towards a low-carbon energy system, but currently no commercial exploitations are known, and for example Norway does not see any immediate plans to start exploitation.

The presence of gas hydrate deposits is associated with risks of hazardous events through dissociation processes such as liquefaction, explosion and collapse which can create crater-like depressions referred to as pockmarks, or submarine landslides (León, Llorente and Giménez-Moreno 2021). Climate change modelling predicts that natural gas hydrates in certain fjords in Svalbard could disappear through dissociation over the next few decades as the bottom-water temperature increases (Betlem, et al. 2021) resulting in climate change driving methane emissions to the atmosphere. For example in Isfjorden over 1 000 pockmarks have been recorded, which could have formed due to sudden changes to the sediment conditions for example from melting glaciers' debris falling to the seafloor and compressed the sediments or due slower changes from thawing of permafrost in near-shore areas (Roy, et al. 2015). Contrary to the fjord occurrences, large gas hydrate occurrences identified at 650 m depth to the north-west of Greenland have been assessed as relatively inert to current levels of climate change (Cox, et al. 2021).

The impact of gas hydrates on local and regional benthic biodiversity is not well studied, and therefore the potential environmental impacts of extraction are also not well understood (Hovland and Roy 2022). Gas hydrate occurrences and seeps from the fields on the Norwegian shelf are known to be associated with very different benthic habitat features; Nyegga hydrocarbon seep at 730 m depth features pockmarks, blocks of carbonate-cemented sediment and exotic fauna; Husmus at 330 m depth features pockmarks and potential coral reefs; whereas the Ormen Lange at 950 m depth has no features on the seafloor (Hovland and Roy 2022).

OSPAR could generate a knowledge base of benthic habitat features associated with seabed methane occurrences and cold seeps.

4.2 Underwater noise

Underwater noise is a significant pressure in Arctic Waters. The Arctic regions underwater sound properties are defined by cold water, salinity gradients, relative shallowness, strong winds and currents and sea ice which is a source, shield and diffuser of underwater sound (PAME 2021b). Regions which are ice covered and quiet for much of the year are considered more sensitive to ship noise when it is present than other regions, since the animals of the region have come to rely on acoustic communications (PAME 2021b). Arctic Council WG CAFF has created a metadatabase and a map of passive acoustic monitoring instruments throughout the Arctic region (CAFF 2023b).

The intensity of underwater noise in Arctic Waters is assessed as low on a regional scale (OSPAR 2023f). However, locally and over short time-periods underwater noise could occur at high intensities with significant impacts. Examples of activities that could give rise to underwater noise impacts include tourism that could exert underwater noise as well as noise above the surface for example from helicopters, seismic surveys associated with oil and gas exploration, or military activities that could give rise to high intensity underwater noise for example from the use of powerful sonars, explosives or fast-moving vessels.

Shipping noise levels in the Barents Sea are considered to be high in winter and continue to be high in summer when noise levels are distributed more broadly also affecting the Central Arctic Ocean (PAME 2021b). Sources include for example transit shipping and fishing trawlers. A temporal increase in underwater noise in the Barents Sea was detected from 2013-2019 (PAME 2021b). The Arctic shipping season could triple in length by 2050 and shipping routes and their usage could change, which could introduce underwater ship noise to currently largely unaffected areas (OSPAR 2023f). Increased traffic to windfarms or cruise ship tourism could also increase the ship noise levels in the future (OSPAR 2023f), and the Svalbard Archipelago is already a heavily visited tourism destination for cruise ship expeditions. A potential emerging source of underwater noise pressure are acoustic hubs for autonomous vehicle navigation.

The natural Arctic soundscape includes resident beluga whale whistling and buzzing, bowhead whale singing, walrus knocking and spring mating calls of bearded seals (PAME 2021b). Ambient sound levels are largely driven by natural physical processes and are higher in the summer months (PAME 2019c), though increasingly ship noise and other anthropogenic sound is becoming prevalent in Arctic waters (Llobet, et al. 2023). There are knowledge gaps on the impacts from anthropogenic noise on Arctic species, with geographical gaps, taxonomic gaps and methodological gaps having been identified (PAME 2019c). Bowhead whales have been observed to avoid noise from oil and gas exploration activities, beluga whales and narwhals react to noise from icebreakers, whereas ringed seals are apparently less sensitive than the whales (PAME 2019c). Arctic cod and shorthorn sculpin adjusted home ranges and movement behaviour in response to shipping noise (PAME 2019c). There are still uncertainties around sound propagation in the Arctic, as model parametrisation needs to better take sea ice morphology into account and models require more field validation (PAME 2021b).

OSPAR could consider whether underwater noise should be seen as a key pressure to address in Arctic Waters both at a regional and local scale and requiring more monitoring and assessment efforts.

OSPAR could work with the Arctic Council to strengthen the understanding of underwater noise based on ongoing shipping related work, with a view of building a joint knowledge base that could be brought to the attention of the IMO.

4.3 Non-indigenous species

Non-indigenous species (NIS) can have significant impacts on marine habitats at regional and local scale, especially if they become invasive (CAFF 2017). With the progression of climate change, there is a growing concern of new introductions or an increasing rate of secondary spread of existing NIS (Figure 6). Currently there is no strong evidence for climate change related secondary introductions of NIS spreading from other areas (OSPAR 2023p). However, the intrusion of warm and nutrient-rich Atlantic and Pacific water into the Central Arctic Ocean has created favourable conditions for non-Arctic species to propagate (NERC-BMBF 2021).

Marine invasive pathways in the Arctic

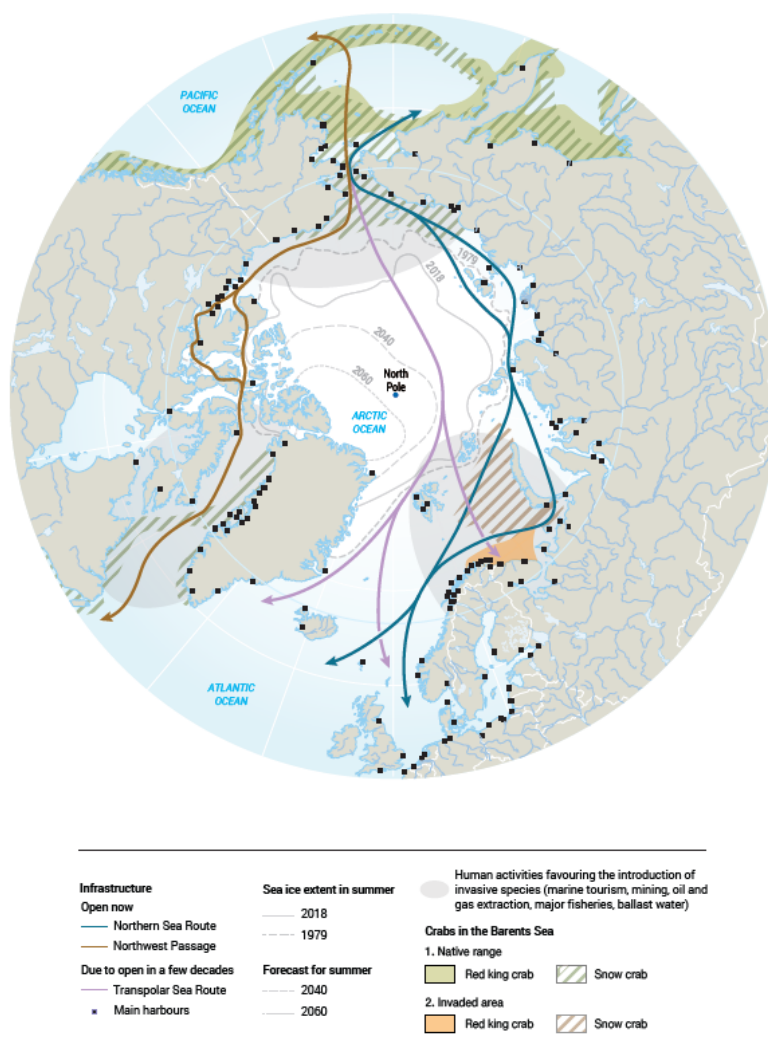


Figure 6. Existing and potential future NIS introduction pathways and spread. (copied from (Schoolmeester, et al. 2019))

The only NIS mentioned by OSPAR in 2000 for Arctic Waters, was the Kamchatka crab (*Paralithodes camtschaticus*) also known as red king crab (OSPAR 2000). The red king crab was released by the Soviet Union in the 1960s -1980s, and after initially spreading fast the population is considered to have peaked in 2010 and has since become less dense with reduced reproduction, attributed to fisheries measures (OSPAR 2023n). The westward spread of the red king crab is managed in Norway by allowing unrestricted harvesting west of 26° East (Norwegian Ministry for Climate and Environment 2020). However, in 2020 local populations spreading southwards were found in Troms County, and further spread north is expected due to climate change (OSPAR 2023n). Red king crabs have impacted the benthic communities with several benthic species now occurring at lower abundances and exhibiting reduced average size (OSPAR 2023n). Sámi have expressed concern regarding the introduction of red king crab disrupting the ecological balance (Saami Council 2023).

Snow crab (*Chionoecetes opilio*) was first recorded in fisheries as by-catch in 1996 (Kuzmin, et al. 1998) and now occurs in high densities in the Barents Sea. Snow crab is believed to have spread naturally from Bering Strait to the Barents Sea, although possible human influence in the spread has not been excluded (Norwegian Ministry for Climate and Environment 2020). While there is still substantial uncertainty around the impact on the wider ecosystem and the long-term abundance and extent of the snow crab population, studies from neighbouring areas show lower biomass of other benthic species in areas where snow crab occurred for a long time (Norwegian Ministry for Climate and Environment 2020). It appears to have formed a self-sustaining population that is predicted to further increase in size (Jørgensen and Primicero 2007, Mullowney, et al. 2018). Snow crab is regularly observed in the south-eastern Barents Sea and has proven to be an important

competitor to native benthic predators (Gebruk, et al. 2021). Snow crab is believed to expand into areas with suitable bottom water temperature, which is lower than the preferred temperature of the red king crab (Norwegian Ministry for Climate and Environment 2020).

A third invasive decapod in Arctic Waters is the Atlantic rock crab (*Cancer irroratus* Say, 1817) that has been observed in Icelandic waters (Gislason, et al. 2014). Since being first observed in 2006 the species has rapidly spread along the coast and occurs at similar densities as in its native North American range.

Pink salmon (*Oncorhynchus gorbuscha*), which is a north Pacific salmonid, is now found in Arctic Waters as far north as Svalbard. It matures rapidly, and feeds on similar prey to endemic char species, and it is therefore feared pink salmon might outcompete local salmonid populations that have anadromous (sea-going) migrations (Bengtsson, et al. 2023). The spread of pink salmon has been rapid, and therefore more frequent regional assessments could be helpful in understanding the spread and impacts. Indigenous Knowledge holders have expressed concern regarding the input of nutrients to the Deatnu river from the pink salmon that die after spawning, and many knowledge holders have also noted the increase of riparian vegetation around the river making access difficult (Saami Council 2023).

“My father used to say that a good ice slide is useful– it cleans the bottom of the river (Deatnu). Now pink salmon comes up the river to spawn, and it dies afterwards. A lot of biological material gathers. I expect soon all the sand banks will be overgrown by grass and trees. Soon we can’t get to the river side without bringing a chainsaw.” (Saami Council 2023).

NIS can be introduced to Arctic Waters through different vectors. One potential source is species escaping from aquaculture facilities and posing a risk for genetic pollution of wild species, in particular for wild Atlantic salmon (*Salmo salar*). Another significant vector of spread is hull fouling of boats, for example the highly invasive sea squirt *Didemnum vexillum* have been found on the west coast of Norway and could be a species to consider especially under climate change scenarios (OSPAR 2023n). The Arctic Council CAFF and PAME working groups have developed an Arctic Invasive Alien Species (ARIAS) Strategy and Action Plan (CAFF and PAME 2017b). As one step in its implementation, the CAFF-PAME project on NIS will explore shipping as a vector for NIS spread under two different climate scenarios, and will describe the impacts of current NIS as well as document the many others potential species of concern (CAFF 2021b). Molecular methods are being developed for environmental monitoring to detect new NIS introductions and could potentially become a valuable tool for early detection in the sensitive Arctic environment (ICES 2020a).

OSPAR could collaborate with the CAFF/PAME NIS project and explore potential synergies from joint data management processes with the OSPAR-HELCOM joint expert group on NIS, as well as sharing information on molecular monitoring methods.

OSPAR could assess rapidly spreading non-indigenous species, such as pink salmon, more frequently, to create the evidence based of regional secondary spread to support appropriate management action.

4.4 Hazardous substances

No change in the pressure exerted by hazardous substances on the Arctic Waters marine environment has been detected in recent years, and this is interpreted as a good status with a low degree of confidence (OSPAR 2023h). Major declines in the concentrations of the most persistent organic pollutants (POPs) have been observed in Arctic atmosphere and in Arctic biota over the past 15 years (AMAP 2021c). The status assessment for the Greenland-Scotland ridge area found that the chemical status in biota was good, with the prediction for 2030 also being good (OSPAR 2023h). The highest concentrations of organohalogen compounds (OHCs) and POPs have in the past been measured between Greenland and Svalbard, where the largest number of effect studies are also available (AMAP 2018b). There was insufficient data to assess sediment status, and no assessment was possible for Barents Sea or the Norwegian Sea (OSPAR 2023h).

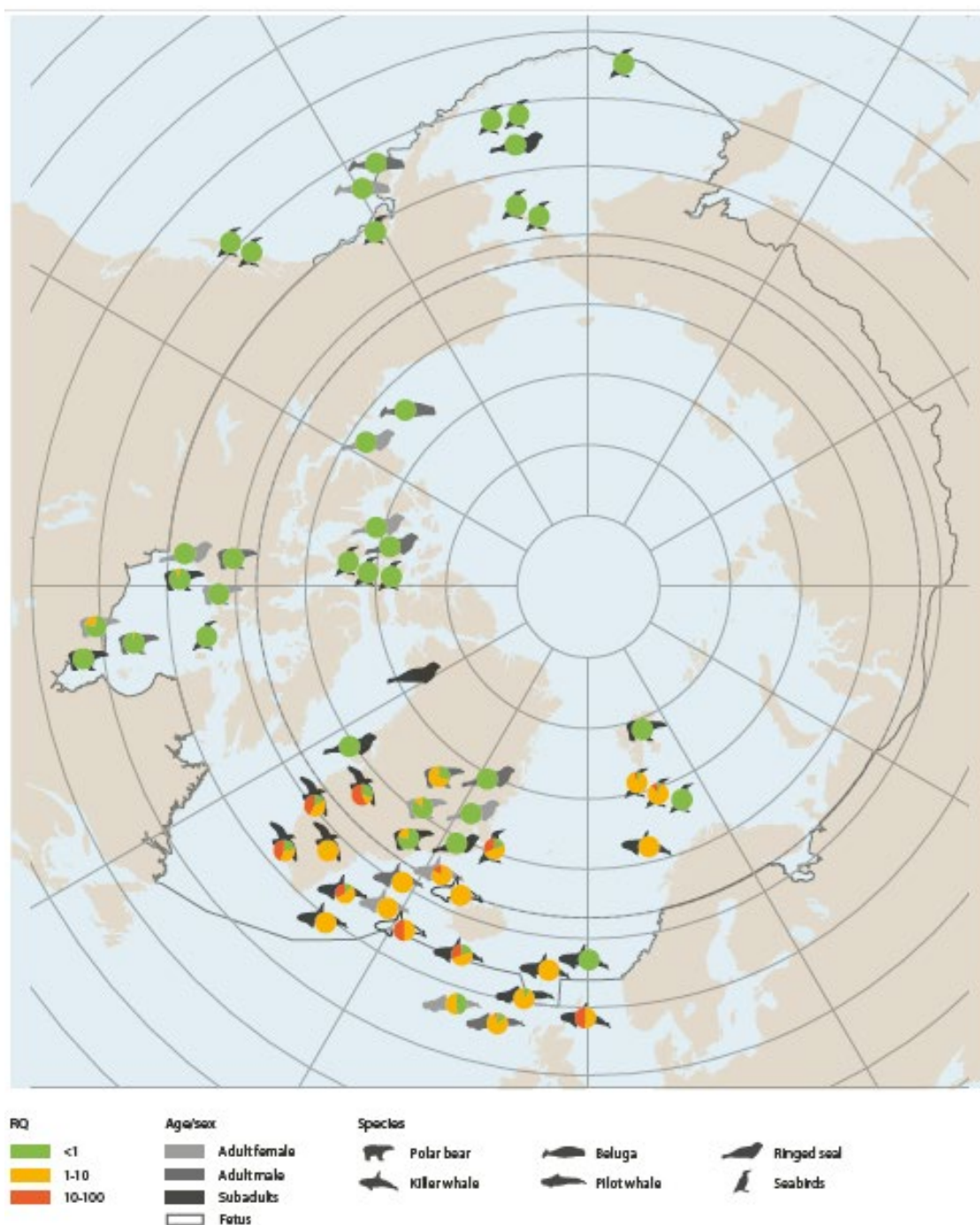


Figure 7. Risks quotients from PCBs on immune and hormone systems of biota across the Arctic (copied from (AMAP 2018b)).

Bioaccumulation of mercury and POPs in the Arctic results in impacts on the health of the exposed wildlife as well as on humans (AMAP 2018b). The Arctic Council Working Group AMAP has developed a comprehensive assessment of mercury (Hg) and its impacts in the environment as a contribution to the Minamata Conventions effectiveness assessment, with a chapter detailing the contributions of Indigenous Peoples using Indigenous Knowledge and bioaccumulation studies (AMAP 2021b). This report has also made use of OSPAR environmental monitoring information. Global anthropogenic mercury emissions have increased but this trend is not reflected in the Arctic background air monitoring stations, most of which showed downward trends albeit smaller declines than in temperate regions (AMAP 2021b). Mercury concentrations in biota showed both upward and downward trends, with the fastest increase in concentration among guillemots (*Cephus grylle*) in the Faroe Islands (AMAP 2021b). Bioaccumulation in marine mammals, and the effects of climate change on this process, vary across the Arctic region with significantly decreasing mercury concentrations in ringed seals from the Canadian Arctic (-2,4 to -8% / year), whereas ringed seals in

Greenland did not exhibit any trends (OSPAR 2023j). The most important explanatory factor appears to be shifts in food-web structure and prey abundance due to climate change (OSPAR 2023j).

Various processes in sea ice and snow have been found to enrich persistent organic compounds, resulting in high concentration pulse-like releases during the spring melt, concentrations have been measured in Arctic surface water that were similar to North Sea coastal sites (NERC-BMBF 2021). The channels created by ice-breakers could potentially be locations with higher concentrations of hazardous substances, for example from ship-scrubber discharges, along heavily trafficked navigational routes. Oil spills and operational discharges containing oil could be another source of pollution in particular in the navigational channels. Oil spills are short events that have a long-term impact on the Arctic marine environment.

Input of hazardous substances from sources and activities within Arctic Waters is limited, however it could be noted that for example the heavy metal copper (Cu) could leak out from aquaculture facilities and accumulate in the sediment locally. Atmospheric transport and deposition is the major pathway for spread of organic pollutants into the Arctic region, while ocean currents are not a major pathway. As an example of the pathways, the compound “Gen-x” (hexafluoropropylene oxide-dimer acid) which has recently been taken into use upon the global restrictions on the use of perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) has been found at higher concentrations in the cold low-salinity surface water exiting the Arctic through the Fram Strait compared to concentrations in the warmer high salinity water entering the Arctic from the North Atlantic, indicating atmospheric transportation and deposition (NERC-BMBF 2021). Based on current knowledge it is anticipated that transportation pathways of POPs to the Arctic region will be impacted by climate change (AMAP 2021c). For example, climate change could result in concentrations of persistent organic pollutants increasing through remobilisation of previously deposited substances (AMAP 2021c). There is a very high level of uncertainty in estimating how hazardous substances in the Arctic region will react under climate change conditions (AMAP 2021c).

Climate change can result in an increase in forest fires incidence and intensity globally and in the Arctic region, which has been widely observed in recent years. This could release mercury from the soils or drive other pollutants into the atmosphere (OSPAR 2023h). Arctic region air quality can be negatively impacted by transportation of ash by air currents from far away forest fires, and this black carbon can have a negative impact on cryopelagic habitats. Arctic soils and wetlands may also be polluted by past practices of negligent waste handling (e.g. placing drums with waste on frozen lakes in winter) or infrastructure management (e.g. road oiling to reduce airborne dust) (Robin des Bois 2009). The Arctic Council working group Arctic Contaminants Action Programme (ACAP) has completed several projects to map local sources of pollution from waste dumpsites and clean up such sites, for example in the Kola peninsula (ACAP 2021). In addition, the Barents Council as an important actor has worked in collaboration with AMAP to identify the Barents Environmental Hot Spot list (Barents Council 2021).

OSPAR could further strengthen the collaboration on assessing hazardous substances, for example by further strengthening OSPAR-HELCOM-AMAP HARSAT (Harmonised Regional Seas Assessment Tool) and joining forces on data collection and sharing.

OSPAR could contribute to exploring the exacerbating climate change pressure on hazardous substance pressures in Arctic Waters.

OSPAR could consider contributing to the knowledge base on hazardous substances in surface waters, in particular along navigational channels and lanes, for example by evaluating whether oil spills, oil discharges or scrubber-discharges could be a significant pressure, and to bring the information to the attention of IMO.

OSPAR could consider identification of polluted sites and removal of waste from polluted sites as a priority.

4.5 Marine litter

Marine litter is a significant pressure globally, and is a transboundary pressure seen for example in the accumulation sites in the Barents Sea where plastics from other areas are observed. Negotiations are ongoing for an international legally binding agreement, the Global Plastics Treaty.

Marine litter is found throughout the Arctic region, including in sea ice, seafloor sediments and throughout the water column and along the coast (PAME 2019a). Vital Arctic economic sectors such as tourism, fisheries and shipping are sources of marine litter but they can also be impacted by the pollution (PAME 2021c). Projected future increases in tourism activities may increase the marine litter pressure in Arctic Waters (OSPAR 2023g). A source of litter from within the Arctic region is non-existent or deficient waste management systems in coastal Arctic communities, and some of the litter may stem from communities or industries further inland (PAME 2019a).

Up to 50-100% of the macrolitter washed ashore on beaches or accumulated on the seafloor appears to stem from fishing activities, with items such as nets, floats and other debris observed (PAME 2019a, OSPAR 2023g). Ghost fishing by discarded fishing gear is a type of macrolitter that causes entanglement and mortality to marine life, exerting both a pollution and a mortality pressure. Data from three Icelandic beaches showed a median total abundance of 252 items per 100 m, of which 97% were plastic items (OSPAR 2023g). Density of litter in the Barents Sea and Norwegian seas were 202 and 279 items/km² respectively in one study, with fishing-related items and plastics the most common items (OSPAR 2023g). The amount of floating litter appears to be lower in the Arctic region compared to the North Sea based on studies of plastic ingestion by fulmars (PAME 2019a).

Microplastic pollution has been observed in the Arctic region on sea ice, in snow, in surface and sub-surface ocean water as well as in deep-sea sediment (AMAP 2021c). Microplastics are plastic particles, typically <5 mm, and it could be noted that even smaller nanoparticles exist but these are currently not monitored. There is a general lack of knowledge on how microplastics become incorporated in sea ice, and what the impacts are on the sea ice properties (AMAP 2021c). The quality of the microparticles that have been found suggest multiple sources, both local and long-range transport (AMAP 2021c). High abundance of microlitter fibres was found around Iceland in fine grained muddy sediments with high organic content which is typical cod nursery and feeding ground habitat (Loughlin, et al. 2021). The high number of detected microlitter fibres could be associated with higher fishing intensity in the area (Loughlin, et al. 2021). Microplastics appear to be transported into the Arctic Ocean by surface currents (OSPAR 2023g), while the flow of sea ice from the Central Arctic Ocean through the Fram Strait has been proposed as a mechanism for transportation of microlitter into the Greenland Sea (PAME 2019a)

Unlike in other OSPAR Regions, the OSPAR marine litter monitoring programme does not provide a good coverage in Arctic Waters and no downward trends were detected in beach litter mainly due to low data availability prohibiting the calculation of robust results (OSPAR 2023g). Further work is needed to standardise monitoring methods and reporting to enable a better understanding of how litter moves across regions (ICES 2020e). The Arctic Council working group AMAP is currently preparing the first monitoring plan on microplastics and litter in the entire Arctic ecosystem (AMAP 2023). The CAFF experts working on seabirds have noted the OSPAR monitoring protocols for monitoring and assessing ingestion of plastics by seabirds and the central data storage approach and compiled information on how collection of this type of information could be done across the Arctic region (Linnebjerg, et al. 2021).

OSPAR could explore synergies in the implementation of the OSPAR Regional Action Plan on Marine Litter and the Arctic Council WG PAME Marine Litter Action Plan, to tackle the regional-global pressure in an effective way, prioritising actions related to input of litter from fishing.

OSPAR could consider facilitating more coordination between marine litter and hazardous substances experts, to create a better understanding of the role of microplastics as a vector for the spread of hazardous substances in the Arctic environment.

OSPAR could support the Arctic Council WG CAFF in exploring if the centralised database for seabird ingestion of plastics could be suitable for use.

4.6 Eutrophication

Inputs of nutrients have long been considered by the OSPAR Commission to be low in Arctic Waters and thus eutrophication effects have not been an issue of concern (OSPAR 2000). Atmospheric deposition of nitrogen makes up about 75% of the total nitrogen input to the Arctic Waters, and successful implementation of the Gothenburg Protocol of the Convention on Long Range Transboundary Air Pollution, and incorporation of

those targets in legally binding EU directives and national legislation has reduced the nitrogen input (OSPAR 2023a).

In contrast, waterborne nutrient inputs to Arctic Waters have increase since the 1990s due to the increasing aquaculture industry, and whether this input is giving rise to eutrophication effects is considered to be a knowledge gap on which no OSPAR assessments have been made (OSPAR 2023e). In addition, climate change could result in increasing stratification or biological activity in warmer surface waters, or nutrient loading through riverine runoff, depending on land-use in the catchment (OSPAR 2023p). Such scenarios could contribute to a further change in the eutrophication status in the future (OSPAR 2023p).

OSPAR could assess localised eutrophication effects from aquaculture.

4.7 Radioactive substances

Levels of radioactivity in the Arctic from human activities are low and decreasing (AMAP 2015). While there is no relevant nuclear industry in Arctic Waters, the marine environment receives the dispersion of discharges from industries in temperate regions as well as discharges of radionuclides from oil and gas extraction activities within the region (OSPAR 2023d). Nearly all radionuclide discharges from the oil and gas sector are from produced water extracted from the reservoirs which include naturally occurring radionuclides (such as lead-210, polonium-210, radium-226 and radium 228), and discharges have remained at a stable rate over the past decade (OSPAR 2023d).

Radionuclide discharges could increase in the future if more extractive industry activities take place in the Arctic region, including for example from uranium mining (AMAP 2015). It could also be noted that in the Arctic region there are nuclear facilities and/or activities for example in Russia and Canada that could result in nuclear inputs to the environment, these include terrestrial facilities, floating facilities and fallout from testing activities. There could also be an increase in nuclear fuels being used to power shipping in the future. The uptake of radioactive substances in organisms could increase in warmer waters and remobilisation of radionuclides from coastal sediments could take place due to increased storminess and sea level rise due to climate change (OSPAR 2023p).

4.8 Light pollution

Light pollution from human activities is a pressure that primarily impacts the marine environment through disturbance of species by attracting or repelling the animals, but it could also interfere with natural processes steered by the natural light availability. Infrastructure developments such as oil rigs can introduce light pollution, however shipping is potentially the most important source of human made light that would need to be considered (CAFF 2017). Ships that travel through areas that are dark can attract seabirds which can lead to collisions and mortality, this could be a particular issue if a ship happens to travel through an aggregation area of seabirds.

4.9 Mortality and disturbance to species and habitats

Direct mortality to species and disturbance to species and habitats is an important overarching pressure that is linked to many human activities and impact on the species and habitats in different ways. Selective extraction, or harvesting, of species through fishing and hunting activities cause direct mortality, and the activities can furthermore cause additional mortality through incidental by-catch of non-target species. The long-term sustainability of these human activities depends upon the level of mortality caused and the recruitment and reproductive rate of the species. Subsistence harvesting tends to cause lower absolute mortality compared to commercial harvesting activities, but the relative mortality on a specific species and populations needs to be evaluated carefully to manage the level of pressure being exerted.

Disturbance can arise for example from fishing activities and deep-seabed mining where both activities can result in re-suspension of sediments, which in turn can lead to smothering or erosion of benthic habitats with significant disturbance impacts on the benthic communities. Underwater noise is a pressure that impacts the marine environment through disturbance, and even mortality, of species. Human presence can cause disturbance to species, for example by causing nesting seabirds to take flight and leave their nests exposing them to additional predation risk.

5. State-change of the Arctic Waters marine environment

Key message:

- The Arctic Waters marine environment is undergoing rapid and fundamental changes due to climate change, which could result in a more dynamic and unstable ecosystem state which is not yet well understood.
- The thermohaline circulation is changing with complex interactions between ocean currents and in particular the cold, fresh meltwater originating in the melt of Arctic glaciers and permafrost.
- Biodiversity status appears to be relatively good, exemplified by benthic habitats consisting of species sensitive to disturbance and improving status of some historically decimated marine mammal populations.
- Atlantification and borealisation has been observed as changes in species composition in the phyto- and zooplankton communities, and as changes in range and distribution among fish and marine mammal species.
- The proportion of water column feeding seabirds reflecting not good status is higher than in other OSPAR Regions, the reason is not known but could be a sign of climate change causing temporal mismatch in food source availability close to breeding colonies.
- The OSPAR mandate to create and disseminate regional information about ecosystem components, including to inform conservation measures, is important since many species move across national boundaries.

Arctic Waters ecosystem components are currently undergoing rapid change. Thus, this description of the state of the ecosystem components can only be a snapshot in time. Arctic Waters ecosystems may be on track towards a new more dynamic state that is more unpredictable and that is not yet well understood. Change can happen on non-linear trajectories making it difficult to anticipate the rate of change, or tipping points of ecosystems.

Ecosystem based management of human activities is based in a solid understanding of the functions and carrying capacities of the ecosystem. The challenge for OSPAR in implementing the approach in Arctic Waters is allowing the measures to manage human activities to adapt fast enough to the changing ecosystem. If there was a better understanding of the timeline for some of the potential changes, this could inform OSPAR work in determining which actions would need to be taken in the short-, medium- or long-term.

There are different types of ecosystems across the vast Arctic Waters Region with different characteristics. This report does not go into a comprehensive description of all biodiversity components in all different types of ecosystems, however it could be relevant in future OSPAR work to use the Large Marine Ecosystem boundaries (Figure 2 top panel) developed in the Arctic Council. Indigenous Peoples perception of the status of the species and habitats provides a valuable perspective and important information.

OSPAR could develop an approach to categorise the timeline of ecosystem change due to climate change pressures, to inform implementation of the ecosystem approach.

OSPAR could consider using the Large Marine Ecosystem boundaries, developed in the Arctic Council working group PAME (Figure 2 top panel), as a basis to define assessment unit boundaries for OSPAR common indicators.

5.1 Currents and cryosphere

The water of the ocean is in constant flux; surface water evaporating and freezing, freshwater flowing into the ocean from glaciers and rivers; and the large ocean currents moving water like big underwater rivers. The ocean water circulation sets the scene for other marine ecosystem components, and currently changes in the ocean currents are being observed due to climate change. The general circulation and geology of Arctic Waters has been previously described, highlighting the North Atlantic deep-water formation and outflow into the world ocean where it ventilates the deep seas as an important feature (OSPAR 2000). Outflow of cold

water from the high Arctic and mixing with warmer saline Atlantic waters flowing north-east on the North Atlantic Current (NAC), which has branched off the Gulf stream, creates deep-water formation areas where the high-density water sinks into the deep-sea contributing to driving the Atlantic Meridional Overturning Circulation (AMOC).

Atlantification and borealisation of the Arctic region refers to stronger incursions of warm and saline waters from the Atlantic reaching the high Arctic, changing the marine environment from Arctic to boreal. Currents bringing more Atlantic waters into the Arctic Basin could result in reduced stratification and potentially altered nutrient fluxes (Polyakov, et al. 2020). Feedback processes that are not yet fully quantified and understood would be set in motion, for example how the warmer currents might inhibit sea ice formation and impact biological processes in the cryopelagic habitats (Polyakov, et al. 2020). Atlantic-origin ocean-warming in the Arctic region has slowed slightly since 2010, whereas freshening of the upper ocean has spread since first observed in the mid-2010s (ICES 2020d). Ongoing changes in ocean currents, in terms of temperatures and salinity, are not uniform across Arctic Waters. The AMAP sea-surface salinity models do not cover the OSPAR Arctic Waters well but gives indications of a possible salinity change around the boundaries of the modelled area (AMAP 2021a). Freshening has recently influenced the Greenland Sea, the northern Norwegian Sea towards the Fram Strait and the Bering Sea, with observed pulse-like intrusions of temperature anomalies (in the order of 1°C relative to the long-term mean) in the 1990s and 2000s (ICES 2020d). The deep outflow water from the Norwegian Sea became saltier and warmer in the 1990s and 2010s, whereas Irminger Sea deep water freshened during the same period (OSPAR 2023p). The inflow to the Norwegian Sea of colder and fresher water, which had continued for 3-4 years, ceased in 2021 (ICES 2022). The east Greenland coast is experiencing a freshening of surface waters that are also 1-2 °C warmer year-round compared to mean conditions in 1981-2010 in recent years (ICES 2020h).

The AMOC has weakened compared to a century ago based on sea surface temperature observations both in situ and reconstructed observations, however data are insufficient to quantify the magnitude of change or the significance of the climate change pressure (IPCC 2019). Warmer surface waters and increased outflow of freshwater from melting glaciers has the potential to disrupt the deep-water formation. The drivers behind the AMOC are not fully known and climate scenario models remain uncertain, but some recent observations of sea surface temperature variability may be an early warning of an approaching tipping point in this thermohaline circulation system (Michel, et al. 2022). There is low confidence in any predictions on timing or magnitude of the unlikely but plausible tipping point of the AMOC suddenly shifting or weakening (OSPAR 2023p), but as any change in the AMOC would have very strong social and environmental effects it is important to take the possibility into account (Michel, et al. 2022).

Geological evidence has been used to validate models for how glaciers respond to climate change (Newton, et al. 2020) which in turn has been used to deduce that the spiral tracks, 5-30 km long left by icebergs grounded 430 000 years ago on the Norwegian shelf, was due to the NAC being weaker than today and North Atlantic deep-water formation taking place at a lower latitude (Newton, et al. 2016). A weaker NAC left the Arctic experiencing a colder period, due to limited heat transfer, while Europe was in a warmer deglaciation phase (Newton, et al. 2016). Sediment records of diatoms south of Iceland show a colder period some 2 000 years ago for which the drivers are believed to be a strengthening of the East Greenland Current and/or melting of the Greenland ice sheet in response to a negative North Atlantic Oscillation (Orme, et al. 2018).

Climate change driven melting of land-based ice, such as the Greenland ice sheet and other glaciers, could result in increased freshwater influxes which might impact the AMOC as well as contribute to sea level changes (OSPAR 2023p). The global mean sea level has increased 0.20 m between 1901 and 2018, and the average rate of the rise has increased from 1.3 mm/y to 1.9 mm/y and then to 3.7 mm/y in the time periods 1901-1971, 1971-2006, 2006-2018 respectively (IPCC 2023). Due to continuing deep ocean warming and ice sheet melt, sea level rise is unavoidable and will remain elevated for thousands of years (IPCC 2023). Sea level rise is not as big a concern within Arctic Waters compared to other OSPAR Regions due to the coastal profile, but it is a concern in other OSPAR Regions. The mass balance of glaciers on Svalbard has been decreasing throughout the 70-year period during which glaciers have been studied within the Archipelago (Geyman, et al. 2022, Norwegian Polar Institute 2023). The 2020-2021 total mass change for the Greenland ice sheet was -85 ±16 Gt, which is less than the -264 ±12 Gt per annum average from the period 2002-2021 (Moon, et al.

2021). The Greenland ice sheet is becoming more unstable, and in conjunction with the predicted increase in incidence of extreme weather events, predictions of future change to the ice sheet balance could become more uncertain (Moon, et al. 2021). Discharge from rivers into the Arctic Ocean have increased by 8% in the time period 1971-2019 (AMAP 2021a). There are still large uncertainties in modelling permafrost hydrology, and different parametrisations yield different climate model results with very different predictions of the land-atmosphere energy and moisture exchange, and for example result in widely different predictions of cloudiness (de Vrese, et al. 2022).

Arctic sea ice is diminishing both in terms of extent and coverage (OSPAR 2023p). Since 1979 Arctic sea ice extent and thickness have declined by 43% (AMAP 2021a). The extent has very likely decreased for all months of the year between 1979 and 2018, with the decline for September likely to have been unprecedented for the last 1 000 years (IPCC 2019). There is a downward trend for Central Arctic Ocean minimum summer sea-ice extent, and exceptionally low extent was recorded in 2012 (Skjoldal 2022). Old, multiyear pack ice used to be a dominant feature in the Central Arctic Ocean, however the multiyear ice that now occurs is young, only 2-3 years old (Skjoldal 2022). The quality of sea ice is characterized by its thickness. Concerningly, models indicate that the sea ice thickness will become reduced from >2 m to 1.5 m in the Central Arctic Ocean by mid-century which would make the ice even more prone to melting and further retreat (AMAP 2021a).

East Greenland experienced an unusual nearly sea ice free summer 2021, due to a general low pressure over the Arctic Ocean which limited the circulation and ice export through the Fram Strait (Moon, et al. 2021). Sámi Indigenous Knowledge holders have described how fjords do not freeze over in winters as much as in the past. For example, the Varjjatvuotna-Varangerfjord used to have a 7-8 km wide ice cover in the 1980s, a 5 km cover in the 2000s and currently only the innermost parts freeze solid (Saami Council 2023). The knowledge holders also describe a relationship to the sea ice conditions offshore;

“When I was a child, I remember my grandmother (who passed away in 1980) referring to the ice in the Arctic Ocean. I was impatiently waiting for lasting warm summer days as soon as the snow melted in May. My grandmother replied that you can’t expect stable summer weather before the ice in the Arctic Ocean has retreated. This tells me that people were relating to the Arctic ocean and the ice without ever having been there to see it or to have models showing the ice cover shifts.” – Sámi from eastern coastal area (Saami Council 2023).

The Inuit Siku Atlas (sea ice Atlas) (Figure 8) is one example of an open platform that presents Inuit knowledge from Canada (ISIUOP 2019). The Siku Atlas was co-developed using Indigenous Knowledge and scientific knowledge, recognising the knowledge holders as scientists which is significant (Proloux, et al. 2021). The Siku Atlas documents; 1) a characterisation of seasonal ice conditions, 2) the extent and areas of sea ice use, 3) the nature and location of notable sea ice hazards, 4) key harvesting areas, 5) traditional and current ice routes, 6) Inuktitut toponyms (placenames) or terminology associated with ice features, conditions or dynamics and 7) shifts in patterns of sea ice use due to social and/or climatic change (ISIUOP 2019). The Atlas aims to explore linkages between locally specific conditions and broader implications by providing information that is accessible for use by governments, but also for future generations of Inuit (ISIUOP 2019). The Siku Atlas was inspired by the Inuit Land Use and Occupancy project which focussed on mapping land use and describe the Inuit experience, relationship and cultural dependence on the land (Freeman 1976).

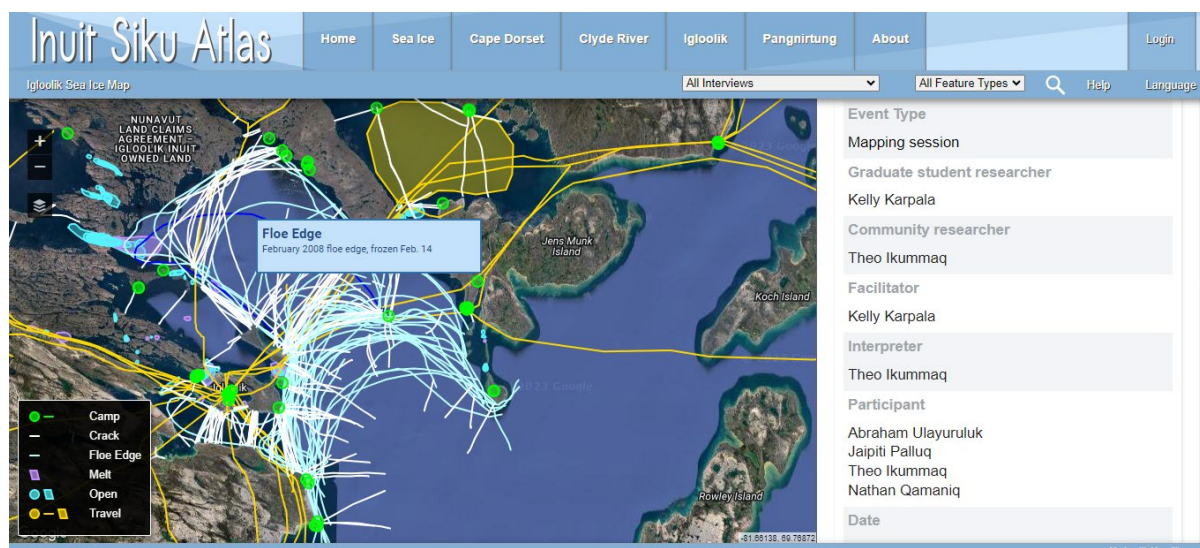


Figure 8. The Siku Sea Ice map makes Indigenous Knowledge from Canada available in digital format while retaining context for the information and allows users to explore the information in an interactive way. Screenshot from https://sikuatlas.ca/index.html?module=module.sikuatlas.igloolik.sea_ice# on 8 July 2023.

The loss of sea ice has many secondary effects. The change from multi-year to first-year sea ice will influence the light conditions in the underlying waters and could result in 200% increase in light transmission into the water column and a change in phytoplankton bloom season (NERC-BMBF 2021). Open water absorbs more energy from sunlight than white ice, thus a loss of sea ice will create enhanced heating of the region (OSPAR 2023p) known as Arctic amplification. Loss of sea ice has increased wave height in the Arctic region during the 1992-2014 period with medium confidence (IPCC 2019). Another potential effect could be a weakening and instability of the polar vortex and jet streams which could cause extreme weather across all OSPAR Contracting Parties (OSPAR 2023p). Increased storminess could be caused by a change in the tracks taken by storms moving northward, and ice-free seas could result in intensified storms due to wider areas of open water over which energy and moisture transfer can take place (OSPAR 2023p).

OSPAR could contribute to improving the understanding of how climate change could impact ocean currents, and how the Arctic Waters Region is connected in particular to the Wider Atlantic.

5.2 Pelagic and cryopelagic habitats

The North Atlantic Current (NAC) creates the subpolar front which sharply delineates Arctic pelagic habitats from the warmer Atlantic pelagic (OSPAR 2023m). The primary productivity of phytoplankton in the pelagic waters forms the base of the marine food-web of which zooplankton are the primary consumers. Sea ice is a dominant feature in the pelagic habitats in the Arctic region and creates cryopelagic habitats with communities of species associated with seasonal and multiyear sea ice. Climate change impacts are anticipated to manifest more quickly in the pelagic habitats compared to other ecosystem components due to the fast reproductive cycles of the phyto- and zooplankton communities (OSPAR 2023p).

Primary productivity is low in the nutrient limited and stratified Central Arctic Ocean where ice algae and phytoplankton associated with the cryopeagic habitat are the main producers (Skjoldal 2022). The north-east Greenland shelf is characterised by low nutrient concentration, especially nitrogen, with the highest concentrations observed at the shelf break where mixing with deeper waters takes place (Møller, et al. 2019). This pattern is reflected in the plankton community, with higher abundance of both phytoplankton and zooplankton at the shelf break (Møller, et al. 2019).

In Arctic ice-free waters, net primary productivity has increased in recent decades and earlier spring phytoplankton blooms have been detected (IPCC 2019). For example, in the Arctic part of the Barents Sea primary productivity has increased and spring blooms in shelf areas have been observed earlier, however in the sub-Arctic part the impacts have not yet been seen although temperatures have increased (Siwertsson, et al. 2023). In the Norwegian sea, zooplankton biomass declined in the mid 2010's and has since remained at a low level (ICES 2022).

Observed atlantification of Arctic pelagic habitats includes zooplankton community composition changes with declines in abundance of Arctic copepod and amphipod species such as *Calanus glacialis* and *Themisto libellula*, a northward distribution shift of copepod *Calanus finmarchicus*, and a doubling of biomass of krill (OSPAR 2023m). Climate change impacts on the abundance, distribution and composition of the zooplankton community, could alter the behaviour of animals feeding on zooplankton. The migrations and feeding patterns of baleen whales could for example change. An increase in krill abundance in the Arctic could also result in interests from fisheries, potentially by shifting fleets currently operating in Antarctica.

Thousands of sea ice-associated species have been described, ranging from bacteria to crustaceans, however it is believed that many species are still unknown (CAFF 2017). The cryopelagic community of the Central Arctic Ocean is endemic and highly specialised (ICES 2020f). Multiyear sea ice has a more complex underwater structure, with pack ice ridges and other formations, compared to annual sea ice (Skjoldal 2022). Multiyear ice has a much richer biotic community than young ice – with algal mats and invertebrate and fish communities associated with the topographically variable underside of the ice. These communities have been important in the past both directly as food for higher trophic organisms, but also in sympagic-benthic coupling, whereby nutrients are delivered to the biological communities that live on the sea floor with upwelling returning nutrients to surface waters seasonally. The replacement of multi-year sea ice by annually formed sea ice due to climate change will change the physical habitat and the associated community (CAFF 2017).

Sea ice amphipods seem to be associated with the complex multi-year ice habitat (CAFF 2017). Ocean currents and smaller gyres are believed to be important features for the ice amphipods to maintain their populations in the water column during the periods between sea ice formation and melt, however many aspects of the population dynamics remain unknown (Skjoldal 2022). The decline in ice amphipod abundance around Svalbard since the 1980s could possibly be explained by a change in ice algae community structure (CAFF 2017). Although the biomass of the ice associated zooplankton is an order of magnitude lower than the pelagic zooplankton biomass, the ice associated zooplankton are nonetheless known to be important prey items for seabirds such as little auk (*Alle alle*) and Brünnichs guillemot (thick-billed murre) (*Uria lomvia*) and other high trophic level predators such as polar cod (*Boreogadus saida*) and ringed seal (*Pusa hispida*) (Skjoldal 2022).

The remoteness of the Arctic Waters pelagic habitats results in long-term monitoring being challenging and expensive. Few phytoplankton microscopy timeseries exist, and although zooplankton monitoring has been carried out more extensively it has not been done very systematically (CAFF 2017). The Arctic Council Working Group CAFF has recommended that sea ice biota monitoring should be improved by establishing annual monitoring from land-fast sea ice, by developing standardised monitoring protocols and by monitoring opportunistically from drifting sea ice during cruises (CAFF 2017). Satellite-based measurements of sea ice coverage and water colour, as an indication of plankton biomass, is one of the few existing biological time series datasets available for the Central Arctic Ocean (ICES 2020f). Satellite based remote sensing could prove to be a powerful monitoring tool, while recalling the importance of *in situ* measurements for validation at regular intervals (Scarrott, et al. 2021). Satellite products that model the shape of the ocean-surface have been found to provide useful high-resolution datasets highlighting heterogenous areas associated with fronts, currents and bathymetry which could help explain the distribution of marine species at scales that will never be achieved with *in situ* measurements (Scarrott, et al. 2021). Satellite measurements have been used to show that annual primary productivity was high in 2021 compared to the 2003-2020 mean, while a 1 700 km long area of low chlorophyll-a concentration was found to stretch from Greenland to Barents Sea which was likely associated with cooler than average sea surface temperatures (Moon, et al. 2021). Addressing a knowledge gap of how remote sensing products could be used for temporal change analysis could provide valuable tools for ocean sciences that were originally developed for terrestrial systems (Scarrott, et al. 2019).

OSPAR could engage with the European Space Agency to identify specific satellite products that could be used to increase the knowledge base of the long-term and large-scale pelagic habitat changes in Arctic Waters.

5.3 Benthic habitats

The seafloor in Arctic Waters is highly diverse and creates many unique benthic habitats with specialised communities of species. They range from seagrass meadows in shallow sandy coastal bays, to muddy habitats

with only small numbers of worms and crustaceans, to towering chimneys at deep-sea vent fields. Benthic habitats are connected to the pelagic habitats above and the input of nutrients.

The benthic community below a polynya, a sea ice free area due to upwelling, showcases higher biomass compared to other shelf areas in north-east Greenland, reflecting a higher productivity in the water column at such upwelling sites and the importance of the polynya habitat (Hansen, et al. 2019). Compared to other shelf areas, the biomass contribution of bivalves was low with the majority made up of annelids and arthropods along the north-east Greenland shelf (Hansen, et al. 2019). These benthic habitats are also directly impacted by ice, with iceberg scouring marks have detected at over 100 m (Hansen, et al. 2019). The seafloor habitats off northeast Greenland are among the least studied areas in the world (Hansen, et al. 2019), while for example the Barents Sea benthic habitats have been well studied.

The biomass of megabenthic organisms has been declining over recent decades in the Barents Sea, and a minimum was recorded in 2015 (CAFF 2017). The reasons behind the decline are not known but factors such as climate change resulting in warmer waters, predation from species such as snow crab, or pressures from trawling are possible (CAFF 2017). Megabenthic communities around Spitsbergen Bank and Novaya Zemlya have not shown similar declines (CAFF 2017). Megabenthos species are presumed sensitive to bottom-trawling, and in the sub-Arctic part of the Barents Sea the highest megabenthic biomass observations are from locations of high trawling intensity, including outlier observations with high biomass of *Geodia* sponges (Siwertsson, et al. 2023). Fishing activities have resulted in 30-50% of known cold water coral reefs having been damaged along the northern coast of Norway in the Barents Sea, a 20-fold decrease of sponge biomass and depletion of Iceland scallop (*Chlamys islandica*) in the region (CAFF 2017). There were no benthic habitat indicators included in the Norwegian panel-based assessment of the ecosystem condition of Norwegian Barents Sea shelf ecosystems that reflect impacts of bottom-trawling which was recognised as adding uncertainty to the assessment of landscape ecological patterns (Siwertsson, et al. 2023).

The Atlantic is a global hotspot for deep-sea cold-water coral reefs. In Arctic Waters *Lophelia* reefs occur at shallow depths along the Norwegian coast, but more regularly at depths of 200 - 1 200 m. Intensive mapping efforts have resulted in new reefs being discovered in the Barents Sea and Norwegian sea (OSPAR 2023I). Furthermore, selected *Lophelia* reefs within marine protected areas have been monitored regularly since 2012 and has shown reefs remaining in overall good health and in stable condition (OSPAR 2023I). Bottom-contacting fishing gear activities may be limiting the extent of the *Lophelia* reefs, and a future significant pressure is the shoaling of the aragonite saturation horizon due to ocean acidification and climate change (OSPAR 2023I). Dense cold-water coral gardens made up of bamboo coral (*Keratoisis* sp.) have been document at 800 - 1 400 m depth on the north-east Greenland shelf slope (Hansen, et al. 2019). Dead coral was found deeper in the soft sediments of the coral garden locations, possibly functioning as an anchor for the living communities, and silica spines were found deep in the sediment as well as in the sponge *Stelletta raphidophora* (Hansen, et al. 2019). The sponge *Stelletta raphidophora* together with *Geodia hentscheli*, *G.parva* have been found to form cold-water sponge aggregations known as 'ostur' (cheese bottom) north of Iceland, the Denmark Strait and off Greenland and north of Svalbard (Burgos, et al. 2020). Deep-sea sponge aggregations occur at shallower depths along the Norwegian fjords than elsewhere across the OSPAR Maritime Area (OSPAR 2023I).

Seapen and coral communities characterise pristine benthic habitats, sensitive to disturbance. Fish and other invertebrate fauna are associated with coral garden patches, with higher biomass than seen elsewhere on the north-east Greenland shelf (Hansen, et al. 2019). The iconic giant seapen *Umbellula encrinus* has been observed to grow to over 2 m high and forming old communities on the northeastern Greenlandic shelf slope (Hansen, et al. 2019). Climate change impacts on benthic habitats in Arctic Waters can include displacement and re-suspension of sediments due to increased storminess which can impact hard substrate habitats such as cold-water coral reefs, especially if they have become weakened due to ocean acidification (OSPAR 2023p). Other impacts could be warming of the sea water close to the seabed resulting in declining oxygen concentrations (OSPAR 2023p)

Deep-sea hydrothermal vent fields and oceanic ridges are considered to be in good condition in Arctic Waters (OSPAR 2023I). Surveys at the Seven Sisters and Jan Mayen vent fields have discovered dense mats of bacteria on which anemones and snails feed, carnivorous sponges living symbiotically with methane-oxidising

bacteria, calcareous sponges, hydroids and large numbers of sea lilies (Norwegian Ministry for Climate and Environment 2020). Endemic species specialised to hot temperatures have been observed at the Loki's Castle vent field (Norwegian Ministry for Climate and Environment 2020). There are indications of possible longline fishing along the upper bathyal ridges of vent fields, and this could result in fragile vent chimneys breaking if fishing gear becomes entangled (OSPAR 2023I).

Maerl beds are created by the calcified structures of red algae. The habitat occurs in Arctic Waters where they exhibit the best condition across the OSPAR Maritime Area, however in this region the habitat is under threat from ocean acidification and temperature increase which will cause a slow but significant reduction in condition and distribution over the coming decades (OSPAR 2023I).

Along the coasts, macroalgae such as kelp grow on hard substrates. In the Arctic region, multiannual kelp species have typically been found below 5 meters depth due to ice scour, but more recently the minimum depth has become shallower with the reduction in coastal sea ice (Skjoldal 2022). Large areas of kelp forest dominated by *Laminaria hyperborea* and sugar kelp (*Saccharina latissima*) along the north Norway coast have been overgrazed by sea urchins in the past decades and have therefore become red listed nationally (Norwegian Ministry for Climate and Environment 2020). The more southern areas have seen re-establishment of kelp recently, possibly due to poorer sea urchin recruitment in warmer water (Norwegian Ministry for Climate and Environment 2020).

Coastal soft substrates include habitats such as eelgrass (*Zostera*) beds. These seagrass habitats shows an overall downward trend in distribution, extent and condition (OSPAR 2023I). The current status in Greenland remains unknown due to the patchy maps and knowledge (OSPAR 2023I). Seagrass beds have been identified as important blue carbon sequestering habitats, protecting the integrity of habitat ensures that carbon rich sediments remain stable. Climate change impacts could cause the northern distribution limit of *Zostera* beds to expand, however there are threats to the condition of the kelp and seagrass habitats from increased turbidity close to coasts from storms or reduced light penetration and darkening of coastal waters due to increased run off from increased precipitation which can exacerbate local pressures from eutrophication and coastal development (OSPAR 2023I).

Visual benthic habitat mapping activities, in particular in the deep-sea, are difficult and expensive. In the northernmost parts of the Arctic Waters these efforts are even further complicated by sea ice. For example vast areas of the Greenland Sea benthos remain unstudied, with recent improvements in the southern regions where a long-term monitoring programme for marine bottom-living invertebrate fauna was launched in 2015 to detect vulnerable marine ecosystems from trawl by-catch in fish surveys (ICES 2020h, Blicher and Hammeken 2021). Sampling does not yet provide a comprehensive description of the benthos of the Greenlandic east coast (ICES 2020h). Modelled habitat maps could be used to guide efforts in mapping and surveying sites to validate occurrences of sensitive benthic habitats (Burgos, et al. 2020). For example, the cold 'ostur' habitat is modelled to occur in the Norwegian and Greenland seas at depths below 1 500 m, however sampling effort in the area is low and no observations have been reported (Burgos, et al. 2020). The NovasArc project, completed for the Nordic Council of Ministers, has contributed to a more detailed classification of the habitat types and has modelled habitat distribution for eleven vulnerable marine ecosystems and assessed the proportion at risk from bottom trawling as a basis for management advice (Buhl-Mortensen, et al. 2023). Benthic habitat maps are also incomplete closer to the coast, and it can be more complicated to accurately model habitat distribution for example within the variable environment of fjord ecosystems. In addition to mapping habitats, it would also be important to collect more monitoring data from selected location to study the change over time in habitat quality.

OSPAR could coordinate international benthic habitat mapping efforts and work collectively to bring together information about modelled habitats in Arctic Waters to inform monitoring programmes.

5.4 Fish

Fish are an important component in marine ecosystems, and while several hundred species have been observed in the Arctic region there are no known fish species that reside solely within Arctic Waters. The dominant pressure on fish populations in the OSPAR Maritime Area is extraction of biomass through fishing activities (OSPAR 2023a).

The OSPAR assessment of fish in Arctic Waters was only possible for the Norwegian waters, due to a lack of reported data for other areas (OSPAR 2023k). This is a reflection of the overall difficulty in accessing sufficient data to assess fish as an ecosystem component, and while for example some limited information on fish has been collected through dedicated expeditions to the high-Arctic fjords and adjacent shelf North-East Greenland (TUNU-programme 2002-2017) (ICES 2020h) the information was not made available to contribute to the OSPAR assessment. The assessment found that out of the 23 assessed stocks 35% achieved the thresholds, 30% failed the threshold and 35% were unknown (OSPAR 2023k). For coastal stocks, neither of the two assessed cod stocks were in good status (OSPAR 2023k). For deep-sea fish, Greenland halibut was in good status, blue ling was not in good status and silver smelt, tusk and roundnose grenadier were unknown (OSPAR 2023k). For pelagic fish, Norwegian spring spawning herring, mackerel and blue whiting were in good status, while horse mackerel and capelin were not in good status, and porbeagle and basking shark were unknown (OSPAR 2023k). For demersal fish, cod, haddock, beaked redfish and saithe were in good status, golden redfish and spurdog were not in good status, and ling, greater forkbeard and starry ray were unknown (OSPAR 2023k). There are indications, based on improved recruitment over recent years, that the status of spurdog is improving although the abundance remains low compared to historical levels (OSPAR 2023k).

Polar cod (*Boregadus saida*) is a pan-Arctic species, the most abundant species of cod in the Arctic region (CAFF 2017) and abundant in particular in shelf break habitats (Bouchard 2020). The polar cod population has moderate to high genetic diversity and no spatial population structure which is consistent with a large population size (Maes, et al. 2021, Quintela, et al. 2021). Climate change is predicted to cause warmer Atlantic water to move northwards which may have negative impacts on polar cod, however in the high Arctic polar cod might benefit from warming (Geoffroy, et al. 2023). The biomass of polar cod in the Barents Sea has fluctuated and shown a downward trend over the past decade (Norwegian Polar Institute 2023). Recent low recruitment rates of polar cod in the Barents Sea could partially be explained by a loss of sea ice, which has reduced available habitat for spawning and larval refuge from predators such as the northward expanding Atlantic cod (*Gadus morhua*) (CAFF 2017). There are indications of the hatching period shifting to take place earlier in the year in the Greenland Sea where polar cod dominates the ichthyoplankton (Bouchard 2020). Warm years have been associated with partial polar cod recruitment failure, as eggs and larvae experience thermal heat stress (Bouchard and Maes 2020). A cold refuge is created for polar cod eggs and larvae by the cold meltwater from glaciers running into the sea west of Greenland during the summer months resulting in cold subsurface even when the temperature of the surface water reaches 10 °C (Bouchard and Maes 2020). Due to anti-freeze agents in its blood, polar cod can use the sea ice habitat for shelter and for food such as ice amphipods (CAFF 2017). Polar cod has also been found to feed on temperate and boreal species such as European flounder, European plaice and barnacles (Maes, Schaafsma, et al. 2022). Polar cod is a targeted fishery in the Barents Sea by some states, but generally not considered to be the highest value catch (CAFF 2017).

Greenland halibut (*Reinhardtius hippoglossoides*) is a predatory fish associated with the benthic habitat, but unlike other flatfish it also swims with the ventral side downward and feeds on pelagic fish species such as capelin and polar cod. Greenland halibut is one of the most valuable fishes in terms of catch in the Arctic, with long-lines, deep-water trawls and gillnets from several states targeting the species and taking approximately 100 000 ton/year based on catches from the past four decades (CAFF 2017). Greenland halibut in the North-East Atlantic experienced significant decline due to fishing pressure, but stock rebuilding efforts since the 1980s have been successful (CAFF 2017). Greenland halibut does not yet seem to be adversely affected by climate change although the distribution appears to be changing (CAFF 2017). Greater density of Greenland halibut was observed offshore south of Svalbard compared to closer to the archipelago in a Spanish trawl survey (Garmendia and Iriondo 2019).

Atlantic salmon (*Salmo salar*) is included on the OSPAR List of threatened and/or declining species and habitats (Agreement 2008-06). Although fishing pressure has recently decreased, the species continues to be in poor status, possibly due to increase in other pressures such as genetic modification and translocation of species, introduction of microbial pathogens, input of nutrients, input of organic matter and loss of habitat (OSPAR 2023k). The Sámi describe a change in the spawning habitat of the Atlantic salmon, both in terms of climatic and nutrient conditions of the river as well as the ecological interaction with the competing invasive species pink salmon (*Oncorhynchus gorbuscha*). The Deatnu-Tana river is one of Europe's largest salmon

rivers with one of the largest Atlantic Salmon populations, it is the largest salmon river in Sapmi and thus of importance to the local culture (Saami Council 2023). Due to declining salmon abundance, Norway and Finland implemented a total ban for salmon catch in 2021 and continued the ban in following years, and these measures have had a large cultural and economic impact on Sámi in the area (Saami Council 2023). Sami Indigenous Knowledge holders have said:

“The Pink Salmon is a winner in climate change. Deatnu river never gets good. Salmon is gone. A report here in Finland said that climate change affects salmon quality. The salmon does not move up the river when the temperature is above 20C. We have these temperatures more and more often now.”— said by a Sámi participant at the seminar in Váhtjer (Saami Council 2023).

Mackerel (*Scomber scombrus*) summer feeding distribution range has expanded north-westwards during the mid-2000s to mid-2010s, and then from 2014 to 2019 the range retracted again so that the westward boundary moved from the Greenlandic coast to the coast of Iceland (ICES 2020g). Since 2015 the mackerel distribution has again retracted so that the majority of the stock feeds in the Norwegian Sea (ICES 2022). The reasons behind the range shift have not been clarified (ICES 2020g). The range shift of mackerel resulted in more countries fishing the stock within their EEZs which in turn lead to an international dispute over sharing fishing opportunities and mackerel has been fished over the advised amount (ICES 2020g). Mackerel occurs in temperate waters, and a significant range shift with social implications is a relevant example of a recent climate change driven impact. The biomass of mackerel and blue whiting has continued to decline in the Norwegian sea, while spring-spawning herring biomass has recently increased (ICES 2022).

Atlantification and borealisation of the fish species community can be seen in Arctic Waters. The unusually large abundance of Atlantic cod and other boreal species in adjacent areas are likely to have contributed to the decline of polar cod and other Arctic fish species in the Central Arctic Ocean (ICES 2021). Changing frontal zones between the cold low saline Polar Current and the warmer and more saline Irminger current explains changes on fish distribution along the east Greenland coast (ICES 2020h). Temperature change is the main driver of climate change impact on the distribution of suitable habitat for fish (OSPAR 2023p). Fish stocks in high latitudes are predicted to increase in abundance and biomass (OSPAR 2023k). White anglerfish (*Lophius piscatorius*) has been increasing in Iceland and has been identified as one of the ‘big movers’ with distributional shifts associated with climate change (OSPAR 2023k). Over the past decades, fishers’ logbooks have recorded a southward shift and an increasing catch of cod, a northward shift and declining catch of northern shrimp, while the catch of Greenland halibut has remained stable (ICES 2020h). A significant pelagic fishery of herring and mackerel has emerged off the Greenland coast since 2010 (ICES 2020h).

OSPAR could contribute to assessment efforts to understand both commercial and non-commercial fish species as one ecosystem component to create environmental information of relevance for Arctic Waters fisheries management practices.

5.5 Marine birds

Marine birds have been sighted all the way to the North pole (Skjoldal 2022). The Central Arctic Ocean is the characteristic habitat for Ivory gull (*Pagophila eburnea*) and Ross’s gull (*Rhodostethia rosea*) (Skjoldal 2022). In the wider Arctic region, a total of 64 species of seabirds are recognised (CAFF 2023a). Diving seaducks, such as long-tailed duck (*Clangula hyemalis*), common eider (*Somateria mollissima*) and king eider (*Somateria spectabilis*) occur in Arctic Waters close to coastal areas where they feed in benthic habitats shallower than 50 m (Skjoldal 2022). Lesser black-backed gull (*Larus fuscus fuscus*), ivory gull, Steller’s eider, black-legged kittiwake (*Rissa tridactyla*) and Brünnichs guillemot (thick-billed murre) (*Uria lomvia*) are included on the OSPAR List of threatened and/or declining species and habitats (Agreement 2008-06).

The northeast Greenland coast holds colonies of northern fulmar, black-legged kittiwake, Sabine’s gull (*Xena sabini*), Arctic tern (*Sterna paradisea*), common eider, black guillemot and occasionally Ross’s gull, with Ivory gulls breeding both coastally e.g. at Henrik Krøyers holme and further inland close to Kronprins Christian Land (Skjoldal 2022). Ivory gull breeding populations seems to have remained stable over a 10-year period in the northern areas of Greenland, whereas trends are unknown in more southern areas (Boertmann, et al. 2019a). Ivory gulls breeding in the northern area seem to forage in Wandel Sea coastal and open sea areas, targeting glacier calving fronts and with occasional long distant meandering trips to pack ice areas north of Svalbard possibly looking for polar bear kills on the ice (Frederiksen, et al. 2019). Ivory gull is strongly affected by

decline of sea ice and associated prey and is one of several Arctic-breeding seabird species could in theory shift to year-round High Arctic residency (ICES 2021). Sabine's gull nests have been found on gravelly beaches where arctic fox (*Vulpes lagopus*) is a significant egg predator, and where the gulls feed on chironomid midges in ponds between beach ridges and forage along the ice edge some 20-30 km from the nest site (Frederiksen, et al. 2019). In aerial surveys of the North-East Greenland coast the overall seabird abundance was noted to be lower than on the West Greenland coast (Boertmann, et al. 2019b). Northern fulmars and black-legged kittiwakes were the most commonly observed species (Boertmann, Kyhn and Petersen 2019b). Further south along the Greenlandic east coast, notably by Scoresby Sound, large seabird breeding colonies occur with up to 3.5 million little auks (Skjoldal 2022). The two known Brünnich's guillemot colonies on east Greenland have exhibited opposing abundance trends over the past two decades (Frederiksen, et al. 2019).

The Barents Sea is home to some of the largest breeding colonies of seabird globally, with 20-25 million pairs, many of which breed on Svalbard (Skjoldal 2022). Brünnich's guillemot (1.75 million pairs) and little auk (>1.3 million pairs), black-legged kittiwake (0.9 million pairs) and northern fulmar (0.1-1 million pairs) are the most abundant species (Skjoldal 2022). In Svalbard, on Bjørnøya, Arctic seabird species such as Brünnich's guillemot are declining while more southerly species such as puffin (*Fratercula arctica*), common guillemot (*Uria aalge*) and razorbill (*Alca torda*) are increasing (Norwegian Ministry for Climate and Environment 2020). Atlantic puffins will migrate further and into less productive areas if they breed in large colonies or in areas with poor resource availability in winter, resulting in a higher relative energy expenditure and lower breeding success (Fayet, et al. 2017). In addition to Svalbard, Brünnich's guillemot has declined in northern Norway whereas populations on Iceland and Franz Josef Land appear stable or increasing (OSPAR 2023i). Sea surface temperature correlates with distribution and abundance of both Brünnich's guillemot and the common guillemot, however while both birds have experienced population declines Brünnich's guillemot has declined at a faster rate which is seen as an indication of environmental impacts rather than one species replacing the other, although the role of competition remains unclear (NERC-BMBF 2021). The difference in success between sea bird species is attributed to secondary climate change impacts on food sources, while fisheries pressure are believed to be of minor importance (Norwegian Ministry for Climate and Environment 2020).

The OSPAR seabird assessment for Arctic Waters concluded that the species groups surface feeders, water column feeders and benthic feeders were not in good environmental status, that grazing feeders were in good environmental status, while wading feeders were not assessed (Table 4) (OSPAR 2023a). Wading birds that breed in the Arctic were assessed based on observations in Greater North Sea and Celtic Seas where they winter, showing that in 2010 a third were not in good status and in 2023 more than half of the species were in not good environmental status (OSPAR 2023i).

Table 4. Marine bird species group and species status assessment in QSR 2023. OSPAR listed species are shown in *italics*.

| Species group | Species group status | Species | Population: Breeding (B) Non-breeding (NB) | Species status |
|----------------------|----------------------|---|--|----------------|
| Surface feeders | Not good | <i>Black-legged kittiwake</i> | B | not good |
| | | Common gull | NB | good |
| | | Great black-backed gull | B | good |
| | | Great black-backed gull | NB | not good |
| | | European herring gull | B | good |
| | | European herring gull | NB | good |
| | | Lesser black-backed gull | B | good |
| | | <i>Lesser black-backed gull (subspecies fuscus)</i> | B | not good |
| | | Great skua | B | good |
| | | Northern fulmar | B | not good |
| | | Red-breasted merganser | NB | not good |
| Water column feeders | Not good | <i>Brünnich's guillemot [Thick-billed murre]</i> | B | not good |
| | | Common guillemot | B | good |
| | | Razorbill | B | not good |
| | | Black guillemot | B | not good |
| | | Black guillemot | NB | not good |
| | | Atlantic puffin | B | not good |
| | | Northern gannet | B | good |

| | | | | |
|-----------------|----------|------------------|----|----------|
| | | Great cormorant | B | not good |
| | | Great cormorant | NB | good |
| | | European shag | B | not good |
| | | European shag | NB | not good |
| Benthic feeders | Not good | King eider | NB | good |
| | | Common eider | NB | not good |
| | | Long-tailed duck | NB | not good |
| | | Common goldeneye | NB | good |
| Grazing feeders | Good | Mallard | NB | good |

A pattern which is the opposite in the Arctic Waters compared to other OSPAR Regions, was the higher percentage of water column feeding seabirds in not good environmental status (75%) than that of surface feeding seabirds (40%) (OSPAR 2023i). The reason for the difference in pattern is unknown. Surface feeding birds typically use small food items from the surface or caught during shallow dives, and feed on fisheries discards. Water column feeders dive in pursuit of pelagic and demersal fish as well as invertebrates, giving them a broader selection of potential prey and depth range to utilise compared to surface feeding birds, however they are also exposed to by-catch mortality in fishing gear.

Population decline has been continuing in the Atlantic Arctic in particular for black-legged kittiwakes, representing surface-feeding piscivores, and little auk, representing diving planktivores (CAFF 2021c). The lesser black-backed gull subspecies is a surface feeder that has exhibited exceptionally low breeding success in northern Norway where climate change and pollution remain serious threats with an increasing threat from predators at breeding sites (OSPAR 2023i). Northern fulmar is a surface feeding seabird for which breeding success can lower due to human presence, which is troublesome as the petrel conservation research priorities call for more studies to identify breeding sites and collecting more at-sea data (Rodríguez, et al. 2019). Discards from fisheries was an important food source for northern fulmars in the North Sea and has been found to change their at-sea foraging movements and being attracted to a fishing boat from over 35 km distance (Rodríguez, et al. 2019).

New information from monitoring studies show that seabirds that feed pelagically forage over a larger area than previously thought, at times over 100 km out to sea from the breeding colonies, and this needs to be taken into account when considering overlap with human activities (Norwegian Ministry for Climate and Environment 2020). In the Norwegian sea, seabird species feeding pelagically have decreased substantially in abundance since monitoring began in the 1980s, with common guillemot now being at risk of extinction as a breeding species (ICES 2022). The main pressure is believed to be the observed changes in ocean climate in the Norwegian sea that has impacted prey availability, however other pressures such as competition with fisheries, incidental by-catch, increased predation from white-tailed eagles (*Haliaeetus albicilla*), contaminants and disturbance are also contributing factors (ICES 2022). Incidental by-catch of seabirds in the Arctic is of concern, however the number of by-caught birds is not well known, neither is the impact on specific species (CAFF 2017). Decadal declines of black-legged kittiwakes and common murre resulted in hunting restrictions in the Faroe Islands (CAFF 2017).

Benthic feeding common eider populations are generally healthy, for example in Greenland and Iceland, but in the most recent surveys populations have declined in northern Norway (CAFF 2017), (CAFF 2021c). Common eider populations recovered well after a large reduction in hunting pressure in Greenland (CAFF 2017). Reduced sea ice cover has increased polar bear predation on ground-nesting common eiders and cliff-nesting guillemots (CAFF 2017), but it is not known if this is having a significant impact on the bird populations. Studies of common eider ducks nesting at Svalbard and in northern Norway indicate that higher temperatures may require less metabolism of bodyfat reserves during egg laying and the incubation fasting period, which in turn reduces the amount of lipophilic POPs from tissues in the bloodstream implying a lower exposure level to hazardous substances (AMAP 2021c). Mercury concentrations in Arctic seabirds are increasing, with the one exception of Norwegian black-legged kittiwakes (AMAP 2021b). Low sea ice cover has been found to reduce the access of black-legged kittiwake to cod as a food source, making them more likely to feed on low trophic level food items which in turn was found to be associated with a lower concentration of mercury, but no impact on mercury concentration was observed for little auk when it fed at different trophic levels (AMAP 2018b).

Climate change driven trophic disruption, for example manifesting as a mismatch in timing of the availability of a food-source and the need for the source to support breeding, can be an important mechanism affecting breeding success of top predators such as marine birds in the Arctic (Ramírez, et al. 2017). Timing of egg hatching in surface-feeding seabirds changed rapidly in response to a change in the onset of spring in the Arctic (measured as sea surface temperature) compared to water-column feeding diving seabirds' slower response time (Descamps, et al. 2019). The timing of sea ice melts impacts the pulses of primary and secondary production, which has been shown to impact the breeding success of little auk and Brünnich's guillemot in Svalbard (Ramírez, et al. 2017). The change in sea ice melt has been more pronounced in the open sea than in coastal areas, and little auks that forage in the open ocean have shown stronger impacts compared to Brünnich's guillemots that forage in fjords (Ramírez, et al. 2017). Sea ice conditions have not impacted kittiwake colonies that use glacier fronts to forage (Descamps and Ramírez 2021). Sea ice concentration is connected to the size of guillemots and kittiwake breeding colonies with a 2-year time lag on Svalbard (Descamps and Ramírez 2021). Poor sea ice conditions could result in changes in the food-web chain through poor fish recruitment, resulting in a reduced breeding colony size when the impact has made it through the food-web links (Descamps and Ramírez 2021). Interannual variation in diet composition has been recorded for little auk, black-legged kittiwake, Brünnich's guillemot, and glaucous gull, breeding in Svalbard with hatching success impacted by the diet composition in the preceding year (Hovinen, et al. 2019). Climate change impacts such as sea-level rise and extreme weather events can have strong impacts on nesting seabird colonies and result in habitat loss and breeding failure (OSPAR 2023p). Increased storminess can impact nesting success and the survival rate of foraging adult birds during migrations or in wintering grounds (OSPAR 2023p).

OSPAR could collaborate with Arctic Council WG CAFF to increase the understanding of the status of seabird species groups and identify particular human activities that could be a problem exacerbating climate change impacts, such as temporal mismatch of food availability.

5.6 Marine mammals

There are 23 species of marine mammals that routinely occur within Arctic Waters, nine of which are Arctic endemic species. This includes walrus, ringed seal, bearded seal, sharp seal, hooded seal, bowhead whale, beluga whale, narwhal and polar bear (Kovacs, et al. 2021a). The Arctic endemic species are all tightly ice-affiliated and hence seriously threatened by climate change driven declines in sea ice. The other species are boreal/Atlantic for which climate change impacts are more variable and unpredictable, although many are already expanding their ranges northward, potentially exacerbating the impacts on the Arctic species.

Marine mammals provide many ecosystem services such as top-down control in the trophic food-web (OSPAR 2023j), and nutrient cycling through their faeces as well as bringing a food source to the seafloor through sinking carcasses of dead animals. The status of marine mammals is an indication of the health of the wider ecosystem because these animals are top-predators or at least major biomass consumers (OSPAR 2023j). Hotspots for marine mammal occurrence are in areas of high productivity – such as ocean frontal regions (e.g. the Polar Front), along the ice edge of the Arctic shelf seas, shelf upwelling areas, polynyas in the areas of sea ice and glacier fronts, which are particularly numerous in Greenland and in the Svalbard Archipelago (Hamilton, et al. 2021). Population sizes and trends are not well known for many Arctic marine mammals, which makes conservation and management planning challenging. Many boreal/Atlantic cetaceans migrate north in summer to take advantage of Arctic productivity pulses during the summer months.

Ringed seals (*Pusa hispida*) are ice-breeding specialists that require a combination of stable sea ice for a period that is sufficiently long to accumulate good snow cover in order for them to breed successfully. They give birth in small caves in snow drifts on top of the sea ice. Hence, they usually breed on sea ice that makes contact with land (annual land-fast ice), though some breeding does occur in drift ice areas in the Barents Sea and elsewhere. In Arctic Waters, ringed seals occur along the east coast of Greenland, throughout Svalbard and Frans Joseph Land south to the White and Kara Seas in western Russia. They are very sensitive to the ongoing declines in sea ice cover in the north Atlantic Arctic (Kovacs, et al. 2021a). Although population sizes and trends are very poorly known for ringed seals, changes in ringed seal biology has been observed in the past decade. Their spatial ecology has changed markedly with adults reducing the size of their home ranges, retracting into tide-water glacier refugias (Hamilton, et al. 2016) presumably to have access to glacier ice

pieces for resting, and also to be close to habitat suitable for their favourite prey, polar cod (*Boreogadus saida*) (Lydersen, et al. 2014, Hop, et al. 2023). Summer foraging migrations for younger animals have also changed markedly, with the animals travelling further, searching more broadly, feeding more of the time and resting less of the time than in the past (Hamilton, Lydersen, et al. 2015). Ringed seals eat a lot of different types of prey across their circumpolar range but seem to specialize somewhat regionally. In the Svalbard area their inshore diet is dominated by a single fish species, polar cod, which comprises >75% of their food and this has not changed over recent decades despite declines in this fish species in the region (Bengtsson, et al. 2020). Offshore, they target invertebrates more, similar to behaviour observed in Greenland (ICES 2020h). Population structure is not well studied in ringed seals. In the past it was suggested that the species was panmictic (one global population), but recent studies show that this is not the case, there are ecotypes and genetic differentiation even between closely located areas (Rosing-Asvid, et al. 2023). Polar bears and humans are the main predators of ringed seal.

Two populations of harp seal (*Pagophilus groenlandicus*) exist in Arctic Waters. One breeds on the drift ice in the Greenland Sea and the other breeds in the White Sea in Russia. Both populations have recently displayed quite dramatic reductions in pup production (ICES 2020h, OSPAR 2023j). Nearly all harp seals in the Greenland Sea concentrate on sea ice northwest of the Jan Mayen island in March and give birth around 1 April, they moult on the ice in May, and in June-July-August they swim north along the ice edge into the Barents Sea to forage (ICES 2020h). Harp seals in the White Sea have a similar annual schedule, and they also move to the northern Barents Sea to forage in the summer and autumn, overlapping spatially with animals from the Greenland Sea. Both populations return to their natal site for breeding. Harp seals forage across coasts, fjords as well as open water (Ugarte, et al. 2020) and feed on a variety of small fish as well as invertebrates. Killer whales feed on harp seal pups in east Greenland (ICES 2020h) and polar bears also predate on harp seals wherever the two species overlap. The current population estimate for White Sea harp seals is 1.4 million animals and the trend appears to be modestly stable despite the decline in pup production that was particularly acute for some years in the early 2000s (ICES 2023b). The population size for the Greenland Sea is currently uncertain, model outputs range from 400 000 to 2.5 million (ICES 2023b).

The hooded seal (*Cystophora cristata*) population in the Greenland Sea has experienced long-term declines (ICES 2019, Skjoldal 2022) which appear to be continuing (Kovacs, et al. 2021a, ICES 2023b). The long-term decline has been attributed to over-hunting, however the hooded seal was protected from commercial hunting in 2008 and no recovery has been observed in pup production surveys carried out since then (ICES 2020h). Some subsistence take continues in east Greenland (Ugarte, et al. 2020) but these animals are likely from the north-west Atlantic breeding group given their tendency to moult close to east Greenland in spring, though some few might also be from the Greenland Sea stock which is classified as Endangered (and would now classify as Critically Endangered). Food shortage due to competition with fisheries, predation levels (mainly by polar bear and killer whales) or disease may be the controlling factors preventing the population from recovering (CAFF 2017). The hooded seal gives birth on sea ice in late spring at the end of the drift ice season, and nurse their pups for only four days before mating again and leaving the pupping area, leaving the pups on the ice for a few days before they take to the water and learn to fish for themselves (Kovacs and Lavigne, 1992, Ugarte, et al. 2020).

There are three Atlantic walrus (*Odobenus rosmarus rosmarus*) populations within Arctic Waters. A small population in northeast Greenland numbers a few hundred animals and is decreasing in abundance. Hunting of this population is quota regulated (Kovacs, et al. 2021a). In the northern Barents Sea, one population extends from Svalbard across to Franz Josef Land (Wiig, et al. 2014). This population was nearly extirpated through historical over-hunting, but it has been protected since the early 1950s and is currently increasing exponentially and returning to a more normal sex range and age structure (Kovacs, et al. 2014, MOSJ 2023). The number of animals summering in Svalbard now exceeds 5 000, but in Franz Josef Land numbers are not available. Despite its wide distribution, Atlantic walruses have a relatively narrow ecological niche and only specific areas provide both appropriate haul-out sites and adequate food resources (Born, et al. 1995). Walruses haul out on land in summer and on sea ice in winter where they also breed. They feed in shallow areas with rich production of bivalves (i.e. clams) and require large feeding ground areas supporting their specialised ecological niche (Kovacs, et al. 2021a). Indigenous communities have noticed a change in walrus

stomach contents, shifting from clams to open water fish in some areas, indicating that their preferred benthic food sources might be declining (CAFF 2017).

Narwhals (*Monodon monoceros*) occur within Arctic Waters in east Greenland and also in drift ice areas across the northern Barents Sea east to Frans Josef Land. There is some genetic differentiation between the coastal and offshore groups (Louis, et al. 2020). The drift-ice animals seem to stay offshore year-round (Ahonen, et al. 2019), though when sea ice is abundant near Svalbard they come up onto the coastal shelf (Llobet, et al. 2023) and they are regularly sighted in the southwest of Frans Josef Land. Narwhals can live up to 100 years and some populations exhibit high site fidelity (Ugarte, et al. 2020). Narwhals have been sighted as far as 200 km into the ice fields of the Nansen Basin (Vaquié-Garcia, et al. 2017). Squid, shrimp and fish such as Greenland halibut, polar cod and Arctic cod are typical prey items for narwhals (Skjoldal 2022). Narwhal assessment updates since 2017 included the stocks north of Svalbard, Arctic Basin/Atlantic Arctic and five stocks of East Greenland, the overall assessment shows a declining abundance, with one population over harvested and at risk of extinction (CAFF 2021b). Narwhals are an important target species for hunting in East Greenland, and this activity together with environmental change has been attributed to a population decline of more than 75% compared to modelled population estimates in 1950s (ICES 2020h). Projections based on a modest climate change scenario for future habitat suggests reductions but with some viable habitat existing through to 2100 (Chambault, et al. 2022).

Bowhead whales (*Balaena mysticetus*) occur from east Greenland across the northern Barents Sea to Franz Josef Land within Arctic Waters. This species was driven to near extinction in this Region historically in the first-ever vast commercial whaling operation. The species has a conservative life history strategy, living up to 200 years and maturing slowly meaning it also reproduces slowly. The Spitsbergen population is a unique genetic entity that is derived from the original regional population (Bachmann, et al. 2021). This population occurs in the southern parts of its range in summer and shifts northward in winter, in contrast to the normal migration directions of other bowheads, and is extreme in its tight affiliation with very heavy sea ice cover (Kovacs, et al. 2020). The only available survey estimated a minimum population size of about 350 animals (Vaquié-Garcia, et al. 2017) which was a greater number than had been feared. This resulted in the reclassification of the population from critically endangered (CR) to endangered (EN) in 2021 on the Norwegian Red List (OSPAR 2023j). Clearly, the population is still heavily depleted, and the status must be regarded as poor given that projections for available habitat in the region through to 2100 suggest a complete loss of suitable habitat (Chambault, et al. 2022), but sightings of young animals in east Greenland (Boertmann, et al. 2009), the (acoustic) discovery of several important sites for breeding (e.g. Llobet, et al. 2023) and behavioural plasticity of other bowhead whale populations give cause for some optimism. However, the ongoing reduction of sea ice is a serious concern for North Atlantic bowhead whales since the species feed on ice associated copepods and are currently sheltered from killer whale predation and human activities by the sea ice; shipping and other sources of ocean noise are thought to be a serious concern for this species which communicates over long distances (OSPAR 2023j).

White whales, also known as Beluga whales, (*Delphinapterus leucas*) comprise at least two populations, one in Svalbard and another in the White Sea in Arctic Waters (Kovacs, et al. 2021b). The species also occurs in Franz Josef Land, but genetic studies have not included animals from the Russian high Arctic and thus their affiliation with Svalbard to the west or the Kara Laptev Sea to the east are unknown. White whales were hunted almost to extinction in Svalbard in a series of hunting periods that extended through until the 1960s, some 500 animals currently occupy the archipelago (Vacquité-Garcia, et al. 2020). They are extremely coastal in their distribution and do not migrate. Tide-water glacier fronts are important foraging habitats where they feed on polar cod. They are showing some signs of accepting new, Atlantic, prey types given changes in their spatial ecology (Hamilton, et al. 2019). The population in the White Sea is significantly larger than in Svalbard, numbering some 5 500 animals (reviewed in Kovacs et al. 2021). This population is also regionally resident, remaining year-round in the White Sea or the westernmost parts of the Pechora Sea. White whales, similar to their close relative the narwhal, are long-lived, likely reaching 80-90 years of age. Climate change is likely a serious threat to white whales given their strong affiliation with sea ice, at the very least predation increases, increased disease risk and disturbance from human activities would be expected to have negative impacts.

The northern right whale (*Eubalaena glacialis*) is included on the OSPAR List of threatened and/or declining species and habitats. However, the northern right whale is considered extirpated in OSPAR Maritime Areas with non-existent chances of recovery in the short-term and only occasional sightings believed to be of individuals belonging to populations west of the OSPAR Maritime Area (OSPAR 2023j).

Polar bears (*Ursus maritimus*) are Arctic top-predators. Four of the 20 recognised polar bear populations occur in parts of the Arctic Waters, although some of the populations extend beyond these boundaries. The populations are Arctic Basin, east Greenland, the Barents Sea and a newly recognised population that resides in southeast Greenland (IUCN 2021, Laidre, et al. 2022). The Barents Sea is a so-called divergent ice ecoregion, meaning that sea ice diverges from the shoreline in the summer. Climate change increases the gap between the shore area and the sea ice in this ecoregion, and thus polar bears must adapt to reducing opportunities to hunt for seals in the pelagic habitat (IUCN 2021). The Svalbard polar bear population is experiencing the fastest changes in sea ice, which has already resulted in polar bears needing to swim to denning areas on islands to which they were previously able to walk (WWF 2022b) and bears living on land in summer have shifted to targeting terrestrial prey as soon as spring ice disappears (Hamilton, et al. 2017). Increasing genetic differentiation has already been documented for Barents Sea polar bears because of the lack of exchange previously facilitated by sea ice bridges across the region (Maduna, et al. 2021). Polar bears living in east Greenland inhabit a convergent ice ecoregion, where sea ice collects on the shore (IUCN 2021). The east Greenland polar bear population is thought to have limited genetic exchange with other subpopulations (IUCN 2021). This population has exhibited changes in habitat use, staying closer to shore for longer periods of time compared to tracking studies from the 1990s (IUCN 2021). Both the Svalbard and east Greenland polar bears have exhibited a shift in diet over the past two decades, from predating mainly on ringed seals in coastal areas to predating on harp and hooded seals, which has been attributed to a reduction in ice extent (ICES 2020h). In the Greenland Sea the sea ice reduction has increased polar bear access to the breeding and moulting areas of hooded seal (ICES 2020h). In north and north-east Greenland polar bears have been observed to den in snowdrifts formed next to icebergs that have calved from glaciers and then become anchored in the seabed (Laidre and Stirling, 2020). The denning behaviour is believed to be well established in this population but climate change could make this denning habitat less stable in the future (Laidre and Stirling, 2020). Polar bears fast during extended periods of time, females in their dens and all individuals where there is a lack of sea ice, which results in changing fat reserves and exposure to lipophilic pollutants with higher concentrations measured in thin bears compared to fat bears (AMAP 2021c). Polar bears feeding offshore on sea ice have higher exposure levels of pollutants and exhibit higher concentrations of POPs even though they are fatter than bears feeding on land in coastal areas (AMAP 2021c). If climate change would force polar bears to engage in longer migrations due to retreating sea ice, this could override the energy benefit of high trophic level marine prey (AMAP 2021c). Reduction in sea ice, shift in diet and pollution exposure could have additive and synergistic impacts on polar bears, for example making them more susceptible to disease (AMAP 2021c).

In addition to the endemic Arctic marine mammals, boreal Atlantic marine mammals species also occur, at least seasonally, in Arctic Waters. There are two such seal species. The most wide-spread is the harbour seal (*Phoca vitulina*), which is the widest ranging true seal. It occurs throughout the Arctic Waters Region, from the southernmost boundary to the Svalbard Archipelago. In Greenland, the species declined due to over-hunting to a level where ringed seals are only known to visit a few areas around riverine systems where they swim up-river and feed on arctic char among other things (Ugarte, et al. 2020). Populations of harbour seals are kept at low levels through hunting quotas in Iceland and along the Norwegian coast, in part because of perceived conflicts with fisheries. The population structure in Norway is highly divided, with many small genetically distinct groups. The species range extends eastward along the Murmansk coast of Russia. In Svalbard, there is a unique population (that stems from south Greenland- some 9 000 years ago). This population is protected from hunting because it was small and genetically depleted. However, it is responding positively to climate change, expanding its distribution and increasing its abundance (Bengtsson, et al. 2001). The second species is the grey seal (*Halichoerus gryphus*). The species occurs in Iceland, Norway and the western Russian Arctic, and in 2010 the species was confirmed in southeast and west Greenland (Rosing-Asvind, et al. 2010). Numbers are kept artificially low in Iceland and Norway, via hunting because of fisheries concerns. In Iceland the grey seal population has declined dramatically since the 1990s from 13 000 to approximately 6 000. In Norway the total population is thought to be about 8 000 animals. Pup production

has increased or remained stable in northern Norway but has declined in the most southerly locations (OSPAR 2023j).

Boreal toothed whales occurring in Arctic Waters includes killer whale (*Orcinus orca*) sperm whale (*Physeter macrocephalus*), white-sided or white beaked dolphins (*Lagenorhynchus* spp.), long-finned pilot whale (*Globicephala melas*), harbour porpoise (*Phocoena phocoena*) and northern bottle-nosed whale (*Hyperoodon ampullatus*). Risso's dolphin (*Grampus griseus*) is additionally an increasingly sighted vagrant in the Region. Among the baleen whales, the minke whale (*Balaenoptera acutorostrata*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*) humpback whales (*Megaptera novaeangliae*) and sei whales (*Balaenoptera borealis*) occur throughout open water areas and move across the Arctic Waters seasonally. Historically many of these species were dramatically reduced. Population estimates for these species can be found in (Skern-Maurizen, et al. 2022) and (OSPAR 2023j). Northward extension of the range of many of these species have been documented over the past two decades, which are almost certainly linked to increasing Atlantification and concomitant reductions in sea ice of the Arctic region (Bengtsson, et al 2022).

OSPAR could contribute to identifying particular areas of importance to Arctic marine mammals, such as the sea ice edge or glacier calving fronts, to inform area-based management measures.

6. Understanding the significance of the impacts on Arctic societies

Key message:

- **Biodiversity loss results in less stable and more unpredictable ecosystems.**
- **Historical pollution continues to impact the health of subsistence hunters.**
- **Climate change impacts already impact food security of Indigenous Peoples which is linked to overall health and social well being.**
- **A knowledge gap remains in linking socio-economic and environmental indicators to fully understand the extent of impacts.**
- **The OSPAR mandate to protect the marine environment can mitigate negative impacts on people living in the Arctic if enacted in a respectful and inclusive manner.**

Biodiversity loss results in ecosystems that are less stable, more prone to sudden catastrophic events and provide fewer ecosystem services which benefit and maintain society. In the Arctic Waters, the *State-change of the Arctic Waters marine* environment points towards several risks in the ecosystems becoming increasingly unstable with temporal and spatial mismatches between components as well as range shifts due to the rapidly progressing impacts from climate change. The species and ecosystems in the Arctic region are experiencing cumulative pressures impacting their physical, chemical and biological environment (CAFF 2017). The frequency of contagious diseases observed in Arctic marine species is increasing (CAFF 2017). The pace of change is fast and the dynamic ecosystems may become more unpredictable in the future. The human-induced changes on global ecosystems are creating conditions for fast biological evolution, so fast that changes can be seen within a few years, which creates uncertainty around sustainability of species, ecosystem function and ecosystem services (IPBES 2019).

A well-studied example of environmental pollution impacts comes from the Faroese pilot whale subsistence hunt, where samples have been collected since the 1980s of the blubber and meat in order to provide public advice regarding dietary exposure to pollutants (AMAP 2021c). Previous assessments have expressed uncertainty on whether the mercury concentration in pilot whales constitutes a risk for Faroese consumers, recognising the protective effect of selenium which is present in the diet (OSPAR 2000). The pilot whales have been found to carry high body burdens PCBs, organochloride pesticides and brominated flame retardants, even though the concentrations have not shown impacts on the whales as no significant effect on biomarker levels of vitamin A, D and E have been detected (AMAP 2018b). The health authorities of Greenland have recommended the population to abstain from eating whale meat from the hunt due to the high contaminant load which could make it unhealthy (Ugarte, et al. 2020). Increasingly strict recommendations have been made by authorities not to consume pilot whale ever since 1977 due to the ever-increasing methyl mercury content (AMAP 2021c). While pollutant concentrations have been increasing in pilot whales, they have decreased in Faroese people which is attributed to these policies (AMAP 2021c).

Climate change threatens Arctic livelihoods, culture, identity, health and security in particular for Indigenous Peoples (Constable, et al. 2022). This happens through mechanisms of increased risk of injury, food insecurity and impacts on mental health as well as food- and waterborne disease when higher temperatures result in more microbial contamination (Constable, et al. 2022). Indigenous knowledge holders have emphasised the link between quality of life, health and food security (PAME 2021f). Sámi have experienced that it is no longer possible to build ice cellars for storage and preparation of traditional foods, and have furthermore reported changes in the taste and quality of berries and meat (Saami Council 2023). Negative mental health impacts due to climate change are amplified among those societies relying on subsistence livelihoods and those who already face chronic physical and mental health issues due to socioeconomic inequities and marginalisation (Constable, et al. 2022).

Climate change has impacted subsistence hunters in Greenland by shortening the season when it is safe to travel on sea ice, which in turn has resulted in a decline in the sled dog population (Ugarte, et al. 2020). The impacts also include a shift in targeted species; for example in the southeast of Greenland the summer hunt has shifted from the Arctic narwhals to more boreal species such as dolphins, pilot whales and killer whales

(Ugarte, et al. 2020). A shared trend in villages on the East coast of Greenland is the decreased proportion of common seabirds such as Brünnich's guillemot and black-legged kittiwake taken by the hunters (Flora, et al. 2019). Polar bear hunts by Inuit in Greenland have changed since the 1990s, when dog-sleds were previously used for multi-day hunts on sea ice but more recently polar bears occur closer to settlements and have been hunted in short trips using skiffs or on land (CAFF 2017). Sámi have expressed a concern that it is becoming increasingly difficult to predict how to carry out subsistence harvesting in light of climate change impacts on the Arctic environment (Saami Council 2023). New species occurring in traditional fishing areas could present new opportunities, but they could also indicate a loss of catch of traditional species and a seasonal shift in when activities should be carried out (Saami Council 2023). Sámi have also expressed concern in that management and regulation does not appear sufficiently adaptive and dynamic to respond to the changing environmental realities, for example resulting in regulations mismanaging access to fish stocks in new and more remote areas or a centralisation of power which would limit the adaptive capacity of Sámi fishing communities (Saami Council 2023).

BOX 4: Impacts of environmental change on Saami women

Excerpt from report (Constable, et al. 2022).

Perspectives from Sámi in Finland Feodoroff (2021) stresses that many Sámi women are central to Indigenous-led adaptation. Indigenous women use their bodies as gauges of change. For example, the restoration work in Näätämöjoki River in Finland (Ogar et al., 2020; Feodoroff, 2021) is based on the knowledge of traditional fishers and reindeer herders. IK and Western science offer possibilities to reflect on changes that the waters in Indigenous bodies have known of events of the past (Feodoroff, 2021). Changes in temperature, pain and the gradual passing of pain, waves and intrusions within Indigenous bodies are knowledges that are difficult to communicate according to Feodoroff (2021). Women are sensitive to receiving messages from their home environments. Feodoroff (2021) stresses that Indigenous conservation work is a bodily commitment. This realisation is linked with difficult questions of what or who controls Indigenous bodies. Feodoroff (2021) links present change with lingering impacts of global environmental damage that has not been dealt with or addressed. It may lead to real pain in Indigenous bodies and minds, causing feelings of being nauseated and ultimately causing fade-out, wilt, withering and extinguishment of Indigenous Peoples.

Feodoroff, P., 2021: Indigenous female bodies as indicators of change. In: 2021 Compendium of Indigenous Knowledge and local knowledge: towards inclusion of Indigenous Knowledge and local knowledge in global reports on climate change [Mustonen, T., S.L. Harper, M. Rivera Ferre, J. Postigo, A. Ayanlade, T. Benjaminsen, R. Morgan and A. Okem(eds.)]. nowChange Cooperative, Kontiolahti, Finland, pp1..

Ogar, E., G. Pecl and T. Mustonen, 2020: Science must embrace traditional and Indigenous Knowledge to solve our biodiversity crisis. One Earth, 3(2), 162–165, doi:10.1016/j.oneear.2020.07.006.

To reduce harm to Arctic societies and the environment, there is a call for wider decision-making structures in order to increase indigenous and local-Arctic research, management and input (Moon, et al. 2021). In order for management strategies to be successful, they will need to be inclusive by guaranteeing Arctic peoples' self-determining rights, and they need to manage many sectors simultaneously to account for cumulative effects (Constable, et al. 2022). The sixth Conference of Sámi Parliamentarians in May 2022 emphasised that the green transition cannot violate the Sámi right to self-determination or prevent Indigenous Peoples from exercising their traditional economy and land use (Saami Council 2023). Currently, the burden of climate change is exacerbated by industrial developments in Sapmi, placing the double burden of climate change and mitigation on Sámi society and hampering their adaptive capacity (Saami Council 2023).

BOX 5: Adaptation success underpinned by Inuit knowledge

Excerpt from report (Constable, et al. 2022)

Inuit-led adaptation action is founded on the intention of contributing to and moving towards reformation and eventual transformation of systems to create a 'climate resilient' Arctic. This concept has surfaced in academic climate change literature and discussion and has begun to filter into the climate policy arena, especially within the context of the current COVID-19 pandemic that challenges us all to think about our world differently. With acknowledgement that reform and transformation is needed, the question remains, 'What does this look like?'

Inuit have an answer. System reform and transformation is grounded in self-determination. It is based in a human rights framework and rooted in Indigenous knowledge and culture. It recognises and respects interconnectedness and builds this into solutions. It demands collaboration and true partnership towards action. And it comes from thinking big and across scales. Shaping this change calls for willingness and support to rethink the current economic and governance models that have failed us. For example, decentralising governance and management, while it remains largely unconventional, has been shown to create some of the strongest systems we have. This is, in large part, due to the way in which decentralisation places more value and responsibility on the 'self' in self-determination. Decentralised processes in the Arctic have Indigenous knowledge holders playing a key and lead role in determining, defining and deciding how to work towards positive change.

Any socio-economic analysis of the impacts of green energy transition measures should identify in which way the activities would benefit Indigenous Peoples and local communities, or whether the energy and the profits are mainly for export. The Arctic Council Ministers have agreed to implement the recommendation to incorporate resilience and adaptation of biodiversity to climate change into plans for development of the Arctic (CAFF 2015a). Climate change adaptation strategies that are beneficial in the short term can be maladaptive in the long term for Indigenous Peoples if they do not address colonialism, inequities and injustices (Constable, et al. 2022). For example, privatisation of fisheries can incentivise long-term sustainability under stable conditions by promoting low diversity in harvest resulting in the targeting of an activity to a certain stock; but under rapidly changing climatic conditions this privatisation may not be a resilient approach (Constable, et al. 2022). The extent to which climate change and environmental impacts, including from pollution, will limit the possibilities for subsistence activities in the Arctic remains a knowledge gap. Environmental impacts of economic activity are not explicitly included in economic indicators, such as gross domestic product, and it remains a challenge to develop environmental- and economic indicators that could be applied complementarily to answer these gaps in knowledge (Glomsrød, et al. 2021).

OSPAR could develop links between socio-economic and environmental indicators to improve the understanding of impacts of environmental change on societies.

7. The OSPAR management response in Arctic Waters

Key message:

- **There is a mismatch between the rate of change in the Arctic Waters environment and the speed/slowness of the management response which could potentially be alleviated by exploring new management approaches and steps.**
- **Exploring if OSPAR competency could support delivery of Arctic Council recommendations could be a helpful action, the OSPAR competency to adopt legally binding instruments is relevant in Arctic Waters in particular for areas beyond national jurisdiction.**
- **The OSPAR action of bringing information to the attention of other competent authorities could be relevant in managing many human activities in Arctic Waters.**
- **Regular implementation reporting by Contracting Parties on OSPAR Recommendations contributes to assessing whether the measures are delivering the anticipated outcomes.**

The Contracting Parties of the OSPAR Convention come together in the OSPAR Commission to adopt international legal instruments to protect the North-East Atlantic marine environment. The adopted instruments only bind the Contracting Parties. The OSPAR Commission can agree collective action that all Contracting Parties contribute to, or it can agree national actions that each Contracting Party take individually within its jurisdiction. The OSPAR acquis includes legal instruments and guidelines which are applicable to the OSPAR Maritime Area, including to the OSPAR Arctic Waters (Region I).

OSPAR collaborates with other organisations and authorities, for example by bringing information to their attention regarding marine environment issues related to the human activity under their specific mandate. Observer organisations also contribute substantively to the work of the OSPAR Commission. The Contracting Parties to OSPAR are also parties to other international organisations, thereby coordinated action by the same Parties in a complementary manner is important. All OSPAR Contracting Parties can contribute to measures that protect the Arctic Waters marine environment. Many pressures impacting the Arctic arise from activities outside of the region, and therefore competency to manage the activities does not lie with the Arctic states. This type of issue could also be relevant for international businesses coming into the Arctic region.

It is important to understand if the management response and measures are fit for purpose and delivering anticipated outputs. OSPAR Recommendations include a regular implementation reporting requirement, which provides some of the needed information to assess this aspect. Assessing the effectiveness of a measure in changing the environmental status is a difficult task that OSPAR has not yet fully addressed. Like in other marine areas, there is a consistent need for improved monitoring and mapping efforts and improved coverage, this is another topic where further OSPAR action could be appropriate.

BOX 6: The OSPAR Measures Menu

OSPAR Decision

A legally binding instrument

- Decisions are legally binding to the Contracting Parties of the OSPAR Convention
- Examples include:
 - Decisions to establish collectively designated Marine Protected Areas in the area beyond national jurisdiction
 - Decisions on harmonised mandatory control systems for discharge of offshore chemicals
 - Decisions on carbon dioxide storage

OSPAR Recommendation

A soft-law instrument with an implementation reporting obligation

- Recommendations are non-binding legal instruments adopted by the OSPAR Commission. Contracting Parties to the OSPAR Convention are obliged to complete implementation reporting at agreed intervals on the actions that have been taken
- Examples include:
 - Recommendations on the use and discharge of chemicals
 - Recommendations on management and conservation actions for OSPAR Listed species and habitats
 - Recommendations on the management of collectively designated Marine Protected Areas
 - Recommendations to reduce use and loss of plastics

OSPAR Other Agreement

Non-binding guidelines

- This is a broad category of non-binding documents with varying purposes. OSPAR does not have any systems in place to centrally review how the Agreements are used and applied by Contracting Parties. In special cases, the OSPAR Commission or a Committee may collect information on the use of an Agreement to inform further work.
- Examples include:
 - Monitoring and Assessment guidelines
 - Roadmaps and guidelines for procedures of work
 - The OSPAR North East Atlantic Environment Strategy 2030
 - Memoranda of Understanding with other organisations

The OSPAR Commission has set priorities for work under the OSPAR Convention on many topics through the NEAES 2030, which describes goals and targets that are grouped into 12 strategic and 54 operational objectives. OSPAR can address many issues in the Arctic Waters marine environment under these priorities that can also be linked to priorities of other organisations such as the Arctic Council. Mapping out Arctic Council recommendations and whether OSPAR competency and work could contribute to progressing their implementation could be useful. Communicating the OSPAR mandate to help focus work on the measures and actions that could have the strongest beneficial impact for the Arctic Waters marine environment is needed.

Time is an obstacle to an effective management response, especially when the environment is changing as rapidly as currently seen in the Arctic Waters. A long time passes from an original idea, through a scientific process to delivering policy advice, involving all stakeholders, to adopting a measure and then implementing it. By the time a decision is implemented, the environment may have shifted so that a modified or new measure would be needed. Therefore, identifying all steps and mechanisms that can allow for a timely response would be important. This could include; funding requirements on scientists delivering policy advice before publishing project findings; developing new protocols for responding to observed changes in the environment; developing more operational and ongoing channels of engagement with stakeholders. The Sámi Council has recommended that Sámi representatives be included in national delegations within intergovernmental fora in order to create better partnerships with Saami people in the development of national, regional and international policies and regulation (Saami Council 2023). Closer engagement and regular contact could contribute to a faster management response process.

OSPAR could map out priorities and planned work against Arctic Council recommendations to identify opportunities where the OSPAR mandate could support their synergistic implementation.

OSPAR could work to identify any steps in the management response process that could be speeded up, to allow for a timely response to a changing Arctic Waters marine environment.

7.1 Managing specific human activities in Arctic Waters

The response taken by OSPAR on specific human activities is briefly described as a basis for options for further action in OSPAR Arctic Waters. Other competent authorities are briefly mentioned, especially if an OSPAR action would be to bring environmental information to the authorities' attention.

7.1.1 Managing extraction of living-resources- fishing, hunting, bioprospecting

The OSPAR Convention Annex 5 Article 4 states that no programme or measure concerning a question relating to the management of fisheries shall be adopted under the Annex. This defines that the OSPAR competency excludes fisheries management. For the avoidance of doubt [Agreement 1998-15.2](#) clarifies that the management of fisheries includes the management of marine mammals. The OSPAR competency on bioprospecting has not been clarified in a comparable way.

Through the NEAES 2030, the OSPAR Commission has committed to initiate discussions on the development of an ecosystem based management approach to fisheries (NEAES 2030 operational objective Sx.O2). OSPAR will thus continue long-standing work to assess fisheries impacts on species and habitats, and the level of pressures from physical impacts on the seafloor and litter such as ghost fishing by discarded gear and bring issues to the attention of relevant competent authorities (OSPAR 2023b). However, there are also new components that need to be developed to meet the objective, to enable a more holistic approach to considering fish as an ecosystem component and all possible pressures and trophic links. For example under such an approach, the project proposal to sustain harvest of demersal fish while reducing harvesting of planktivorous fish to alleviate some of the effects of sea ice loss and warming on the higher levels of the food-web (NERC-BMBF 2021) would need to be evaluated on a wider ecosystem level to assess all impacts. For Arctic Waters, the generated knowledge could be brought to the attention of the Joint Program of Scientific Research and Monitoring established under the Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean, in addition to the already ongoing exchange with NEAFC. Coastal Sámi have expressed concern regarding the mismanagement and centralisation of power which limit their adaptive capacity in light of climate change and shifting species (Saami Council 2023). There is a concern that a holistic approach is not being taken and while the ecological balance is disturbed, authorities' management approaches are not attuned to these changes and needs (Saami Council 2023).

Benthic habitats that are sensitive to physical disturbance, removal or damage from fishing have been included on the OSPAR List of threatened and/or declining species and habitats, which in turn is used for example by ICES when developing advice to the North-East Atlantic Fisheries Commission (NEAFC) on occurrences of Vulnerable Marine Ecosystems.

Incidental by-catch of marine animals is a pressure on many species already facing the pressures that come from climate change impacts. The extent of the by-catch pressure is not well known in the Arctic, and this pressure would need to be considered in i.a. a climate change context. Risk maps could highlight calving glaciers and floe edge areas as important feeding grounds for marine birds and highlight the importance of ensuring that no incidental by-catch mortality is caused during the breeding season, for example. Bringing more attention to collection of data on incidental by-catch mortality of marine mammals in particular could be a topic where OSPAR created knowledge on the significance of the pressure could be brought to the attention of other competent authorities, such as IWC or NAMMCO.

OSPAR adopted a Recommendation to promote fishing for litter schemes and education for fishers in 2010. Since then, more measures are being put in place to reduce litter entering the marine environment from fishing activities across the OSPAR Maritime Area to address remaining environmental concerns such as "ghost fishing" by abandoned gear (OSPAR 2023b). Fishing activities appear to be a key source of marine litter in the Arctic, therefore further efforts to implement OSPAR existing measures could be appropriate.

OSPAR could seek to clarify the legal relationship between bioprospecting and Annex 5 of the OSPAR Convention.

OSPAR could consider expanding pressure assessment methods to Arctic Waters, as well as developing risk-based maps and engaging with other authorities and organisations, to improve and better coordinate data collection on incidental by-catch.

OSPAR could make a special data collection effort from the Arctic Waters to augment the OSPAR threatened and/or declining habitats database.

OSPAR could explore whether defining new habitats that are typical to the Arctic could be relevant, for example if a muddy habitat should be defined by a different assemblage of sea-pens.

OSPAR could explore if the implementation of OSPAR measures aiming at reducing input of litter from fishing activities could be strengthened in Arctic Waters.

7.1.2 Managing aquaculture

Actions on aquaculture management in OSPAR have included PARCOM Recommendation 94/6 that covers the reduction of inputs from potentially toxic chemicals used in aquaculture, for which implementation reporting ceased in 2006. However, in 2020 OSPAR decided to initiate a new reporting round on the Recommendation (OSPAR 2023b). In the forthcoming overview assessment of implementation reporting, particular attention could be given to whether Contracting Parties have drawn up best environmental practice and action programmes on reducing input of the hazardous substance, including from lice treatments or copper leaching from the structures, that are of particular concern in Arctic Waters.

Biological impacts from aquaculture need to be addressed in Arctic Waters. The potential for localised eutrophication effects from the expanding aquaculture sector have been identified as a potential problem, but OSPAR has not fully assessed the impact due to technical reasons. It could also be relevant to consider localised eutrophication effects in the context of cumulative effects on a fjord ecosystem. To inform future placement of aquaculture facilities, such assessments could for example be combined with benthic habitat assessments to minimise impacts on sensitive habitats, as well as the considering the full suite of hazardous substances potentially introduced into an ecosystem.

OSPAR assesses the status of Atlantic salmon which is included on the OSPAR List of threatened and/or declining species. In collaboration with NASCO, it could be informative to explore climate change scenarios to describe a potential increase in risk of genetic pollution from aquaculture escapees due to increased storminess, as well as potential impacts on wild stocks from aquaculture facilities possibly being moved further north as water temperatures increase.

OSPAR could assess effectiveness of the measure PARCOM Recommendation 94/6, which provides evidence for best environmental practice, including whether the measure has addressed introduction of hazardous substances of particular concern in Arctic Waters.

OSPAR could collaborate with NASCO in exploring the potential increased risk from aquaculture activities on Atlantic salmon under various climate change scenarios.

7.1.3 Managing oil and gas exploration and extraction

OSPAR has put in place many measures to protect the marine environment from impacts by offshore oil and gas exploration and exploitation activities. Since the activity continues in Arctic Waters, all the OSPAR measures undertaken so far are relevant. OSPAR measures have reduced the oil in production water discharges and the discharge of hazardous substances and drilling fluids (OSPAR 2023b). OSPAR has introduced a ban on dumping of offshore installations in Decision 98/3 on the disposal of disused platforms. Across the entire OSPAR Maritime Area, this has resulted in 170 installations having been brought ashore for disposal, ten derogations having been issued with four under consideration for leaving specific installations in place (OSPAR 2023b). Technical capabilities for the removal of topsides and steel jacket installations have improved and expanded; however, there are still other categories of structures for which the technologies have not developed and that remain eligible for derogation from OSPAR Decision 98/3 (NEAES 2030 operational objectives S9.O2, S9.O3) (OSPAR 2023b). The EU in its new Arctic policy expresses the will to push for oil and gas to remain in the ground in the Arctic but exploration and extraction continue ([JOIN/2021/27 final](#)).

OSPAR has identified that good practice guidelines for geophysical surveys and the use of explosives need to be developed (NEAES 2030 operational objective S8.O1 (OSPAR 2023b)). This is of relevance for the Arctic where exploration activities continue and are even likely to increase, and such measures could possibly be

taken forward with special attention on unique Arctic environment characteristics and features. OSPAR has also developed guidelines to reduce the impact of offshore installations lighting on birds (Agreement 2015-08) which was developed mainly for the OSPAR Region Greater North Sea (Region II).

Oil production activity needs to mitigate against negative effects on Indigenous Peoples subsistence hunting. This could include e.g. ensuring that helicopter noise or general human presence does not influence the distribution of birds or mammals (Boertmann, et al. 2020). Oil and gas operators in the harsh and vulnerable Arctic have special awareness of safety principles, preparedness to mitigate consequences of accidents and emergency response capabilities (Tarantola, et al. 2019). Many technical standards have been developed to ensure technically safe operations in harsh winter conditions, from telecommunication to drilling equipment de-icing and fire protection (Tarantola, et al. 2019).

OSPAR contributes to the regulation of release of produced water from oil rigs, through its Recommendation 2001/1 on management of produced water and Recommendation 2012/5 on a risk-based approach to management of produced water discharges. Releases from many facilities and/or over long time periods could be of concern in the Arctic (Boertmann, Blockey and Mosbech 2020) which could be explored and considered further by OSPAR. Additional measures could be considered in OSPAR in relation to preventing the introduction of hazardous substances and marine litter from offshore oil and gas activities (NEAES 2030 operational objectives S2.O3, S2.O4, S4.O5, S4.O6, (OSPAR 2023b)).

There is a need to develop effective large-scale methods for response to oil spills in dynamic drift ice conditions since no existing methods have yet been proven effective (Boertmann, Blockey and Mosbech 2020). The Environmental Oil Spill Sensitivity Atlases (**Error! Reference source not found.**), created as part of the Strategic Environmental Study Programme for north-east Greenland, identify areas of high sensitivity for the northeast (71°-81.5° N) (Clausen, et al. 2022) and southeast (56°-71°N) (Johansen, et al. 2022). The two Atlases take into account coastal morphology, oceanography and sea ice, biological elements (fish, birds, marine mammals), human use (hunting, fishing, tourism), nature conservation areas, cultural heritage sites, logistics and oil spill response methods. They recognise that while best available data have been used, it is important to update the atlases as new information becomes available (Clausen, et al. 2022) (Johansen, et al. 2022).

OSPAR Decision 2007/2 on the storage of carbon dioxide streams in geological formations is of relevance to the Arctic Waters where carbon capture and storage projects are ongoing. The effectiveness of the measure has not yet been evaluated due to the limited number of ongoing activities, and it would be appropriate to assess this before further measures are considered (NEAES 2030 operational objective S12.O3, (OSPAR 2023b)). OSPAR Decision 2007/1 prohibits carbon dioxide storage in the water column or seabed.

OSPAR could consider developing guidance to prevent impacts from noise caused by oil and gas exploration and exploitation activities.

OSPAR could explore if environmental information on seabed morphology and habitat occurrence could be useful as a best practice knowledgebase, to minimise physical disturbance of sensitive habitats from exploration or transportation activities of oil and gas.

OSPAR could consider additional measures to prevent introduction of hazardous- or radioactive substances and marine litter from offshore oil and gas activities in Arctic Waters.

OSPAR could assess long-term impacts on the marine environment from oil and gas operations, including from long-term release of regulated production waters.

OSPAR could investigate whether there are lessons to be learned from cooperating with the Bonn Agreement on mitigating pollution impacts in the North Sea, which could be helpful for improving spill response guidelines in the Arctic, or whether any Arctic environment amendments would be needed in Recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities.

7.1.4 Managing shipping

The International Maritime Organisation (IMO) International Code for Ships Operating in Polar Waters (Polar Code) came into effect in January 2017 and addresses both safety measures for ships (Part I) and environmental protection measures (Part II). The IMO Polar Code area definition of the Arctic does not include the entirety of Arctic Waters (OSPAR Region I) (see ANNEX 3: Various maps and areas). Therefore, other measures could be needed to protect the marine ecosystems beyond Polar Code boundary from shipping pressures in Arctic Waters. In response to the adoption of the IMO Polar Code, the PAME established the Arctic Shipping Best Practice Information Forum to promote effective implementation of and compliance with the Polar Code by maintaining a publicly accessible web portal with information relevant to each chapter (PAME 2023a).

Potential pressures on the Arctic marine environment that are not addressed in the Polar Code include spill preparedness and response, the risk of introduction of non-indigenous species, the treatment and discharge of grey water, and emissions of air pollutants such as black carbon, sulphur and nitrogen oxides (Prior 2022). Additional environmental protection measures could be considered for example to make quiet ship technology mandatory, more focussed measures to avoid ship strikes with marine mammals or designating the Arctic region as a particularly sensitive sea area (PSSA). There have been discussions, for example in PAME (PAME 2015b), to propose to the IMO that one or more areas in the Arctic high seas be assigned a Particularly Sensitive Sea Area (PSSA) status. There are two PSSAs within the OSPAR Maritime Area in the temperate region. Measures that can contribute to reducing emissions in the Arctic Waters should be considered. Regulating activities such as tank washing or oil spills along shipping routes could be discouraged through regulations and operational surveillance, for example by aerial surveillance of ice-breaker lanes and other heavily trafficked areas.

The use of heavy fuel oil has been banned in the Antarctic since 2011 (Comer, et al. 2020). A ban on heavy fuel oils exists in the territorial waters of Svalbard since 1 January 2022. In June 2021, the IMO adopted a “prohibition on the use and carriage for use as fuel of heavy fuel oil by ships in Arctic waters” as resolution MEPC.329(76) as an amendment to MARPOL Annex 15. The prohibition entered into force 1 November 2022, and will take effect for non-Arctic flagged vessels on 1 July 2024 and for Arctic flagged vessels on 1 July 2029. The exemption impacts have been estimated to result in only a 5% black carbon emission reduction during the exemption period as the measures would eliminate only 30% of heavy fuel carriage and 16% of the use based on historical information (Comer, et al. 2020). The EU package of climate policy measures called ‘fit for 55’ is an example of a set of measures for shipping to reduce the climate impact which go beyond current IMO regulations, however it does not include black carbon (Osipova and Comer 2022). It would be possible for ships visiting European ports and sailing in the Arctic to switch to distillate fuels to reduce black carbon emissions, and many European ships already carry this fuel for when they sail in the Baltic and North Sea emission control areas (Osipova and Comer 2022).

For more temperate areas the Bonn Agreement, which shares a Secretariat with the OSPAR Convention, has relevant lessons learned on surveillance activities which could be of interest in Arctic Waters and more broadly in the Arctic region.

Future development of new port infrastructure, and disturbance from the use of ports, such as habitat degradation from noise, non-indigenous species and maintenance dredging, are important aspects which have not yet been considered and managed on an international scale (WWF 2022a). Climate change needs to be taken into account in planning of infrastructure development projects such as ports to ensure that investments and activities have a positive overall impact, by minimising environmental impacts while creating local jobs and improving access for Arctic societies (WWF 2022a). The holistic ecosystem approach taken by OSPAR and the information that is produced could provide a useful framework for future planning on a regional scale.

The IMO developed guidance on reducing the risk of ship strikes with cetaceans in 2009 (MEPC.1/Circ.674), recognising that minor routeing changes in high-risk areas could lead to substantial reduction in strikes however none of the areas are within OSPAR Arctic Waters. The Government of Canada has embarked on a

⁵ IMO Resolution MEPC.329(76)

[https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.329\(76\).pdf](https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.329(76).pdf)

research project with the aim of developing a network of low-impact marine transportation corridors in the Arctic that encourages marine transportation traffic to use routes that pose less risk and minimise the impact on communities and the environment (Arctic Corridors 2023). The International Whaling Commission (IWC) has worked on guidelines and regulations to reduce risk of cetacean ship-strikes. Ship traffic is a major source of underwater noise that could be considered in conjunction with corridors for marine mammals.

OSPAR could explore its potential role as a convenor to bring Arctic Waters environmental information to the attention of IMO, in collaboration with Arctic Council WGs PAME and EPPR, with a view to expand the set of environmental measures under Part II of the Polar Code, such as quiet ship technologies and mitigating the risk of marine mammal ship strikes.

OSPAR could explore, in collaboration with Arctic Council WG PAME, proposing designation of Arctic Waters, or the wider Arctic region, as a PSSA by IMO as a measure to control polluting emissions.

OSPAR could share lessons learned in mitigating environmental impacts from shipping, by detecting tank washing through beach litter monitoring and cooperation with the Bonn Agreement on operational surveillance of shipping routes.

OSPAR could consider whether any special environmental considerations would be needed in relation to future port infrastructure developments, in applying a precautionary approach to ecosystem-based management.

OSPAR could consider developing approaches for managing potential underwater noise impacts in a warming Arctic more broadly, for example by area-based measures and by bringing specific environmental information to the attention of the IMO.

OSPAR could consider whether it would be relevant to explore the available information on marine mammal distribution to inform future identification of high-risk areas to avoid ship strikes, although this has not to date been identified as a major issue impacting the state of the populations.

7.1.5 Managing tourism

To date, OSPAR has not developed management instruments that would specifically target tourism. Such guidelines could be broadly applicable, with special provisions made for the Arctic Waters marine environment ecosystem components that are particularly vulnerable.

There could be merit in building on good practices developed in Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) for cruise companies to Antarctic that set out strict guidelines for tourism activities at sea and when tourist go to shore. These include establishing a code of conduct, bans on big cruise ships, fuel regulations or the number of tourists that can be landed at a particular coastal site. Cruise ship regulations are in place in Svalbard, but not across the whole Arctic region.

Cruise operators have guidelines on a number of topics to avoid damage to the marine environment, but there could be a need for stronger regulation. For example ship strikes between cruise vessels and the animals being observed can be severe and regulation should be put in place to minimise risks. The Association of Arctic Expedition Cruise Operators (AECO) has developed several guidelines for specific tourism activities in the Arctic region, and has provide this as an annotated inventory to PAME (PAME 2021e).

Arctic cruise tourism could be considered from the point of view of waste management risks for oil spills or discharges of wastewaters, including microplastics. OSPAR measures to address marine litter could be of relevance in relation to tourism, both in terms of best practices for waste management but also in terms of assessment of environmental impacts. There could also be a consideration if such measures could contribute to reducing the likelihood of opportunistic animals being attracted to waste in search of food. Measures to minimise disturbance to species from human presence and noise, for example from tourism activities associated with vessels, helicopters or snowmobiles, could be considered as area-based measures. Such measures could be in place for particular seasons with specific regulations on allowable activities.

OSPAR could consider whether using beach litter monitoring to sites that are particularly sensitive to an increase of litter from tourism could be helpful as an early warning assessment approach.

OSPAR could consider whether it would be appropriate to cooperate in the development of guidelines on sustainable tourism, to protect the marine environment.

7.1.6 Managing renewable energy generation

OSPAR has developed guidance on environmental considerations for offshore wind farm development ([OSPAR 2008/3](#)) to support the identification of issues at all stages from development through operation and into decommissioning. The guidance also includes minimum criteria for EIAs to apply, in order to minimise impacts on marine mammals, including from noise (OSPAR 2023j).

Placement of wind-farms is an important consideration in managing negative environmental impacts. Planning of the marine space in a way that takes cross-border impacts into account would be important, for example by considering conservation objectives of Marine Protected Areas (MPA) adjacent to any renewable energy generation sites. Managing the placement of power-cables could also be a consideration to avoid disturbance of particularly sensitive sites.

OSPAR could explore whether it would be warranted to develop further guidance on offshore wind farm development that would take the specificities of the Arctic Waters into account, for example construction and operation in a quiet marine environment, or special considerations of introduction of marine litter in icy conditions.

OSPAR could consider whether its mandate on guiding power-cable laying operations could be relevant in mitigating wind energy development impacts in Arctic Waters.

7.1.7 Managing aggregates extraction and mining

The International Seabed Authority (ISA) has the competency to manage deep-seabed mining activities in the Area which is beyond national jurisdiction. The OSPAR Commission has undertaken work to describe environmental impacts from deep-seabed mining and identify remaining knowledge gaps (OSPAR 2021). The work is of relevance also for Arctic Waters and can in the future inform any management actions to be taken by OSPAR. Public procurement of minerals can take into account whether extraction has been made in a responsible manner, ensuring that the activity does not run counter to local sustainability and livelihoods developments (Koivurova, et al. 2021). Thus, also actors that do not engage directly in the extractive activity or its permitting, can contribute to sustainable management of the resource. Long-term dialogues between extracting states and procuring states, as well as developing trade relationships or providing funding for sustainable extraction could contribute to a sustainable outcome in sourcing materials for the green transition (Koivurova, et al. 2021).

Deposition of mine tailings at sea from coastal mines has been discussed in OSPAR but no measures or actions have been taken. A project has been planned in PAME on resource exploration and development to take stock of current and planned Arctic coastal and near shore mining operations with the aim to elaborate best practices for marine disposal of waste rock, tailings, sediments and water (PAME 2023c). It would be important for countries to ensure a level playing field for all mining companies in implementing best available practice through regulations, and the OSPAR mandate around prevention of pollution from dumping of wastes could be relevant in this regard to ensure that no toxic or harmful substances from the land-based activity pollute the ocean.

OSPAR could continue engagement with ISA by bringing to the authority's attention information about Arctic deep-sea ecosystem impacts from potential deep-seabed mining activities.

OSPAR could consider developing a legal instrument on disposal of mine tailings from coastal mines into the sea, based on best practice guidelines developed in Arctic Council WG PAME.

7.1.8 Managing scientific research

OSPAR uses information from scientific research as a basis for the ecosystem-based approach to managing human activities, which includes setting out specific research needs. The OSPAR Science Needs Agenda describes the research priorities and is used to guide regional research agendas it can for example be referred to when project funding is applied for in EU funding instruments. This instrument could be used to steer scientific activities to be carried out in a responsible manner.

The 'OSPAR Code of conduct for responsible marine research in deep seas and high seas of the OSPAR Maritime Area' (Agreement 2008-1) sets out principles for how responsible scientific research should be carried out in the area beyond national jurisdiction. Scientific research activities in ecosystems in Arctic Waters could require special considerations.

OSPAR could update its Science Needs Agenda by including a criterion to ensure research efforts are steered towards sustainable practices that do not cause harm to the marine environment.

OSPAR could consider developing an Annex to the OSPAR Agreement 2008-1 for special Arctic provisions for deep-sea and high seas research activities.

7.2 Managing pressures

There are relatively few management measures and actions in OSPAR directly managing pressures. A more common approach is to use the understanding of the significance of a pressure to set reduction targets as a measure and design a management measure targeting the contributing human activities to achieve the target. The previous section on managing specific human activities includes measures to reduce pressures from marine litter from fishing activities, underwater noise and emissions from shipping, and the impacts from lighting at offshore oil and gas operations. These measures are not repeated in this section.

OSPAR has agreed to develop measures for climate change mitigation and adaptation under the NEAES 2030. As climate change is a global pressure it is not within the OSPAR mandate to address fully. For example setting targets is done under the UN Framework Convention for Climate Change (UNFCCC) through the legally binding international treaty the Paris Agreement. Regional OSPAR measures contributing to the global aim include Decisions 2007/1 and 2007/2 on storage of CO₂ streams, and OSPAR Recommendation 2010/2 amending Recommendation 2003/3 on a network of Marine Protected Areas which aims to increase ecosystem resilience, however OSPAR needs to adopt further climate change and ocean acidification specific measures (OSPAR 2023p). Given the strong impact of the pressure in Arctic Waters, this could be an OSPAR regional focus topic. OSPAR measures for climate change mitigation could include expanding existing measures for example with the aim of ensuring carbon storage through natural solutions (NEAES 2030 S12.O1). Protecting the globally significant carbon stocks in muddy benthic habitats has been suggested as a focus for OSPAR to be based on ongoing research efforts in several Contracting Parties (OSPAR 2023p). Muddy benthic habitats occur both in coastal areas and in deeper offshore areas, for example covered by the OSPAR Listed habitats 'Zostera beds' and 'Sea-pens and burrowing megafauna' respectively. Ocean-based measures tend to receive lower scores as potential interventions to address climate change than land-based measures and exhibit higher degrees of uncertainty (Alfthan, et al. 2023). A rapid assessment of potential mitigation measures (Alfthan, et al. 2023) could provide a starting point for further development work in OSPAR on mitigation measures in Arctic Waters.

The OSPAR mandate to address pressures from underwater noise could potentially include area-based measures to steer human activities away from high-risk areas. For human activities for which management measures are outside the OSPAR mandate, such as shipping and fisheries, the action by OSPAR could include bringing the high-risk areas to the attention of other competent authorities such as IMO and NEAFC respectively.

The management response to non-indigenous species in the marine environment focus on preventing introductions, for example through the IMO International Convention for the Control and management of Ship' Ballast Water and Sediments (BMW Convention). But in some cases, more is needed to reduce impacts from secondary spread. Pink salmon is not sufficiently managed and the spread is currently rapid. Pink salmon could be a potential source for food security, but regulation does not allow to target the species at sea which is when it is most suitable as a food source. In this case the managing the spread could possibly be addressed through fisheries measures which are not within the OSPAR mandate.

Hazardous substance emissions appear to be effectively governed through global conventions such as Minamata Convention and Stockholm Convention. However, negotiations of the Stockholm Convention did not clarify how climate and pollutants interact or the cumulative effects where multiple stressors impact one receptor. Also, problems with biomagnification causing high concentrations of toxic substances in animals and

hunters at high trophic levels is an issue that will require a management response for a long time due to the persistence of the hazardous substances. Climate change may increase problems with biomagnification and high concentrations of hazardous substances in Arctic Waters. For example, polar bears may need to switch food source and fast for longer periods, or new shipping channels and melting ice could concentrate pollutants in the surface water. If the scale of this problem was better known, then an integrated management approach could attempt to limit pressures from other human activities on the animals at the highest trophic levels.

OSPAR could develop guidelines for measures on natural solutions to carbon storage that provide benefits to biodiversity and local communities in Arctic Waters.

OSPAR could explore if there is a sufficient evidence base on reducing underwater noise pressure on sensitive species and habitats in Arctic Waters using area-based measures to support future designations of such measures.

OSPAR could assess impacts of climate change on biomagnification of hazardous substances at the highest trophic levels in Arctic Waters, in order to inform an integrated management approach.

7.3 Conservation measures for Arctic Waters species and habitats

The OSPAR List of Threatened and/or Declining Species and Habitats ([Agreement 2006-08](#)) identifies features for which the OSPAR Commission commits to take priority action on conservation. The list identifies the OSPAR Region in which the feature is considered to be under threat and/or in decline and where action should be taken (Table 5). The list also notes if the feature occurs in Arctic Waters but is not considered to be threatened in the Region (Table 6). OSPAR has developed Recommendations for the listed features, setting out both national and collective management actions (OSPAR 2000). Implementation reporting every six years provides information on progress made nationally and collectively. The QSR 2023 status assessments of the features show that while many actions have been taken, ranging from establishment of protected areas to implementation of international and regional fisheries measures and mapping/monitoring and awareness raising actions, the status remains poor for the features in Arctic Waters (Table 5).

Table 5. OSPAR list of threatened and/or declining species and habitats features Listed as threatened and/or declining for Arctic Waters (Region 1) [[hyperlink to feature page for access to Recommendation and background documents](#)] If available, the QSR 2023 status assessment and a brief summary of the measure assessment is listed, empty cells indicate that no assessment has been made, whereas NA indicates that assessment conclusion was not applicable and ? that no conclusion was reached. .

| Feature | Brief measure assessment of management actions | Status |
|---|---|--------|
| <u>Lesser black-backed gull</u> (<i>Larus fuscus fuscus</i>) | National measures, monitoring activities | Poor |
| <u>Ivory gull</u> (<i>Pagophila eburnea</i>) | | |
| <u>Steller's eider</u> (<i>Polystripta stelleri</i>) | | |
| <u>Black-legged kittiwake</u> (<i>Rissa tridactyla</i>) | | |
| <u>Brünnich's guillemot/ Thick-billed murre</u> (<i>Uria lomvia</i>) | National measures establishing protected areas. Monitoring programmes and awareness raising and by-catch reporting projects. | Poor |
| <u>Leatherback turtle</u> (<i>Dermochelys coriacea</i>) | National protective legislation in place. Measures to identify high-risk by-catch areas being undertaken and guidance for handling in case of by-catch. | Poor |
| <u>Blue whale</u> (<i>Balaenoptera musculus</i>) | International and regional measures in place (IWC, IMO, NAMMCO). OSPAR measures not assessed. | Poor |
| <u>Bowhead whale</u> (<i>Balaena mysticetus</i>) | International and regional measures in place (IWC, IMO, NAMMCO). OSPAR measures not assessed. | Poor |
| <u>Northern right whale</u> (<i>Eubalaena glacialis</i>) | International and regional measures in place (IWC, IMO, NAMMCO). OSPAR measures not assessed. | Poor |
| <u>European eel</u> (<i>Anquilla anguilla</i>) | National management plans in place. Measures in place; fish passage facilities, removing obstacles to migration, restocking, increase traceability, reduce hazardous substances. International (CITES) measures in place. | Poor |
| <u>Leafscale gulper shark</u> (<i>Centrophorus squamosus</i>) | International (NEAFC) and regional (EU) fisheries measures in place. | NA |

| | | |
|--|---|------|
| <u>Portuguese dogfish</u> (<i>Centroscymnus coelolepis</i>) | International (NEAFC) and regional (EU) fisheries measures in place. | Poor |
| <u>Basking shark</u> (<i>Cetorhinus maximus</i>) | International (CITES, NEAFC), regional (EU), national measures in place to prohibit fishing. National measures to establish protected sites. | Poor |
| <u>Common skate</u> (<i>Dipturus batis</i>) | Regional (EU) fishing regulations in place. National measures establishing protected areas. | Poor |
| <u>Orange roughy</u> (<i>Haplostethus atlanticus</i>) | | |
| <u>Porbeagle</u> (<i>Lamna nasus</i>) | International (NEAFC, CITES), regional (EU) fisheries measures in place. OSPAR measures identified to be carried out in cooperation with ICES and ICCAT. | ? |
| <u>Sea lamprey</u> (<i>Petromyzon marinus</i>) | Monitoring activities undertaken. | Poor |
| <u>Thornback ray</u> (<i>Raja clavata</i>) | Regional (EU) fisheries measures. By-catch survival studies. | NA |
| <u>Atlantic salmon</u> (<i>Salmo salar</i>) | Measures in place; fish passage facilities, removing obstacles to migration, recovering or introducing spawning gravel, restoring other habitats. Research and awareness projects undertaken | Poor |
| <u>Spurdog</u> (<i>Squalus acanthias</i>) | International (NEAFC) and regional (EU) fisheries measures in place. | Poor |
| | | |
| <u>Coral gardens</u> | National measures in place establishing protected areas. Assessment lead to further protective measures. Mapping actions. Regional (EU) fishing regulations to move on if by-catch is detected and closure areas. | Poor |
| <u>Deep-sea sponge aggregations</u> | National measures establishing protected areas. Mapping activities. International (NEAFC) closure areas. | Poor |
| <u>Intertidal mudflats</u> | | |
| <u>Lophelia pertusa reefs</u> | International (NEAFC), regional (EU) and national measures in place on closures and protected areas. By-catch regulation in place. | Poor |
| <u>Modiolus modiolus beds</u> | | |
| <u>Seamounts</u> | National measures establishing protected areas. Monitoring and mapping activities, awareness raising projects. International (NEAFC) closures. | Poor |
| <u>Zostera beds</u> | National legislation, regulation of physical activities such as coastal construction, awareness raising projects. Assessments of management measures effects. Mapping activities. | Poor |

Table 6. Species and habitats that are included on the OSPAR list of threatened and/or declining species and habitats features for some other OSPAR Region, but noted as occurring within Arctic Waters (Region I).

| Species | Habitat |
|--|---|
| <u>Ocean quahog (<i>Arctica islandica</i>)</u> | <u>Carbonate mounds</u> |
| <u>Dog whelk (<i>Nucella lapillus</i>)</u> | <u>Kelp forest</u> |
| <u>Flat oyster (<i>Ostrea edulis</i>)</u> | <u>Maerl beds</u> |
| <u>Harbour porpoise (<i>Phocoena phocoena</i>)</u> | <u>Ocean ridges with hydrothermal vent fields</u> |
| <u>Cod (<i>Gadus morhua</i>)</u> | <u>Sabellaria spinulosa reefs</u> |
| | <u>Sea-pen and burrowing megafauna</u> |

The existing OSPAR measures have not yet been fully implemented. However, the OSPAR Commission has agreed to prioritise efforts on the measures anticipated to have the strongest positive impact on the marine environment, rather than simultaneously implement all agreed actions, by developing i.a. Regional Action Plan for Marine birds and a Regional Action Plan for Benthic shelf habitats. The actions are intended to protect the OSPAR Listed features, as well as other features of the marine environment more broadly. The ongoing efforts to finalise the Regional Action Plan for Marine Birds notes that actions have been taken by other organisations, and the intention is to build on existing work, find synergies and describe the actions where OSPAR as a regional actor adds most value. Examples of identified work by other organisations include i.a. Arctic Council Conservation of Arctic Flora and Fauna (CAFF) ‘International Ivory Gull Conservation Strategy and Action Plan’, ‘Eider conservation strategy and action plan’, ‘International Murre conservation strategy and action plan’ and ‘International Black-legged Kittiwake Conservation Strategy and Action Plan’ as well as the ‘Arctic Migratory Birds Initiative’ (ABMI); The Nordic Action Plan for Seabirds; African-Eurasian Migratory Waterbird Agreement (AEWA) Resolution 7.6 Priorities for the conservation of seabirds in the African-

Eurasian Flyways and their Single Species Action Plans for e.g. common eider. The work on bird conservation by CAFF is informed by the long-standing Circumpolar Biodiversity Monitoring Programme (CBMP), and to implement the recommendations agreed by Arctic Council Ministers they have identified actions to address stressors on sea birds such as investigating impacts of shipping and offshore developments on seabirds and assessing incidental take of seabirds in commercial fisheries in the Arctic (CAFF 2015a).

The OSPAR QSR 2023 assessments showed that benthic habitats on the shelf have been severely impacted by human activities and focussed protection action is needed through a Regional Action Plan for Shelf benthic habitats. Deep-sea habitat data collection is difficult and expensive, and knowledge is incomplete. The OSPAR Listed habitat 'Seapens and burrowing megafauna' is characterised by species, such as *Funciculina quadrangularis*, *Virgularia mirabilis*, *Pennatula phosphorea* and *Kophobelemnion stelliferum*, and the habitat occurs at depths shallower than 700 m. Seapen habitats formed by the species *Umbellula* spp. and *Anthoptilum* spp. Occur deeper than 700 meters and in colder waters (Burgos, et al. 2020) and building on the findings from the Nordic Council of Ministers work (Buhl-Mortensen, et al. 2023), OSPAR could consider if a deep-sea seapen habitats should be described as a separate habitat type on the OSPAR List of threatened and/or declining species and habitats.

Table 7. Features proposed to be consider for inclusion on the OSPAR List of threatened and/or declining species and habitats.

| Feature | Comment |
|-------------------------------------|---|
| Narwhal | Threatened with local extirpation |
| Beluga whale | Threatened, possibly increasing |
| Kelp forest | In northern Norway kelp forests are possibly coming back in some areas |
| Sea ice and dependent species | Protecting the sea ice habitats requires regulations that follow the dynamic habitat in a temporally and spatially flexible approach. Shipping activities in areas with sea ice retreat should be a focus to mitigate pressures. |
| Polynyas | Important biodiversity areas both over shelf- and deep-waters, upwelling areas that are feeding locations for many species. Mining interests close to polynyas are a future threat. |
| Migratory pathways | Migratory pathways are essential for the survival of species. Climate change could result in food-web changes that causes a shift in migratory pathways, for example if Arctic copepods are no longer a nutritious food-source the migration of whales in pursuit of this food-source could become disrupted. |
| Ocean ridges and hydrothermal vents | |

Additional features could be added to the OSPAR List of threatened and/or declining species and habitats, such as the list of suggested features in Table 7. If features were included on the basis of an anticipatory and precautionary approach, the listing process could for example consider actions to protect climate refugia, either as a listed habitat or that climate refugia of the listed species are protected. A climate refugia approach to conservation measures would possibly require taking areas beyond the OSPAR Maritime Area into consideration.

Protection of single species in isolation is considered less effective than the protection of groups of species or protection of networks of habitats or ecological processes. Protection of migration corridors, which in Arctic Waters could for example be represented by the dynamic sea ice edge, could protect several species utilising the same area. Cooperation with the Convention on the Conservation of Migratory Species and Wild Animals (CMS) could be useful in developing a regional concept for protection of migration corridors. Given the high intensity of human activities in coastal areas that are also areas of high biodiversity, it could be relevant to give special consideration to protecting wider coastal water seascapes.

OSPAR could consider listing narwhal, Beluga whale, kelp forest, sea ice and dependent species, polynyas, migratory pathways and ocean ridges and hydrothermal vents as threatened and/or declining features for Arctic Waters.

OSPAR could consider cooperation with the Convention on the Conservation of Migratory Species and Wild Animals (CMS), in order to develop a regional concept for protection of migration corridors in Arctic Waters.

7.4 Area based conservation measures that manage human activities

The target for protected area coverage and effectiveness of the network in delivering protection outcomes has been set out in the NEAES 2030 operational objective S5.O1 *“By 2030 OSPAR will further develop its network of marine protected areas (MPAs) and other effective area-based conservation measures (OECMs)⁶ to cover at least 30% of the OSPAR maritime area to ensure it is representative, ecologically coherent and effectively managed to achieve its conservation objectives”*. The objective is aligned with the CBD Global Biodiversity Framework (GBF) **Target 3** *“Ensure and enable that by 2030 at least 30 per cent of terrestrial and inland water areas, and of marine and coastal areas, especially areas of particular importance for biodiversity and ecosystem functions and services, are effectively conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories, where applicable, and integrated into wider landscapes, seascapes and the ocean, while ensuring that any sustainable use, where appropriate in such areas, is fully consistent with conservation outcomes, recognizing and respecting the rights of indigenous peoples and local communities, including over their traditional territories.”*.

The OSPAR QSR 2023 assessment found that the OSPAR network of Marine Protected Areas covered 10.8% of the OSPAR Maritime Area in 2021 (Figure 9), and the regional breakdown indicated that the coverage for Arctic Waters (Region I) was 2.9% (Hennicke, et al. 2021). There is no requirement for each Region to meet the coverage target. The functional target of ensuring that the OSPAR MPA network delivers conservation objectives has not yet been reached. Overall, the OSPAR MPA network is not yet considered to be ecologically coherent (i.e. sufficiently protective for specific species and habitats), and the management status does not show that a complete set of management information has been provided, and the effectiveness of the measures in delivering conservation objectives has not been assessed (Hennicke, et al. 2021).

The Arctic Council is conducting work to map the extended and MPAs OECMs as well as Arctic marine connectivity. For CAFF boundary definition of the Arctic, 5.24% of the marine area is protected (Barry, et al. 2023). The Arctic Council Ministers have agreed to advance the protection of large areas of ecologically important marine, terrestrial and freshwater habitats taking into account ecological resilience in a changing climate (CAFF 2015a).

Given the pace and scale of climate change impacts in the Arctic region, a range of measures will be needed to manage human activities (PAME 2021g). Dynamic place-based measures have been identified as needed in order to manage impacts from non-indigenous species or the survival of ice-dependent species under the rapidly changing conditions (PAME 2021g). Dynamic ocean management would be particularly relevant in Arctic Waters where the seasonally variable sea ice edge is an important feature. There is a need to explore how dynamic protection, which could include the use of OECMs, could be implemented. There would also be a need to clarify how dynamic protection would fit in with the overall ocean management framework, for example by tying it to adaptive management which is a principle applied in OSPAR. Dynamic management could increase the speed at which management measures would be taken in an adaptive management approach, for example by developing specific protocols linked to monitoring and assessment findings that would illicit a management response.

OSPAR could develop an approach for dynamic management of the North-East Atlantic linked to the principle of adaptive management.

⁶ the definition of OECMs will follow the definition agreed under the Convention on Biological Diversity.

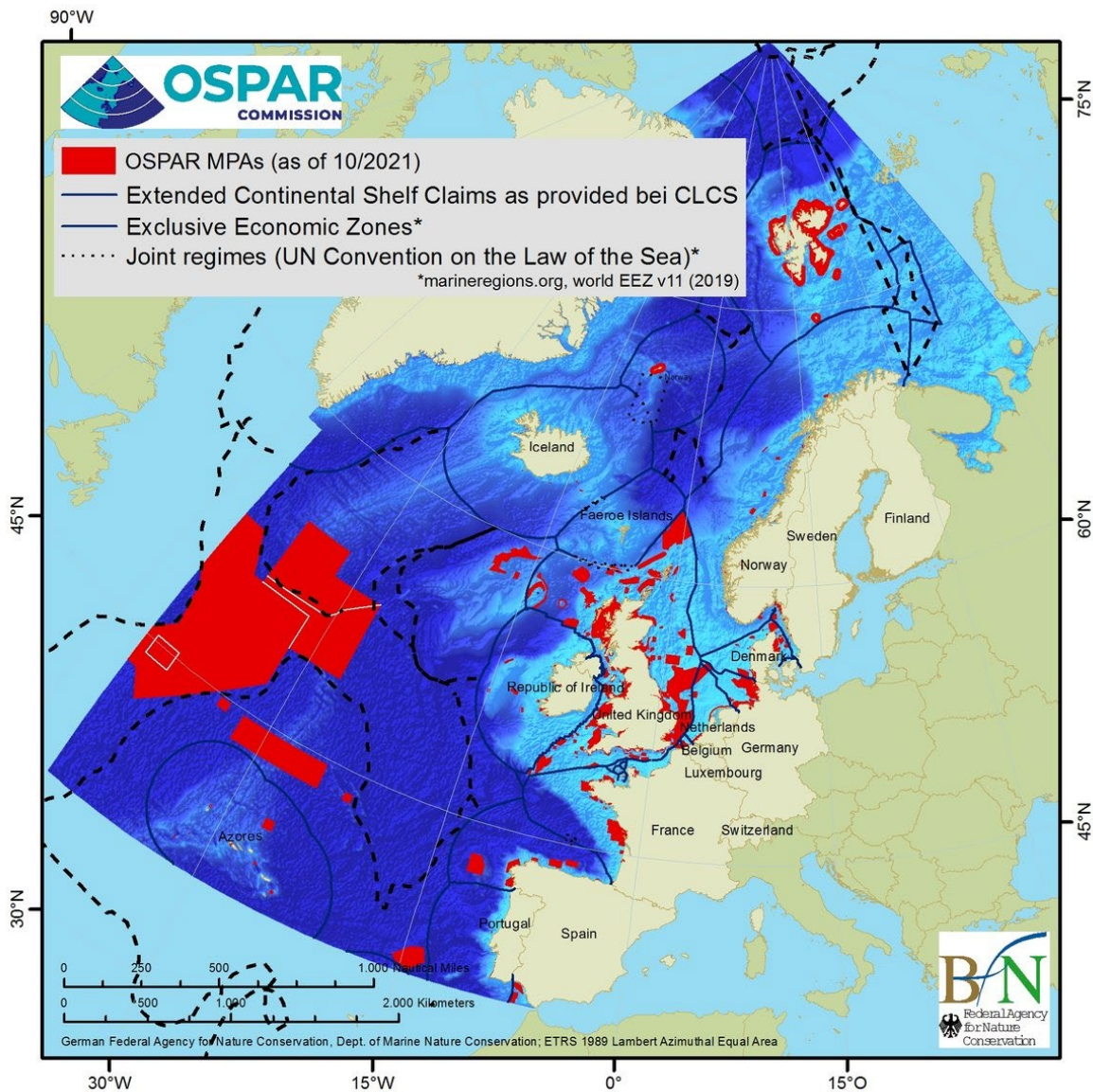


Figure 9. OSPAR network of Marine Protected Areas as of October 2021 (copied from (Hennicke, et al. 2021).).

7.4.1 Other effective area-based conservation measures

OSPAR has included other effective area-based conservation measures (OECMs) in its annual implementation reporting as a voluntary component since 2021. No OECMs have to date been reported for Arctic Waters. It should be noted that regional and commonly agreed guidelines are not yet in place and Contracting Parties are applying national approaches to this measure. OSPAR has agreed a Task under NEAES 2030 S5.O1. to develop OECM guidelines by 2025, with the intention of learning from work in other organisations. Through the Collective Arrangement (Agreement 2014-09) OSPAR and NEAFC have agreed to develop a joint narrative on OECMs, to describe how protective measures from different authorities can overlap and be complementary in areas beyond national jurisdiction.

The inclusion of OECMs in a network of spatial protection measures presents an opportunity to promote additional partnerships (PAME 2021g). Indigenous peoples and local community efforts linked to strengthening subsistence livelihoods or culture can strengthen and protect ecosystem functions, and these efforts could be considered through the OECM framework. These measures may, however, not fit with typical criteria for protected areas, and management activities and designation authorities might not be typical for protected areas (PAME 2017). While areas could qualify as OECMs, Indigenous Peoples have expressed the need to discuss these issues further so as not to mix their management approaches and OECMs. The UNESCO world heritage site Aasivissuit – Nipisat could be an interesting example of an Inuit hunting ground area that has been given a protection based on cultural criteria but that also protects landscape and ecological features.

PAME and CAFF has an ongoing OECM project which intends to develop a toolbox for voluntary guidelines for the Arctic. A report will be delivered in 2025.

OSPAR could explore collaboration with Arctic Council WGs PAME and CAFF in developing OECM guidance.

OSPAR could describe potential Arctic Water specificities related to OECMs, such as the seasonally dynamic sea ice feature.

OSPAR could invite Contracting Parties to report national OECMs to the OSPAR network.

7.4.2 Marine Protected Area

OSPAR Recommendation 2010/2 amending Recommendation 2003/3 on a network of Marine Protected Areas has the purpose of guiding the establishment of a network which is ecologically coherent and well managed. Contracting Parties nominate MPAs established under their jurisdiction to the network, and OSPAR collectively designates MPAs in areas beyond national jurisdiction. OSPAR has developed Guidelines for the identification and selection of Marine Protected areas in the OSPAR Maritime Area (Agreement 2003-17 (amended in 2016)). Appendix 1 of the guideline sets out criteria for the selection of a site;

A. Ecological criteria/considerations

1. Threatened or declining species and habitats/biotopes
2. Important species and habitats/biotopes
3. Ecological significance
4. High natural biological diversity
5. Representativity
6. Sensitivity
7. Naturalness

B. Practical criteria/considerations

1. Size
2. Potential for restoration
3. Degree of acceptance
4. Potential for success of management measures
5. Potential damage to the area by human activities
6. Scientific value.

When OSPAR collectively decides to designate Marine Protected Areas in areas beyond national jurisdiction, a technical nomination proforma is prepared to collect the evidence base against the above-mentioned criteria. The nomination proforma eventually becomes published as a Background Document which provides information to support the implementation of management measures and actions, as defined in an OSPAR Recommendation.

BOX 7: Designating and managing MPAs in areas beyond national jurisdiction (ABNJ)

The adoption of the Agreement under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ Agreement) in June 2023 created a global legal framework to conserve and sustainably use biodiversity in ABNJ. The agreement explicitly states that the new mechanism shall not undermine the competencies of existing organisations.

The OSPAR Regulatory Regime for establishing Marine Protected Areas (MPAs) in Areas Beyond National Jurisdiction (ABNJ) of the OSPAR Maritime Area sets out the competency of the OSPAR Commission as a legal entity to collectively designate MPAs in the OSPAR Convention Maritime Area beyond national jurisdiction. OSPAR has developed guidance on General consultation procedures for establishing Marine Protected Areas in Areas Beyond National Jurisdiction of the OSPAR Maritime Area (Agreement 2019-09) which describes how OSPAR openly and inclusively engages with other competent authorities and stakeholders in developing the nomination proforma description of how a site meets the designation criteria and developing the conservation objectives of the site. The collective designation of an MPA is done through a OSPAR Decision which is legally binding on the Contracting Parties to the OSPAR Convention. The management actions that Contracting Parties will take in the MPA are set out in a OSPAR Recommendation which includes national actions and collective actions. This include i.a. actions to engage with competent authorities regulating human activities occurring at the site which may impact the conservation objectives by bringing information to the other organisations attention.

The collective arrangement (OSPAR Agreement 2014-09) has been set up as a multilateral forum for considering and exchanging on topics related to MPA management in the area beyond national jurisdiction. To date the Agreement has been adopted by OSPAR and the North Atlantic Fisheries Commission (NEAFC). Through this mechanism NEAFC has decided to adopt complementary management measures to the OSPAR MPAs, putting in place fisheries restrictions across much of the MPA sites. Through the mechanism, another organisation could also bring the need for an MPA to be established to OSPARs attention for OSPAR to consider and act upon. The agreement remains open for other authorities with competencies in the area beyond national jurisdiction and could serve as a mechanism for putting in place additional complementary management measures at the MPA sites, for example related to shipping or extractive industries.

This North-East Atlantic regional ocean governance framework recognises the competencies of all competent authorities and allows for effective protection of marine biodiversity through collaboration.

The OSPAR QSR 2023 ecocoherence assessment found significant remaining gaps in the proximity analysis of MPAs in Arctic Waters (Figure 10) with no MPA coverage in the Dinter regions North-East Greenland Shelf, North-East Water Polyna, Barents Sea: White Sea and Norwegian coast: Finnmark (Hennicke, et al. 2021). Eco coherence of the OSPAR MPA network is also measured as replication (i.e. more than one MPA protecting a feature) for features on the OSPAR List of threatened and/or declining species and habitats (Agreement 2008-06) in Arctic Waters, the MPA network has replication for the following OSPAR Listed species and habitats: lesser black-backed gull, Ivory gull, Steller's eider, black-legged kittiwake, thick billed murre, bowhead whale, Atlantic salmon, coral gardens, intertidal mudflats and *Lophelia pertusa* reefs (Hennicke, et al. 2021). The network has no replication for Leatherback turtle, blue whale, Northern right whale, European eel, leafscale gulper shark, Portuguese dogfish, Basking shark, common skate, porbeagle, sea lamprey, thornback, spurdog, deep-sea sponge aggregations, *Modiolus modiolus* beds, seamounts and *Zostera* beds (Hennicke, et al. 2021).

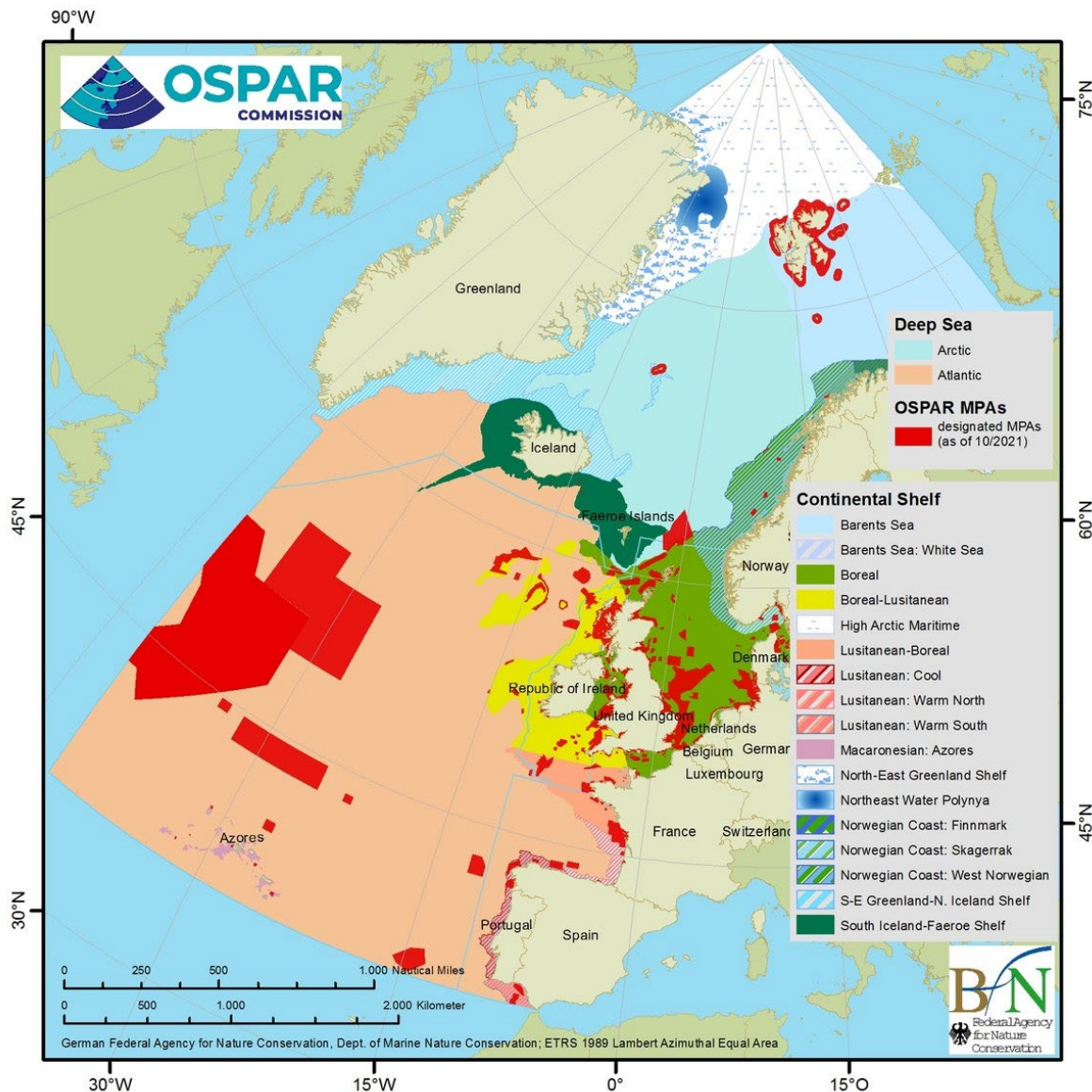


Figure 10. OSPAR network of Marine Protected Areas coverage of the Dinter regions (copied from (Hennicke, et al. 2021)).

The Arctic Council MPA toolbox includes documentation on how connectivity could be considered for species with planktonic life-history phases and species that are active swimmers and flyers, for similar criteria as those used in OSPAR, however additional considerations include ice-obligate species movements between important habitat nodes and whether the species requires ice along its migratory route or whether it can cross open ocean (PAME 2017). Connectivity modelling carried out for over 40 000 locations in the Arctic region used invertebrate and fish pelagic larval duration as a measure, and found that the geographic location and distance had the strongest effect on duration, while the impact of depth was smaller (PAME 2021a). MPAs can function as sources and sinks in a network of dispersing larvae, and importantly a sufficiently large MPA can also allow for self-recruitment of larvae from the species protected within the boundary of the MPA (PAME 2021a). The shelf areas are subdivided by dispersal barriers which in turn are dependent on the traits of the dispersing larvae, while coastal areas tend to be too complex for dispersal models to be accurately applied (PAME 2021a).

The Arctic Council has documented MPAs in the Arctic region, using the IUCN criteria to describe the management regime Greenland (Figure 11) (PAME 2021g). Some of these MPAs are also included in the OSPAR MPA network, for example areas around Svalbard. Areas under national protective management, that have not been nominated to the OSPAR MPA network, provide biodiversity benefits which could be

considered in future OSPAR assessments if the information was made available to OSPAR by Contracting Parties. An example could be national parks in the north-eastern part of Greenland (Figure 11) (PAME 2021g).

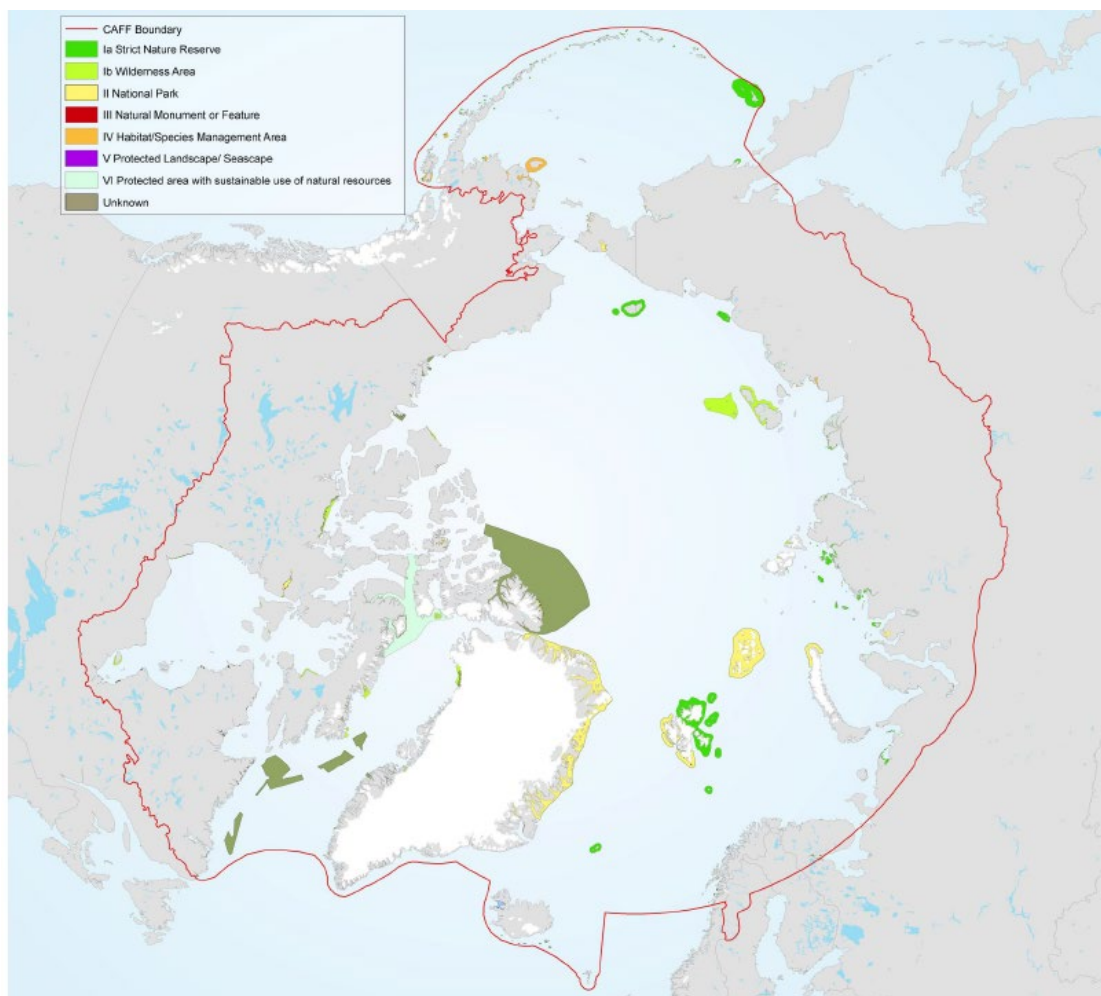


Figure 11. Marine Protected Areas of different protection categories under the Arctic Council. (copied from (PAME 2021g))

Dynamic MPAs have been called for in the Arctic to protect ecologically important areas that move over time, or to protect certain features during a particular season, recognising the changing ecosystem and the need to manage an environment experiencing strong climate change impacts (PAME 2015a). In the light of climate change and ocean acidification, a paradigm shift has also been called for in the establishment of MPAs to one where MPAs are established to protect what is valued and cherished before it is harmed, rather than establishing MPA once a specific local threat has been identified (Swedish Agency for Marine and Water Management 2017). Arctic MPAs should be established in areas that are expected to become refugia and to ensure cumulative effects from all human activities are actively managed at the sites (Swedish Agency for Marine and Water Management 2017). Such refugia could be the sea ice north of Greenland, where summer sea-ice is projected to be the most long-lasting (Swedish Agency for Marine and Water Management 2017). Scattered scientific information about geophysical and biological processes need to be collated and made spatially explicit wherever possible, to support MPA network design and decision making (Swedish Agency for Marine and Water Management 2017). In order for MPAs to function as climate refugia, connectivity between areas and the overall function of the MPAs as a network needs to be taken into account. There would be network links to more temperate OSPAR Maritime Area Regions, as well as links further into the Arctic region than the OSPAR Arctic Waters Region. WWF has developed ArcNet (see BOX 8) which includes a spatial database of conservation features as a basis for a systematic approach to designing an MPA network.

BOX 8: WWF ArcNet

WWF has identified an Arctic Ocean network for Marine Conservation (ArcNet) that prioritises marine life and the important functions and value of the Regions unique ecosystems (WWF 2021). The first aim of ArcNet is to identify an ecologically representative and well-connected Arctic network of priority areas for

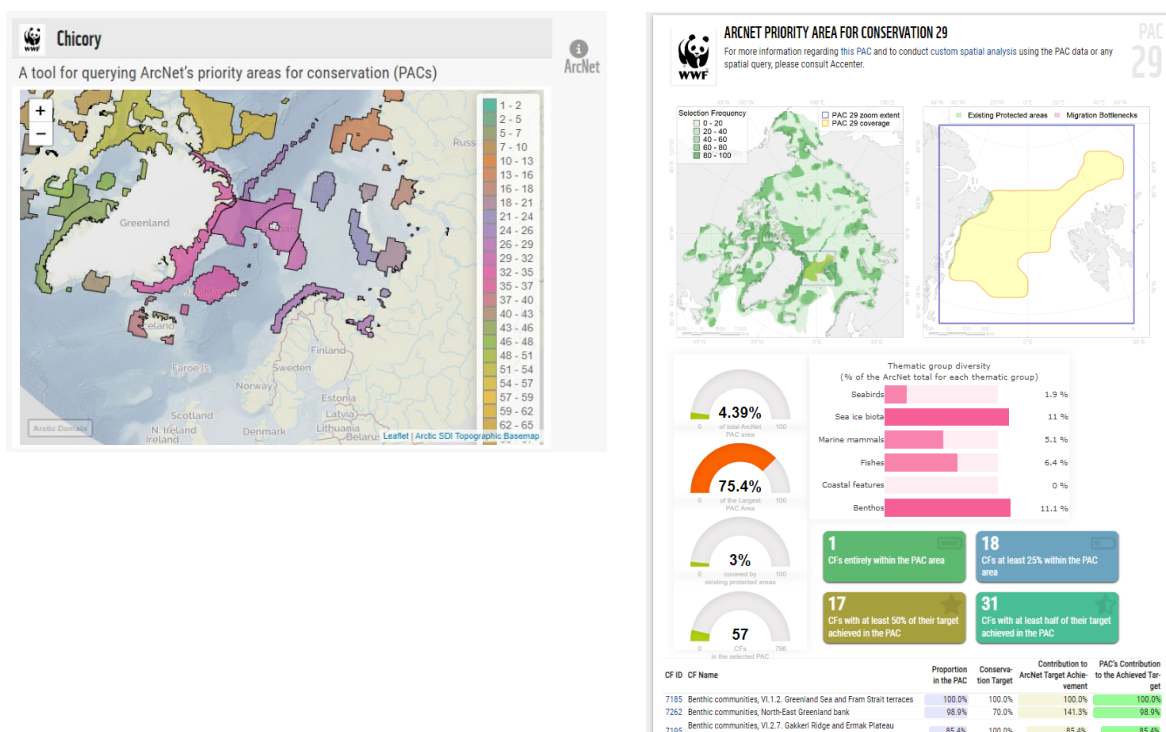
conservation (PACs), and the second aim is to make sure the resources and outputs are used to help design, implement and manage a conservation network in the Arctic Ocean. ArcNet identifies priority areas for conservation and migration bottlenecks, with an aim to support the establishment of a whole-ocean MPA network, to support the resilience of interrelated ecosystems (WWF 2021). MPAs are seen as the core tool to be put in place, however OECMs are suggested as expanding the toolbox to achieve management of human activities and protection of the marine environment (WWF 2021).

ArcNet has been identified using systematic conservation planning applying expert solicitation supported by the Marxan software, which identifies multiple spatial solutions to achieve predefined conservation goals. The ArcNet Technical Report (Solovyev and Platonov 2021) documents how the areas for conservation were identified and gives an overview of the analysis and steps taken, with documentation available in Google drive the report is provided upon request. ArcNet was designed on the principles and criteria of the Arctic Council MPA framework (PAME 2015) (cf ArcNet Guide page 9, and ArcNet Tech report section 1.3)

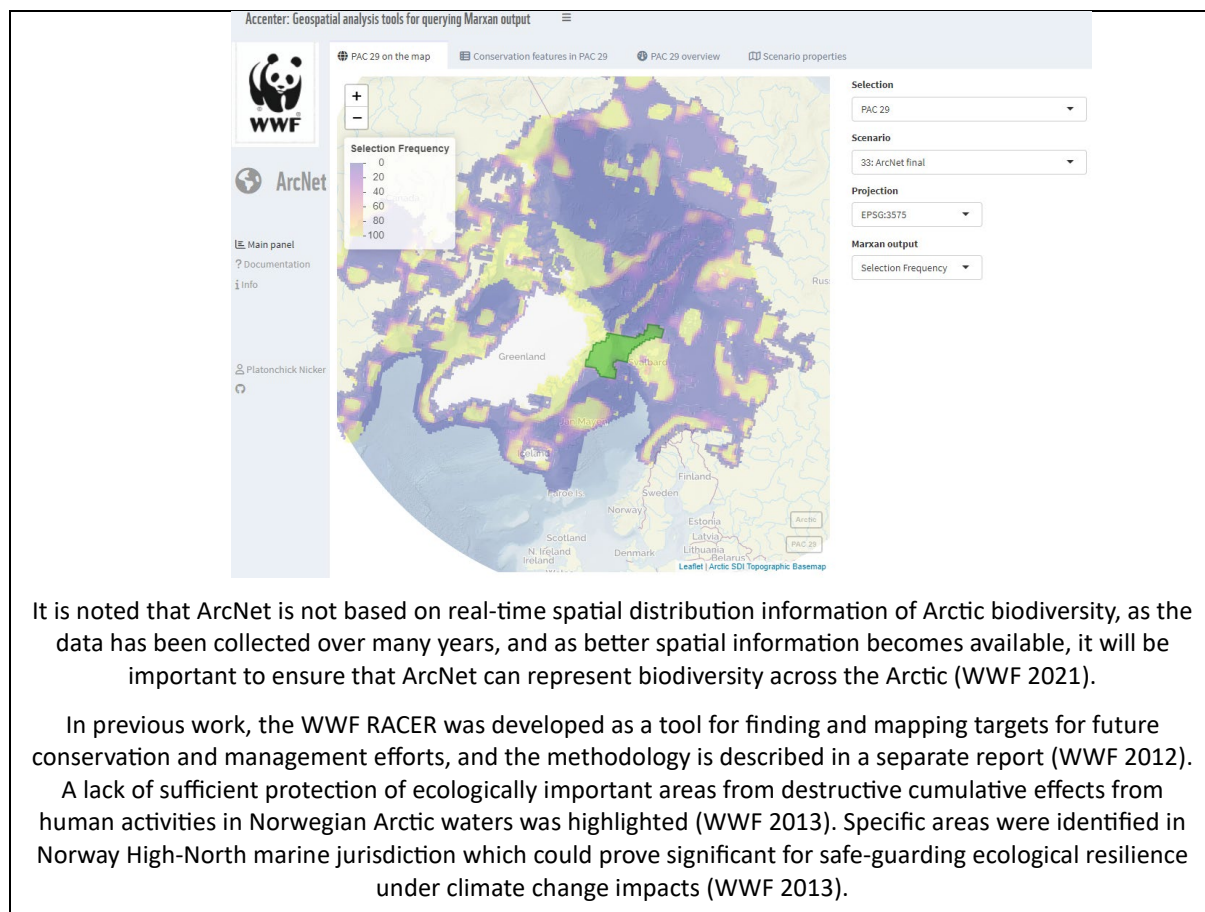
WWF have developed web-portals that present area specific information and present and facilitate access to the spatial data that were used for the ArcNet analyses:

Area specific information – <https://wwf-arctic-programme.github.io/chicory/navigation.html>

When selecting an area, for example PAC 29, the portal provides access to a site specific data sheet



Spatial data – <https://wwfarcticprogramme.shinyapps.io/accenter/>



OSPAR has the competency to collectively designate MPAs in areas beyond national jurisdiction within the OSPAR Maritime Area. In 2016 the OSPAR Biodiversity Committee considered a draft nomination proforma prepared for the Arctic Ice High Seas Marine Protected Area (OSPAR BDC 2016). The OSPAR Commission considered the draft nomination proforma in 2016 and communicated this development to the Arctic Council. The draft nomination proforma information was available to the AOWG process as a resource. The draft nomination proforma outlines the aim of the proposed designation to be the creation of a measure to protect Arctic sea ice against additional impacts resulting from human activities to strengthen the resilience and capacities of these ecosystems and the biological diversity they contain, so as to better adapt to the effects of climate change. The draft nomination proforma describes hydrological and geological conditions as well as sea ice conditions and the biological communities of the area. The proposed MPA boundary sits within a wider area that was later described by the CBD as an Ecologically and Biologically Significant Area (see ANNEX 4: Recognising and building on work by the Arctic Council, other organisations and Multilateral Environmental Agreements). The proposed high seas sea-ice MPA borders the 2019 interim designation of Canada's Tuvaijuittuq MPA (see dark green 'unknown' status area in Figure 11). This designation was made to protect some of the oldest and thickest sea ice in the Arctic and recognising future threats to the habitat for example from ice breaking if shipping intensities increase (PAME 2021g).

If OSPAR would progress the establishment of an MPA in areas beyond national jurisdiction in the Arctic Waters under the Arctic Roadmap, the process would require substantive discussions to co-create the knowledgebase and take into account the needs and interests of all stakeholders in order to move forward through consensus. Engagement with indigenous communities is an important component of Arctic MPA work, as is cooperation with and through relevant competent authorities (PAME 2015a). It could be relevant to describe how the provisions for Indigenous Peoples engagement in recently adopted BBNJ Agreement would be taken into account in such a process.

A well-designed network of MPAs can improve regulatory predictability, which in turn can inform sustainable business plans, since it allows for the actors to take the ecologically and culturally sensitive areas into account, to mitigate adverse effects at an early stage of planning (PAME 2015a). It is important to facilitate collaborative social interactions among various involved stakeholders and actors to ensure the measures are

well aligned to the social system in the area where new MPAs are established (Alexander, Armitage, et al. 2017). Clarity on the process by which important areas are identified and considered for spatial protection is important in this regard. The CAFF/PAME framework of Large Marine Ecosystems with area specific prioritised indicators and features could be useful, as could an update of the information on Arctic EBSA as a baseline for a systematic approach to further develop the OSPAR MPA network.

OSPAR could further develop guidance on how to use the climate refugia and connectivity concepts as a basis for future proofing the OSPAR MPA network.

OSPAR could discuss how engagement with Indigenous Peoples, connectivity aspects, and protection of features for which the MPA network is not yet deemed sufficient, could be taken into account in future national MPA designations or updates of management plans and objectives for existing MPAs.

OSPAR could invite Contracting Parties to nominate national protected areas to the OSPAR MPA network.

OSPAR could describe the process for identifying priority sites to be considered for collective MPA designation in areas beyond national jurisdiction in Arctic Waters.

OSPAR could describe how to take the provisions for Indigenous Peoples in the BBNJ Agreement into account in a collective identification and/or designation process for an MPA in areas beyond national jurisdiction in Arctic Waters.

OSPAR could collectively designate MPAs in areas beyond national jurisdiction in Arctic Waters, building on previous proposals and information.

8. Options for action

There are many options for future action that OSPAR could take in Arctic Waters based on the evidence in this report. This section provides a summary of options for action that have been identified throughout the report. The tables are present options in no order of priority and without advocacy. The list is not a comprehensive set of all the possible actions and measures that OSPAR could take, nor does it indicate that OSPAR would implement any of these identified options.

Further considerations in OSPAR will identify the actions and measures to be taken forward and how to best organise the work under the priorities of the OSPAR North-East Atlantic Environment Strategy 2030. In this consideration, OSPAR could also refer to Arctic Council priorities set out for example in the Arctic Biodiversity Assessment (ABA) recommendations. After a first screening of the priorities for future work against the identified options, a first step in a future process would be to describe an OSPAR Task which would include scoping out progress made on the topic in any other organisation and a timeline for progressing work.

OSPAR aims to collaborate with other organisations and avoid double work. Two organisations can work productively on the same subject matter through coordination by making best use of the complementary of competences and knowledge to successfully and synergistically complete an action. Progress could be made simultaneously and in parallel on several actions, and different actions could often be taken forward by different groups of people supported by resources from different sources.

Some general notions related to options for action in OSPAR Arctic Waters:

- When OSPAR began work in the 1970s there was a focus on the Greater North Sea due to regional issues with industrial pollution. Climate change could now create a comparable need for a regional shift of attention to Arctic Waters.
- Arctic Waters should be treated as any other OSPAR Region. Measures and actions that have been successful in other Regions should also be effective in Arctic Waters if fully implemented. The OSPAR experience from more heavily trafficked and industrialized regions could be useful in an Arctic Waters context, for example if wind-energy development becomes more intense. There is a need to be vigilant and get ahead of the impacts by ensuring adequate and up-to-date regulations of activities and activity levels, in particular since higher activity intensities are expected in the future in Arctic Waters.
- Arctic Water specificities could include issues around Indigenous Peoples engagement, protecting sea ice or managing deposition of coastal mine tailings at sea. There is a need to consider which questions are being asked and how, to ensure that communication happens in a respectful and effective way and that focus remains on issues where OSPAR has a useful mandate to act.
- OSPAR should make use of Indigenous Knowledge, and Indigenous Knowledge holders should make use of OSPAR as an authority that can progress protection and sustainable use. OSPAR would need to learn how to best engage with Indigenous Peoples, which would include asking how they would like to be engaged. OSPAR could have a role in coordinating regional implementation of the CBD GBF which has committed to the inclusion of Indigenous Peoples.
- Political will needs to be galvanized on Arctic Waters action. Implementing actions can be a slow process. Therefore the AOWG ought to be a long-term undertaking and not terminate at the end of the OSPAR Arctic Roadmap in 2025.

The options for action are loosely organised based on type. The first table in section 8.1 includes actions associated with ocean governance or actions OSPAR could take through its relationship with other organisations. The second table in section 8.3 lists suggestions for measures that OSPAR could take action on developing. The third table in section 8.3 includes actions linked to strengthening the overall knowledgebase through assessment, monitoring and data processing. The group has been done with the intention of facilitating considerations of the options in a next step in OSPAR.

If a reader wishes to explore options for action per substance topic, they may refer to the main chapter text where the actions are highlighted as blue **OSPAR could...** sections. Here the reader can also find the information describing a gap or an issue that the action could address. The tables include suggestions for next steps on the actions.

8.2 Options for action on ocean governance and institutional collaboration

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
|--|---|
| Arctic Council cooperation | |
| ...invite Arctic Council Working Groups that are not yet OSPAR Observers to apply for Observer status to facilitate future cooperation. | Invite OSPAR Heads of Delegation to discuss the proposal of an invitation. |
| ... take an active role, through its Contracting Parties, as Observer to the Arctic Council and its relevant Working Groups. | <p>Invite, in particular those Contracting Parties that are party to both organisations, to link up ongoing activities and represent information at respective working group meetings, as well as linking up national experts contributing work to the organisations to make best use of synergies.</p> <p>Strategically identify those actions where Secretariat representation would be most expedient.</p> |
| ...carry out a comprehensive review of Arctic Council strategic objectives to identify shared priorities and synergies in ongoing work, by inviting Arctic Council Working Groups to share a list of priority recommendations for consideration | <p>Invite the Arctic Council to provide a consolidated list of all their agreed actions on topics of shared interest.</p> <p>Invite PAME, CAFF, AMAP (and other WGs as relevant) to submit a list of their priority recommendations to OSPAR Committees to identify if the OSPAR mandate could be used to progress implementation.</p> <p>Describe the mechanisms for interacting when proposing;</p> <ul style="list-style-type: none"> • an information gathering collaboration • joint measure development work • coordinated engagement with third party competent authorities |
| ... map out priorities and planned work against Arctic Council recommendations to identify opportunities where the OSPAR mandate could support their synergistic implementation. | <p>Map out existing OSPAR Tasks against the list to identify synergies of ongoing work and against OSPAR objectives to identify future opportunities for collaboration.</p> <p>Invite Contracting Parties to present QSR 2023 assessments and underlying data to PAME, CAFF, AMAP to ensure synergies and avoid double work.</p> <p>Draft a list of synergistic tasks to be taken forward in</p> <ol style="list-style-type: none"> 1. the short-term |

| Option for OSPAR action “OSPAR could...” | Ideas for next steps on the action |
|--|---|
| | 2. the long-term |
| ... explore if the OSPAR mandate could be used to progress priorities and recommendations of the Arctic Council. | Invite AOWG to describe, in theory, in what instances Contracting Parties could progress implementation of Arctic Council recommendations using the OSPAR mandate. Based on the previous mapping action of ongoing work and priorities, list practical examples that could be further considered. |
| Indigenous People engagement | |
| ...explore Indigenous Peoples participation in the work of the Commission, for example through national delegations, by inviting organisations representing the relevant Indigenous Peoples to become Observers, or through other means. | Invite OSPAR Heads of Delegation to discuss the most appropriate solution to ensure sufficient representation in a way that enables timely engagement. |
| ...develop regional guidelines for consultation and engagement with Indigenous Peoples, and explore different ways of ensuring that future engagement of Indigenous Peoples is appropriately resourced, noting that capacity issues can be helped through funding but this may not be sufficient. | Invite AOWG to draft a proposal by reviewing regional best practice guidelines as well as national examples of how engagement has been conducted. Co-create the guidelines with Indigenous Peoples organisations. |
| ... identify the main areas of work of interest for Indigenous Peoples as an important step to ensure that engagement is relevant and reflects local needs, which may differ from focus areas of international negotiations. | Invite AOWG to consider |
| ... co-create a narrative with Indigenous Peoples on how marine environment protection actions to increase ecosystem resilience can improve the livelihoods of Indigenous Peoples. | Invite AOWG, BDC and Indigenous Peoples organisations to discuss how OSPAR protective measures could contribute to food-security. Draft a narrative text that would provide context for OSPAR measures, such as area based conservation measures. |
| ... explore OSPARs role as a regional legal entity in supporting the implementation of the BBNJ Agreement within the Arctic Waters, taking into account the rights and needs of Indigenous Peoples. | Invite OSPAR Heads of Delegation to discuss the role OSPAR should take. |
| ... describe how to take the provisions for Indigenous Peoples in the BBNJ Agreement into account in a collective identification and/or designation process for an MPA in areas beyond national jurisdiction in Arctic Waters. | Invite AOWG and Indigenous Peoples organisations to draft a proposal for how an OSPAR process in developing measures for the area beyond national jurisdiction would engage and consult Indigenous Peoples in light of the BBNJ Agreement. |
| Engagement and coordination with other organisations | |
| ...explore OSPARs unique mandate to convene and coordinate actors in Arctic Waters through an instrument such as the Collective Arrangement. | Invite OSPAR Heads of Delegation to discuss whether the Collective Arrangement could be a model for engagement with other competent authorities on Arctic Waters issues. Could for example be done from the regional perspective to implementing BBNJ Agreement. |

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
|---|--|
| ... explore linkages with the Arctic Economic Council to progress economic and social analysis for human activities of shared interests. | Invite the AEC to provide a business perspective to OSPAR ICG-ESA work on human activities of shared interest/focus, such as energy generation (oil, gas and renewables), tourism and the blue economy. The organisation could perhaps qualify for OSPAR Observer status. |
| ... consider bringing marine environment impact information to the attention of militaries with a view of mitigating negative impacts, for example related to underwater noise or at locations with sensitive ecosystems. | Invite OSPAR Heads of Delegation to discuss whether to engage with military activities. Invite the Executive Secretary to communicate with regional military organisations on environmental protection and impact issues. |
| ... explore if it could have a coordination and facilitation role for research activities in Arctic Waters by all its Contracting Parties, including by non-Arctic states. | <p>Invite CoG to support Arctic Council monitoring efforts by focusing in particular on bringing forward information on monitoring activities and one-off surveys and studies carried out by non-Arctic OSPAR Contracting Parties. Establish OSPAR process for non-Arctic CPs to feed into AC PAME/CAFF/AMAP action, e.g. to inform CBMP when CPs might visit their stations</p> <p>Support the Parties to CAOFA in developing understanding of CAO marine environment. Invite OSPAR CPs that are also CAOFA parties (NO, EU) to e.g. bring across OSPAR scientific information of relevance, share experiences of Collective Arrangement approach and work on ecosystem based management.</p> <p>Noting the PAME project "Synthesis Report on Ecosystem Status, Human Impact and Management Measures in the Central Arctic Ocean (CAO)"</p> |
| ... consider cooperation with the Convention on the Conservation of Migratory Species and Wild Animals (CMS), in order to develop a regional concept for protection of migration corridors in Arctic Waters. | Invite Contracting Parties that would participate in the CMS CoP in February 2024 in Uzbekistan to explore options for raising Arctic migration corridors as a topic of future collaboration. |
| ... explore its potential role as a convenor to bring Arctic Waters environmental information to the attention of IMO, in collaboration with Arctic Council WGs PAME and EPPR, with a view to expand the set of environmental measures under Part II of the Polar Code, such as quiet ship technologies and mitigating the risk of marine mammal ship strikes. | Invite Heads of Delegation if OSPAR would have a role by bringing together knowledge in particular also from the Bonn Agreement and using the MoU with IMO as a vehicle for further dialogue. |
| OSPAR management approaches improvement and development | |
| ... explore how the speed at which regional management actions can be taken could best support global ocean governance management actions that may take longer to implement, and how to progress management and action in light of the uncertainty of impacts and fast pace of change. | <p>Introduce a consideration/criterion for when developing new measures that environmental benefits and costs/impacts do not become spatially de-coupled.</p> <p>Hold a dialogue with OSPAR Observers on how state and sub-state actors could communicate and collaborate on policy development and implementation for the marine environment</p> |
| ... develop an approach to categorise the timeline of ecosystem change due to climate change pressures, to inform implementation of the ecosystem approach | Invite WG COCOA to propose categories for the pace of environmental change, and categories for the anticipated speed/slowness of implementing a response |

| Option for OSPAR action “OSPAR could...” | Ideas for next steps on the action |
|--|--|
| ... work to identify any steps in the management response process that could be speeded up, to allow for a timely response to a changing Arctic Waters marine environment. | <p>Explore if overview assessments of implementation reporting on Recommendations could be used more directly by the OSPAR Commission to review and revise management instruments to speed up possible revisions, for example the area extent of measures protecting a mobile species</p> <p>Explore if there could be a new type of instrument through which signals from research could reach management implementation faster.</p> <p>Include such aims or criteria in the OSPAR Science Needs Agenda</p> |
| ... develop an approach for dynamic management of the North-East Atlantic linked to the principle of adaptive management. | <p>Discuss whether expanding the area coverage of existing measures, or more temporal flexibility in applying measures or some complementary new type of instrument is the best approach.</p> <p>Invite BDC to create a task group for drafting a background document on dynamic management</p> |
| ... discuss how engagement with indigenous communities, connectivity aspects, and protection of features for which the MPA network is not yet deemed sufficient could be taken into account in future national MPA nominations to the network. | Invite BDC and ICG-MPA to discuss the issues and review whether any further guidance needs to be developed for the nomination of MPAs to the OSPAR network, including identifying any need for revising Recommendation 2010/2. |
| OSPAR Convention | |
| ... seek to clarify the legal relationship between bioprospecting and Annex 5 of the OSPAR Convention. | Invite JL to draft legal advice. |

8.2 Options for action on developing and adopting OSPAR measures

| Option for OSPAR action “OSPAR could...” | Ideas for next steps on the action |
|--|--|
| Human activities | |
| ... consider the need to develop a code of conduct for bioprospecting activities, in particular if activities are carried out jointly with scientific research activities which could warrant, for example, developing an Annex to OSPAR Agreement 2008-1 on the code of conduct for deep-sea and high seas scientific research. | Invite BDC to discuss the issue in light of potential JL legal advice on bioprospecting. |
| ... discuss whether a measure on benefit sharing from bioprospecting in Arctic Waters is needed, in particular clarifying how the BBNJ Agreement would support the Indigenous Peoples participation. | Invite Heads of Delegation to consider in light of potential JL legal advice on bioprospecting. |
| ... explore if environmental information on seabed morphology and habitat occurrence could be useful as a best practice knowledgebase, to minimise | Invite OIC and BDC to discuss whether for example the OSPAR database on threatened and/or declining habitats could be used as a test case. |

| Option “OSPAR could...” | for | OSPAR | action | Ideas for next steps on the action |
|--|-----|-------|--------|--|
| physical disturbance of sensitive habitats from exploration or transport activities of oil and gas. | | | | |
| ... consider additional measures to prevent introduction of hazardous- or radioactive substances and marine litter from offshore oil and gas activities in Arctic Waters. | | | | Invite OIC to explore whether particular Arctic Waters provisions could be relevant. |
| ... investigate whether there are lessons to be learned from cooperating with the Bonn Agreement on mitigating pollution impacts in the North Sea, which could be helpful for improving spill response guidelines in the Arctic, or whether any Arctic environment amendments would be needed in Recommendation 2010/18 on the prevention of significant acute oil pollution from offshore drilling activities. | | | | OSPAR/Bonn Secretariat to facilitate transfer of lessons learned. |
| ... explore, in collaboration with Arctic Council WG PAME, proposing designation of Arctic Waters, or the wider Arctic region, as a PSSA by IMO as a measure to control polluting emissions. | | | | Collate an evidence base on ship traffic physical impacts on sea ice and how such changes affect sea ice properties and impact sea ice habitats and ecosystems Contribute to the evidence base created in the Arctic Council on black carbon and methane emissions from ships and their impacts on sea ice |
| ... consider whether any special environmental considerations would be needed in relation to future port infrastructure developments , in applying a precautionary approach to ecosystem-based management. | | | | Invite EIHA to consider. |
| ... consider developing approaches for managing potential underwater noise impacts from shipping in a warming Arctic more broadly, for example by area based measures and bringing specific environmental information to the attention of the IMO. | | | | Invite EIHA and ICG-Noise to consider, with a particular focus on contributing to work and projects of relevance in PAME. |
| ... consider whether it would be relevant to explore the available information on marine mammal distribution to inform future identification of high-risk areas to avoid ship strikes , although this has not to date been identified as a major issue impacting the state of the populations. | | | | Update the knowledgebase for risk areas for ship strikes with cetaceans, and as a further step consider risk under future climate and population growth scenarios to build risk maps or recommended shipping corridors, building on IWC regulations and collaborating with CAFF, PAME and IUCN to identify important marine mammal areas |
| ... consider whether it would be appropriate to cooperate in the development of guidelines on sustainable tourism , to protect the marine environment. | | | | Identify ecosystem features sensitive to tourism impacts in Arctic Waters, especially for types of tourism that are predicted to increase. Build on e.g. AECO that have developed guidelines for cruises. Bring any agreed OSPAR measures to the attention of relevant stakeholders. |

| Option “OSPAR could...” | for | OSPAR | action | Ideas for next steps on the action |
|--|-----|-------|--------|--|
| ... explore whether it would be warranted to develop further guidance on offshore wind farm development that would take the specificities of the Arctic Waters into account, for example construction and operation a quiet marine environment, or special considerations of introduction of marine litter in icy conditions. | | | | Invite EIHA to identify sensitivities of arctic species to disturbance and mortality from development and operation of wind energy activities. |
| ... consider whether its mandate on guiding power-cable laying operations could be relevant in mitigating wind energy development impacts in Arctic Waters. | | | | Invite EIHA to update guidelines on cable laying that takes into account sensitive environmental receptors, such as fragile benthic habitat structures or species sensitive to electromagnetic disturbance. |
| ... continue engagement with ISA by bringing to the authority’s attention information about Arctic deep-sea ecosystem impacts from potential deep-seabed mining activities. | | | | Invite EIHA to take Arctic Water ecosystems into account when developing background documents on deep-seabed mining. |
| ... consider developing a legal instrument on disposal of mine tailings from coastal mines into the sea, based on best practice guidelines developed in Arctic Council WG PAME. | | | | Invite EIHA to evaluate whether the knowledgebase collected by PAME on mine tailings disposal could form the basis for a Background Document that would be a basis for developing an OSPAR Recommendation. |
| ... update its Science Needs Agenda by including a criterion to ensure research efforts are steered towards sustainable practices that do not cause harm to the marine environment. | | | | Invite CoG to develop criteria that would steer funding to scientific research, and to update the OSPAR Science Needs Agenda accordingly. Disseminate the criteria to other funding programmes. |
| ... consider developing an Annex to the OSPAR Agreement 2008-1 for special Arctic provisions for deep-sea and high seas research activities . | | | | Invite EIHA and BDC to conduct a scoping study of nationally used deep-sea research methods and evaluate whether an update would be needed for special Arctic provisions. |
| Pressures | | | | |
| ... explore synergies in the implementation of the OSPAR Regional Action Plan on Marine Litter and the Arctic Council WG PAME Marine Litter Action Plan to tackle the regional-global pressure in an effective way, prioritising actions related to input of litter from fishing. | | | | Complete a scoping exercise to identify synergies by comparing OSPAR work to PAME Marine Litter RAP and ongoing projects on: Arctic Coastal Cleanup, Fishing Practise & Gear Inventory: Enhancing Understanding of Abandoned Lost or otherwise Discarded Fishing Gear (ALDFG) and Marine Litter Communication and Outreach Activities Review all the existing OSPAR measures on litter to identify any measures which could be beneficial if the degree of implementation was increased in the Arctic |
| ... explore if the implementation of OSPAR measures aiming at reducing input of litter from fishing activities could be strengthened in Arctic Waters. | | | | Discuss with <u>RAP ML</u> task leads to see if any Arctic fishing specific aspects could be addressed, for example in; B4.2. <i>Stimulate circular design and developments in waste management of fishing and aquaculture gear</i> ; B4.3. <i>Promote practical solutions for reducing the impacts of certain specific fishing related items, such as net cuttings and dolly rope</i> ; B4.5. <i>Raise awareness</i> |

| Option "OSPAR could..." | for | OSPAR | action | Ideas for next steps on the action |
|--|--|-------|--------|--|
| | | | | <i>and improve education in the fishing sector, including the strengthening of the OSPAR recommendations on Fishing for litter and on Sustainability Education Programmes for Fishers</i> |
| ... assess effectiveness of the measure | PARCOM Recommendation 94/6, which provides evidence for best environmental practice, including whether the measure has addressed introduction of hazardous substances of particular concern in Arctic Waters | | | Invite HASEC to complete the implementation reporting round and overview assessment with a particular focus on Arctic Waters. |
| ... consider developing guidance to prevent impacts from noise caused by from oil and gas exploration and exploitation activities. | | | | Invite EIHA and OIC to explore the issue of whether an OSPAR guidance would be useful. |
| ... develop guidelines for measures on natural solutions to carbon storage that provide benefits to biodiversity and local communities in Arctic Waters. | | | | Invite WG COCOA to develop draft guidelines in collaboration with BDC and ICG-ESA. |
| ... explore if there is a sufficient evidence base on reducing underwater noise pressure on sensitive species and habitats in Arctic Waters using area-based measures to support future designations of such measures. | | | | Invite EIHA to assess the spatial distribution of noise in Arctic Waters and to combine it with spatial information on distribution of species with BDC. Use a risk-map approach to identify if quiet areas exist where they are most needed, and whether area based measures could be applied to improve the situation if not. |
| Conservation measures | | | | |
| ... explore whether defining new habitats that are typical to the Arctic could be relevant, and for example if a muddy habitat should be defined by a different assemblage of sea-pens. | | | | Invite BDC and ICG-POSH to develop new habitat definitions and update the habitats definition Agreement, assess the feature using the Texel-Faial criteria for inclusion on the list and develop an OSPAR Recommendation for management actions. |
| ... consider listing narwhal, Beluga whale, kelp forest, sea ice and dependent species, polynyas, migratory pathways and ocean ridges and hydrothermal vents as threatened and/or declining features for Arctic Waters. | | | | Invite BDC and ICG-POSH to assess the feature using the Texel-Faial criteria for inclusion on the list, including updating the habitat definitions, and develop an OSPAR Recommendation for management actions. |
| ... explore collaboration with Arctic Council WG PAME and CAFF in developing OECM guidance . | | | | Reaffirm OSPAR engagement in the CAFF/PAME project steering group. Invite an OSPAR task lead to cooperate with the project leads to scope out draft proposals for guidelines to be discussed for example at the CAFF/PAME project event back to back with the third International Conference on Ecosystem Approach to Management (EA) in the Arctic Large Marine Ecosystems (LMEs) OSPAR and Arctic Council to organize a CBD SOI workshop to understand practices on OECMs, could be interesting for ICC and Saami council esp on legal regimes on indigenous protected and conserved area. Consider OECM establishment, for example for seasonal sea ice boundary associated migratory routes or glacier calving area cold-water refuges in the breeding season. |

| Option “OSPAR could...” | for | OSPAR | action | Ideas for next steps on the action |
|---|-----|-------|--------|--|
| ... describe potential Arctic Water specificities related to OECMs , such as the seasonally dynamic sea ice feature. | | | | <p>Invite an OSPAR task lead to build on the Arctic EBSA discussions to draft first proposals.</p> <p>Engage with the CAFF/PAME OECM project to develop more substantial considerations. Noting PAME/CAFF projects; - Other Effective Area-based Conservation Measures (OECM) in the Arctic Marine Environment. - Revisiting the Framework for a pan-arctic network of MPA's (2015) for potential updates. - Expansion and refinement of the MPA-Network Toolbox</p> <p>Describe how protected areas outside the OSPAR Maritime Area could have synergistic effects with OSPAR measures given e.g. seasonal migrations of protected species.</p> |
| ... invite Contracting Parties to report national OECMs to the OSPAR network. | | | | <p>Invite reporting of existing national OECMs to the OSPAR network.</p> |
| ... further develop guidance on how to use the climate refugia and connectivity concepts as a basis for future proofing the OSPAR MPA network . | | | | <p>Invite BDC and ICG-MPA to specify the features that would need additional connectivity in the OSPAR MPA network and use climate change scenario models to identify potential refugia areas to develop a list of proposed areas to consider. Identify whether collective designations by OSPAR in the area beyond national jurisdiction or national designations would best address the needs.</p> |
| ... discuss how engagement with Indigenous Peoples, connectivity aspects, and protection of features for which the MPA network is not yet deemed sufficient, could be taken into account in future national MPA designations or updates of management plans and objectives for existing MPAs . | | | | <p>Encourage establishment of MPAs in EEZ and nomination of the measures to the OSPAR database</p> <p>Review if any OSPAR Listed features for which replication is not yet in place could be protected through an MPA to increase ecoherence.</p> |
| ... invite Contracting Parties to nominate national protected areas to the OSPAR MPA network. | | | | <p>Invite reporting of existing MPAs to the OSPAR network. Invite CPs to review their existing protected areas against the OSPAR nomination criteria to identify areas that would qualify in the network.</p> |
| ... describe the process for identifying priority sites to be considered for collective MPA designation in areas beyond national jurisdiction in Arctic Waters. | | | | <p>Invite BDC and ICG-MPA to document the process from initial “horizon scanning” and proposals from any OSPAR Contracting Party or Observer until OSPAR Commission agreement to proceed with a proposal as a Task to develop a nomination proforma. Document the information sources used to inform the process.</p> |
| ... collectively designate MPAs in areas beyond national jurisdiction in Arctic Waters, building on previous proposals and information. | | | | <p>Describe in a Task the nomination proforma for any given site to be developed.</p> |

8.3 Options for action on assessment, monitoring and data

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
|---|--|
| Assessment | |
| ... develop working procedures or guidelines for blending different types of information , ensuring that Indigenous Knowledge is stored and used appropriately, to co-create knowledge and improve ocean literacy, which could ensure that local needs are communicated in ways to influence global debates as well as facilitating implementation or regional and global policies on a local scale. | Develop a CEMP Guideline for assessment procedures using Indigenous knowledge, specifying data storage issues. |
| ... consider conservation economy , which suggests working towards more regional economies that are more self-sufficient and resilient as well as less depleting of natural resources, as a framework in its work on economic and social analysis, when considering social impacts of measures and actions. | Invite ICG-ESA to review the concept and whether it would have merit in OSPAR work. |
| ... consider assessing more human activities of relevance specifically in Arctic Waters, for example military activities. | Invite EIHA to consider hunting, kelp harvesting, bioprospecting, military activities, scientific research, land-use change and forestry, waste handling and waste-water management, freshwater resource management and geoengineering including carbon sequestration for the next round of assessments. |
| ... contribute to developing approaches for assessing cumulative effects from human activities regionally . | Invite ICG-EcoC to consider. |
| ... assess cumulative impacts from all pressures from aquaculture , to clarify the local impacts on fjord ecosystems in a holistic manner. | Invite ICG-EcoC to consider developing a localised cumulative effects assessment, nested within a regional assessment. |
| ... assess localised eutrophication effects from aquaculture. | Invite ICG-EUT to collect data and information to support threshold-based area specific assessments for localised eutrophication effects in coastal areas. |
| ... assess the risk on the genetic integrity of wild salmon and cod populations from climate change impacts, including from a potentially increasing occurrence of escapes from aquaculture facilities due to increased storm frequency | Invite WG COCOA to develop an assessment base describing the modelled frequency and intensity increase in storminess. Collaborate with EIHA in assessing the potential risk of breakage and escapees at aquaculture locations. |
| ... contribute to strengthening the knowledge base on pollution levels in ice-breaker channels , including from ship scrubber emissions | Invite HASEC to carry out a scoping exercise on pollution levels in surface waters, including work from EIHA on ship scrubbers. Bring information to the attention of PAME. |
| ... consider facilitating more coordination between marine litter and hazardous substances experts, to create a better understanding of the role of microplastics as a vector for the spread of hazardous substances in the Arctic environment. | Invite HASEC and EIHA to discuss how to link experts working on hazardous substances and microliter. |

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
|---|---|
| ... contribute to understanding the risk of interactions between ships and migratory species in Arctic Waters, in particular south of the IMO Polar Code boundary. | Invite BDC, ICG-COBAM and OMMEG to |
| ... contribute to identifying marine areas that are particularly sensitive to pressures from tourism due to their ecological features. | Invite EIHA to consider. |
| ... contribute to the knowledgebase of impacts from windfarm development and operations on the Arctic Waters. | Invite EIHA to consider. |
| ... continue work to create a knowledgebase on deep-sea ecosystem impacts from deep-seabed mining activities and, as a priority, focus on describing impacts on deep-sea ecosystems in the Arctic Waters. | Discuss with leads describing OSPAR work related to deep-seabed mining on whether any Arctic-specific environmental issues should be explored and documented Collaborate with the Arctic Council to create a knowledgebase on impacts to Arctic deep-sea ecosystems |
| ... assess cumulative pressures in Arctic Waters and trial different assessment approaches depending on data-availability. | Develop description of a specific assessment task for the cumulative effects group ICG-EcoC, building on ICES ecosystem overview conclusions and building on work by CAFF/PAME that have worked on ICES/PICES/PAME EA projects |
| ... contribute to creating a knowledgebase on the significance of black carbon emissions from shipping as well as oil and gas operations in Arctic Waters. | Invite HASEC, OIC and EIHA to consider. |
| ... generate a knowledge base of benthic habitat features associated with seabed methane occurrences and cold seeps . | Invite BDC to consider. |
| ... consider whether underwater noise should be seen as a key pressure to address in Arctic Waters both at a regional and local scale and requiring more monitoring and assessment efforts. | Invite EIHA and ICG-noise to: Expand the impulsive underwater noise reporting registry; Expand the ambient underwater noise monitoring network; Adapt (sea ice modelling in particular) and apply the underwater noise assessment framework to Arctic Waters. Noting the PAME projects: - Underwater Noise in the Arctic: Understanding Impacts and Defining Management Solutions - Phase II, - Management of the Arctic Marine Oil and Gas Associated Noise |
| ... work with the Arctic Council to strengthen the understanding of underwater noise based on ongoing shipping related work, with a view of building a joint knowledge base that could be brought to the attention of the IMO. | Collaborate and contribute to efforts of PAME, working with CBMP/CAFF, on ship intensity monitoring project to develop modelled underwater noise maps, and underwater noise mitigation and evaluation scenarios, and bring this jointly to the attention of IMO, basing work on the OSPAR ambient noise assessment |

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
|---|---|
| ... assess rapidly spreading non-indigenous species , such as pink salmon, more frequently, to create the evidence based of regional secondary spread to support appropriate management action. | <p>Invite ICG-COBAM to develop a pink salmon species specific common indicator assessment on spread and impacts, which would be updated frequently.</p> <p>Contribute to the work of CAFF/PAME project Marine Invasive Alien Species in Arctic Waters, to improve the understanding of the risk of introduction of non-indigenous species, using OSPAR tools such as the ballast water exemption protocols or the database used for assessments</p> |
| ... further strengthen the collaboration on assessing hazardous substances, for example by further strengthening OSPAR-HELCOM-AMAP HARSAT (Harmonised Regional Seas Assessment Tool) and joining forces on data collection and sharing. | <p>Invite HASEC to specify what operational steps would be needed to further strengthen the collaboration.</p> |
| ... contribute to exploring the exacerbating climate change pressure on hazardous substance pressures in Arctic Waters. | <p>Assess the potential change in atmospheric input of hazardous substances from the Contracting Parties under different climate change scenarios. Collaborate with AMAP:</p> <p>Develop a conceptual approach to evaluating risk for different ecological compartments due to remobilisation of hazardous or radioactive substances, for example remobilisation from sediments affected by increased storminess and by melting snow and ice</p> <p>Study biomagnification in the marine foodweb under different climate change scenarios and the impact of different concentrations on species</p> |
| ... consider contributing to the knowledge base on hazardous substances in surface waters, in particular along navigational channels and lanes, for example by evaluating whether oil spills, oil discharges or scrubber-discharges could be a significant pressure, and to bring the information to the attention of IMO. | <p>Explore environmental impacts from discharges of grey water when taking place over the long-term in a cold marine environment, building on e.g. the PAME project "Wastewater discharges in the Arctic – a survey of current practice".</p> |
| ... consider identification of polluted sites and removal of waste from polluted sites as a priority. | <p>Invite HASEC to consider.</p> |
| ... consider using the Large Marine Ecosystem boundaries, developed in the Arctic Council working group PAME (Figure 2 top panel), as a basis to define assessment unit boundaries for OSPAR common indicators. | <p>Invite Committees, and ICG-COBAM, to consider LMEs as assessment unit boundaries for Arctic Waters</p> |
| ... contribute to improving the understanding of how climate change could impact ocean currents , and how the Arctic Waters Region is connected in particular to the Wider Atlantic. | <p>Invite WG COCOA to update OSPAR descriptions of climate change impacts on ocean currents. Focus on understanding the pelagic habitat, and ocean currents driven by AMOC.</p> |
| ... contribute to assessment efforts to understand both commercial and non-commercial fish species as one ecosystem component to create environmental information of relevance for Arctic Waters fisheries management practices. | <p>Invite BDC to consider.</p> |

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
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| ... collaborate with NASCO in exploring the potential increased risk from aquaculture activities on Atlantic salmon under various climate change scenarios. | Invite BDC and WG COCOA to consider. |
| ... collaborate with Arctic Council WG CAFF to increase the understanding of the status of seabird species groups and identify particular human activities that could be a problem exacerbating climate change impacts, such as temporal mismatch of food availability. | <p>Strengthen existing OSPAR BDC (JWG BIRD) and AC CAFF (CBIRD) collaboration</p> <p>Complete T&D status assessment for ivory gull and Steller's eider to inform future management measures focus</p> <p>Explore the environmental and human factors resulting in surface feeding seabirds being in not good status in the Arctic</p> <p>Develop Arctic specific action to be included in the RAP Seabirds - for example on seasonal protection of feeding grounds supporting specific breeding colonies – by deepening existing collaboration with CAFF and the CBird group</p> |
| ... contribute to identifying particular areas of importance to Arctic marine mammals , such as the sea ice edge or glacier calving fronts, to inform area-based management measures. | Invite BDC to consider. |
| ... consider expanding pressure assessment methods to Arctic Waters, as well as developing risk-based maps and engaging with other authorities and organisations, to improve and better coordinate data collection on incidental by-catch . | Describe when incidental by-catch mitigation measures have come into effect, explore their effectiveness as a change in by-catch over time, make proposals for how to improve the effectiveness of the measures including other mitigating measures such as area based closure/risk areas |
| ... assess impacts of climate change on biomagnification of hazardous substances at the highest tropic levels in Arctic Waters, in order to inform an integrated management approach. | Invite HASEC to consider. |
| ...develop links between socio-economic and environmental indicators to improve the understanding of impacts of environmental change on societies. | Invite CoG and ICG-ESA to consider |
| Monitoring | |
| ... contribute to the development of an ocean acidification monitoring programme in Arctic Waters. | Invite WG COCOA to develop proposals as a CEMP appendix. |
| ... share lessons learned in mitigating environmental impacts from shipping, by detecting tank washing through beach litter monitoring and cooperation with the Bonn Agreement on operational surveillance of shipping routes . | Invite EIHA to consider. |

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
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| ... consider whether using beach litter monitoring to sites that are particularly sensitive to an increase of litter from tourism could be helpful as an early warning assessment approach. | Invite EIHA to consider. |
| ... engage with the European Space Agency to identify specific satellite products that could be used to increase the knowledge base of the long-term and large-scale pelagic habitat changes in Arctic Waters. | Invite the OSPAR Secretariat to renew contacts with European Space Agency, and invite ICG-COBAM and the pelagic habitats expert group to provide a description of the data products that would be most helpful. Focus on remote sensing data products that could be delivered regularly for temporal monitoring and region-wide comparable datasets. Eventually develop a regional survey protocol for validating with in situ measurements. |
| ... coordinate international benthic habitat mapping efforts and work collectively to bring together information about modelled habitats in Arctic Waters to inform monitoring programmes. | Invite BDC to consider. |
| Data collection, reporting and processing | |
| ... consider improving information sharing practices and consider using alternative sources of information on human activities to improve the understanding of activity intensity and distribution. | Invite CoG and ICG-QSR to develop guidance on using non-OSPAR data for assessments. |
| ... compile regionally comparable spatial information data sets about human activity occurrence and intensity as a basis for future assessments. | Invite EIHA to issue data calls for spatial human activity information in Arctic Waters. |
| ... make a special data collection effort from the Arctic Waters to augment the OSPAR threatened and/or declining habitats database . | Invite BDC and ICG-POSH to consider. |
| ... work to improve the coverage and spatial resolution of sensitive benthic habitat maps as a basis for spatial assessment of aquaculture impacts in areas of overlap. | <p>Invite BDC to particularly address Arctic Waters in the next data call for the OSPAR benthic habitats database, and to invite in particular coastal data submissions.</p> <p>Invite ICG-POSH to explore if the OSPAR Regional Action Plan on benthic shelf habitats could support the expansion of regionally comparable assessments to be developed for Arctic Waters, or to develop coordinated survey efforts, focus on verifying modelled locations for sensitive benthic habitats and returning to previously sampled locations to build trend information</p> |
| ... collaborate with the CAFF/PAME NIS project and explore potential synergies from joint data management processes with the OSPAR-HELCOM joint expert group on NIS , as well as sharing information on molecular monitoring methods. | As a first scoping step, invite BDC, ICG-COBAM and HELCOM/OSPAR JEG NIS to share a brief documentation of the centralised data storage facility with the CAFF/PAME project. |
| ... support the Arctic Council WG CAFF in exploring if the centralised database for seabird ingestion of plastics could be suitable for use. | As a first scoping step, invite the OSPAR fulmar database managers to share a brief documentation of the database with CAFF. |

| Option for OSPAR action "OSPAR could..." | Ideas for next steps on the action |
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| ... consider inviting noise from military activities to be included in national data reporting , with a view to minimise negative environmental impacts from the activities. | <p>Invite HOD to discuss whether to collect military noise data.</p> <p>Invite EIHA and ICG-Noise to update reporting templates to allow for activity category to be included.</p> |

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ANNEX 1: List of Participants for the OSPAR Arctic Workshop

The OSPAR Arctic Workshop was held 16-18 October 2023 in Copenhagen, Denmark upon the kind invitation of the Kingdom of Denmark.

The workshop participants reviewed a first draft version of the *OSPAR Arctic Waters report Evaluating evidence and identifying options for action*. Through world cafe group discussions as well as plenary discussions, the participants provided both detailed and specific steer on the content and structure of the report which was implemented for the final version.

| Last name | First name | Organisation |
|--------------------|-----------------|--|
| Amelot | Arthur | ACOPS |
| Avellan | Lena | HavElan |
| Axe | Philip | Swedish Agency for Marine and Water Management |
| Badhe | Renuka | European Polar Board |
| Basile | Marco | IOGP |
| Bistrup Halvorsen | Linda | Ministry of Environment of Denmark |
| Brandtberg | Nathia | Kingdom of Denmark |
| Buschman | Victoria Qutuuq | Inuit Circumpolar Council |
| Christensen | Tom | Aarhus University / CAFF (CBMP: Circumpolar Biodiversity Monitoring Programme) |
| Drabløs Pettersen | Eirik | Norwegian Ministry of Climate & Environment |
| Durussel | Carole | OSPAR Commission |
| Dusik | Jan | WWF Global Arctic Programme |
| Ekebom | Jan | Ministry of the Environment, Finland |
| Elisenberg | Anja | Ministry of Climate and Environment |
| Faksness | Liv-Guri | SINTEF Ocean |
| Gabarro | Carolina | ICM/CSIC |
| Gebruk | Anna | University of Edinburgh |
| Gudmundsdottir | Soffia | PAME International Secretariat |
| Guilissen | Gaëlle | Robin des Bois |
| Gunn | Vikki | Seascope Consultants/Global Ocean Biodiversity Initiative |
| Hansen | Johan Arne | |
| Hedman | Jenny | Swedish Ministry of climate and enterprise |
| Heinrich | Katharina | Arctic Centre, University of Lapland |
| Herata | Heike | German Environment Agency |
| Hjelle Hatlebrekke | Hanne | SINTEF Ocean |
| Jensen | Louise Kiel | Norwegian Polar Institute |

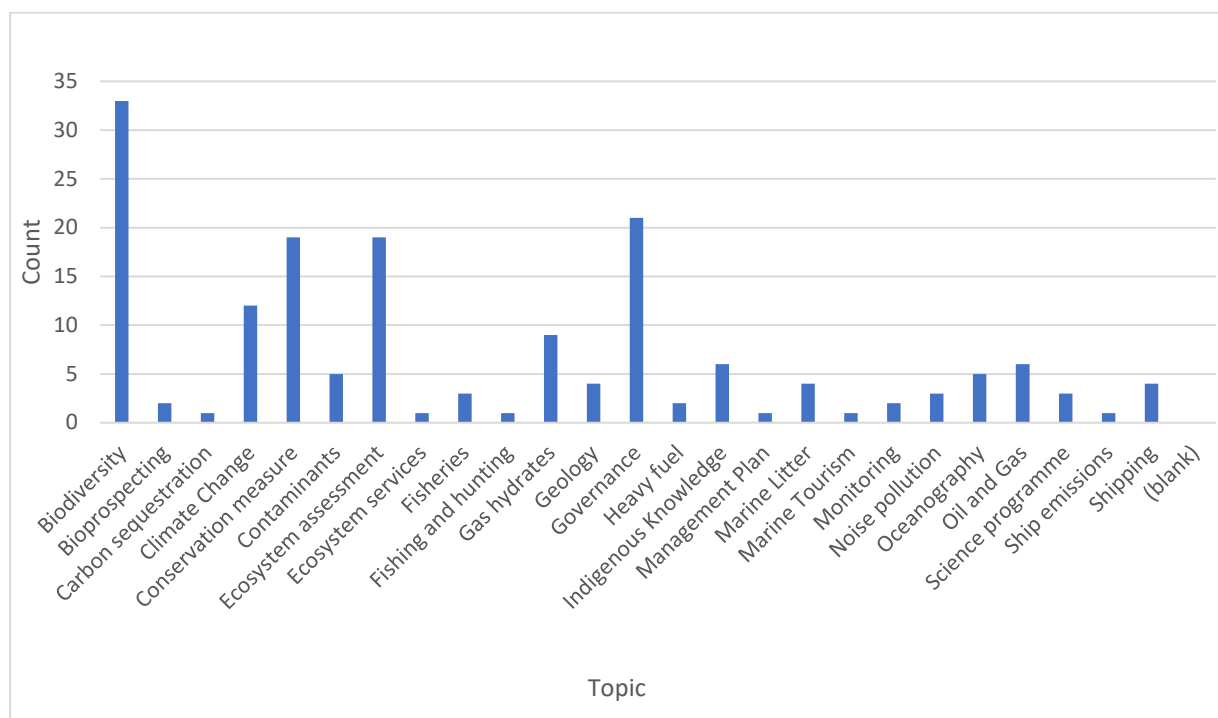
| Last name | First name | Organisation |
|----------------------|-------------------|--|
| Johansen | Malin Kjellstadli | Norwegian Polar Institute |
| Johnson | David | Seascope Consultants Ltd (GOBI) |
| Kovacs | Kit M. | Norwegian Polar Institute |
| Løvendahl | Ane-Marie | Chair of the OSPAR Commission |
| Martín | Itziar | Ministry for the Ecological Transition and Demographic Challenge. Spain. |
| Mikalsen | Tor | Saami Council |
| Mosbech | Anders | Aarhus University, Department of Ecoscience |
| Nielsen | Palle Smedegaard | Greenland government |
| Nilsson | Jessica | Swedish Agency for Marine and Water Management |
| Nissen | Katrine | Danish Environmental Protection Agency |
| Nymand | Josephine | Greenland Institute of Natural Resources |
| Ó Cadhla | Oliver | Department of Housing, Local Government and Heritage, Ireland |
| Ó Maille | Pádraic | Smácht |
| Olsen | Steffen Malskær | Danish Meteorological Institute |
| O'Tuathail | Seán | OSPAR Commission |
| Pattinson | Dominic | OSPAR Commission |
| Rødven | Rolf | AMAP |
| Sommerkorn | Martin | WWF Global Arctic Programme |
| Szleper | Vincent | Ministry for Ecological Transition and Territorial Cohesion, France |
| Thaulow | Inge | Government of Greenland |
| Thomas | David | University of Helsinki |
| Thorning Christensen | Mia | Kingdom of Denmark |
| Tindbæk | Aviaja | Government of Greenland |
| Varkevisser | Eva | Ministry of Agriculture, Nature and Food Quality (NL) |
| Viljanen | Sara | Ministry of the Environment, Finland |
| Winsnes Johansen | Tonje Margete | Saami Council |

ANNEX 2: The source material

The Arctic Outcomes Working Group invited Contracting Parties and Observers to OSPAR to submit information sources in spring 2023 to be used as a basis for the OSPAR Arctic Waters report.

A total of 168 sources were submitted from a range of actors covering a wide range of topics by June 2023 to the AOWG. The source material was not categorised upon submission, and has only been categorised by the contractor to provide a sense of the material (A. Figure 1) noting that some documents covered more than one topic which is not reflected.

The OSPAR Arctic Workshop in October 2023 complemented the original set of source material with additional sources for topics that were seen as not being sufficiently well covered. Contributions were made during the workshop as well as through written contributions following the event.



A. Figure 1. Overview of the source material topics.

Overall, the sources were of very different nature, some being an authoritative status assessment, such as the OSPAR QSR 2023 which includes 120 separate assessments, whereas others were short 1-page blog posts.

It is not possible to reflect all the rich source material detail in the OSPAR Arctic Waters report. If a reader would like to explore the sources in more detail, the selection in the following list could provide an interesting read;

| Source title | Access: |
|---|---|
| Norway's integrated ocean management plans | https://www.regjeringen.no/en/dokumenter/meld.-st.-20-20192020/id2699370/ |
| Marine Mammals of the Greenland Seas | https://natur.gl/wp-content/uploads/2020/06/Ugarte-et-al-2020-Marine-Mammals-Greenland.pdf |
| State of the Arctic Marine Biodiversity Report | https://caff.is/marine/marine-monitoring-publications/state-of-the-arctic-marine-biodiversity-report/431-state-of-the-arctic-marine-biodiversity-report-full-report |
| Ecosystem Assessment of the Central Arctic Ocean: Description of the Ecosystem | https://ices-library.figshare.com/articles/report/Ecosystem_assessment |

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|--|---|
| | of the Central Arctic Ocean Description of the ecosystem /20191787 |
| Arctic Ocean Review Final Report May 2013 | https://pame.is/document-library/pame-reports-new/pame-ministerial-deliverables/2013-8th-arctic-council-ministerial-meeting-kiruna-sweden/293-arctic-ocean-review/file |
| Marine Protected Areas in a Changing Arctic | https://oaarchive.arctic-council.org/handle/11374/2663 |
| Climate Change in Sápmi – an overview and a Path Forward | https://www.saamicouncil.net/documentarchive/sami-climate-report |
| Greenland Sea – An updated Strategic Environmental Impact Assessment of Petroleum Activities | https://dce2.au.dk/pub/SR375.pdf |

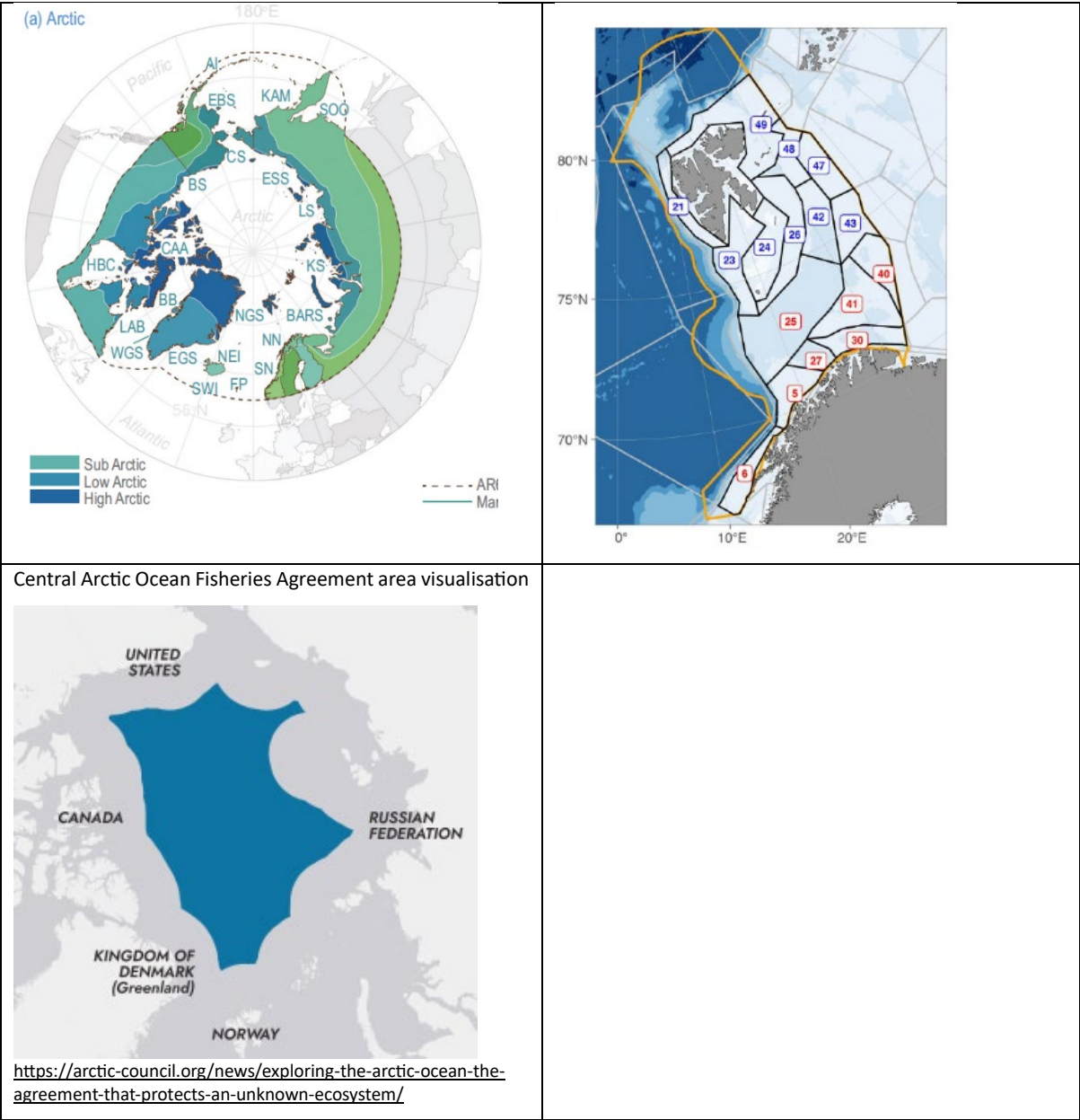
The following sources provide lists of scientific papers and reports which could be of interest to the AOWG if there is a need for further detailed technical information in future work;

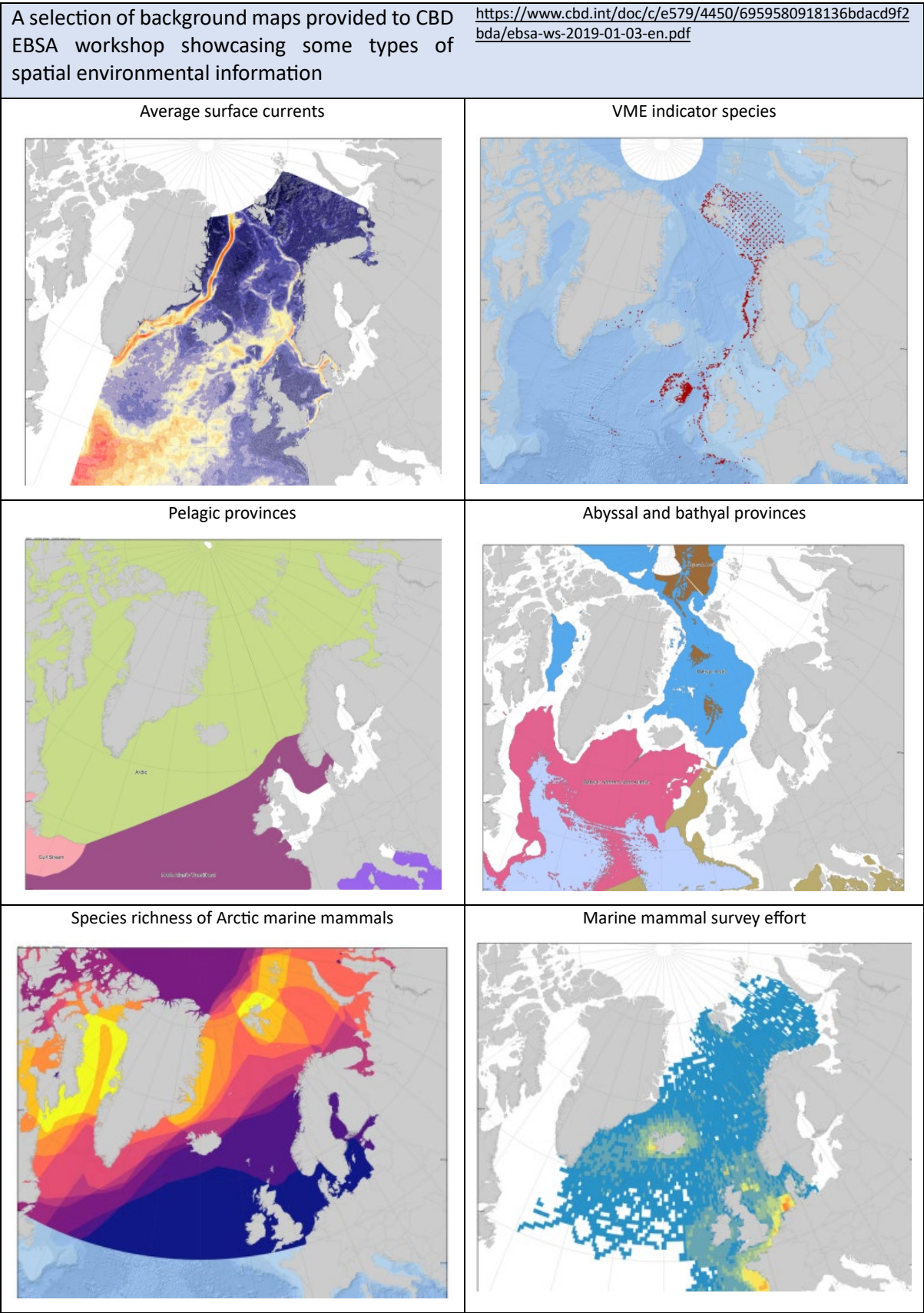
| Source title | Access: |
|---|---|
| List of publications from NERC Arctic Research Programme | http://arp.arctic.ac.uk/news/published-papers/index.html |
| List of publications from NERC-BMBF Changing Arctic Ocean Programme (2017-22) | https://www.changing-arctic-ocean.ac.uk/science-outputs/publications/ |
| Emerging Arctic Research Areas and Approaches | https://www.changing-arctic-ocean.ac.uk/wp-content/uploads/2021/11/AO-CAO-Booklet-WEB.pdf |
| Reports of the Institute of Marine Research, Norway | Reports Institute of Marine Research (hi.no) |
| Nordic Council of Ministers work on MPAs and OECMs | https://www.norden.org/en/publications |

ANNEX 3: Various maps and areas

This annex provides some maps for inspiration from the source material.

| Some definitions of 'Arctic' | |
|---|--|
| <p>"high arctic" defined as area where average July temperature does not exceed 5 °C Greenland Sea SEIA on petroleum activities (Boertmann, Blockey and Mosbech 2020)</p> | <p>Arctic Ocean Review final report, geographic scope. (PAME 2013a)</p> <p>"In the marine area, the AOR project covers the central Arctic Ocean, and in addition, the surrounding seas: the Bering Sea, the East Siberian Sea, the Chukchi Sea, the Beaufort Sea, the Davis Strait, Baffin Bay and Labrador Sea, the Greenland Sea, the waters around Iceland and the Faroe Islands, and northern parts of the Norwegian Sea, the Barents Sea, the Kara Sea, and the Laptev Sea. The oceans and seas included in this definition comprise an area of ... 20 million km² and are referred to as the 'Arctic marine environment'. The Baltic Sea is not included here."</p> |
| <p>CAFF boundary, Circumpolar Biodiversity Monitoring Programme https://www.caff.is/monitoring</p>  | <p>IMO Polar Code boundary Copied from (PAME 2020a)</p>  |
| <p>IPCC polar report area descriptions Copied from (Constable, et al. 2022)</p> <p>Polar regions include the Arctic, ..., Iceland, Greenland, Faroe Islands and some sub-Arctic areas (e.g., Bering Sea and Aleutian Islands as well as the Fennoscandian and Siberian boreal areas)...</p> | <p>Barents Sea panel-based assessment – delineation of ecosystem, Blue = Arctic, Red = sub-Arctic. Copied from (Siwertsson, et al. 2023)</p> |





ANNEX 4: Recognising and building on work by the Arctic Council, other organisations and Multilateral Environmental Agreements

There are a large number of organisations with a mandate to work within OSPAR Arctic Waters (Region I) as well as several Multilateral Environmental Agreements (MEAs) that are applicable to these waters. One aspect of the complexity of ocean governance arises from different organisations having different mandates, different sets of Contracting Parties, different spatial coverage and the various global, regional and national agreements regulating specific topics.

This annex identifies an indicative and non-exhaustive list of some of the relevant organisations and MEAs that are of relevance to OSPAR's work in Arctic Waters. They are shown in alphabetical order. The list should not be read as a comprehensive overview, nor as legal interpretation of any organisations mandate.

Indicative and non-exhaustive list of organisations Multilateral Environmental Agreements (MEA) applicable to OSPAR Arctic Waters (Region I).

| Organisation | Information and relevant instruments and/or documents |
|--|---|
| Arctic Council (AC) | <p>Leading intergovernmental forum promoting cooperation in the Arctic. Website: https://arctic-council.org/</p> <p><i>Selected relevant instruments:</i></p> <ul style="list-style-type: none"> • 1991 Declaration on Arctic Environmental Protection Strategy • <u>Ottawa Declaration</u> of 1996 establishing the Arctic Council • Arctic Council <u>recommendations</u> <p>Relevant working groups:</p> <p>ACAP – Arctic Contaminants Action Programme AMAP – Arctic Monitoring and Assessment Programme CAFF – Conservation of Arctic Flora and Fauna EPPR – Emergency Prevention, Preparedness and Response PAME – Protection of the Arctic Marine Environment SDWG – Sustainable Development Working Group</p> <p>There is also a standalone Expert Group on Black Carbon and Methane (EGBCM).</p> <p>The Arctic states have also negotiated the following legally binding agreements under the auspices of the Arctic Council:</p> <ul style="list-style-type: none"> • <u>Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic</u>, signed 2011 • <u>Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic</u>, signed 2013 • <u>Agreement on Enhancing International Arctic Scientific Cooperation</u>, signed 2017 <p>See an overview of some key Arctic Council strategies and projects in the section below.</p> |
| Arctic Economic Council (AEC) | <p>Independent organization created by the Arctic Council during the 2013-2015 Canadian chairmanship. The organisation facilitates Arctic business-to-business activities and responsible economic development. Website: https://arcticeconomiccouncil.com/</p> <p><i>Selected relevant document:</i></p> <ul style="list-style-type: none"> • <u>AEC Strategic Plan 2022 – 2025</u> |
| Association of Arctic Expedition Cruise Operators (AECO) | <p>International association for expedition cruise operators operating in the Arctic and others with interests in this industry. Website: https://www.aeco.no/</p> |

| | |
|---|---|
| | <p><i>Selected relevant document:</i></p> <ul style="list-style-type: none"> • <u>AECO Guidelines</u> |
| Barents Euro-Arctic Council (BEAC) | <p>Forum for intergovernmental cooperation on issues concerning the Barents region. Website: https://barents-council.org/barents-euro-arctic-council/about-the-council</p> |
| Barents Regional Council (BRC) | <p>Council uniting the member counties and a representative of the indigenous peoples in the northernmost parts of Finland, Norway and Sweden. Website: https://barents-council.org/barents-regional-council/about-the-council</p> |
| Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO) | <p>Organisation that promotes international cooperation in marine sciences to improve management of the ocean, coasts and marine resources. Website: https://www.ioc.unesco.org/en</p> <p><i>Selected relevant document:</i></p> <ul style="list-style-type: none"> • <u>IOC Medium-term Strategy 2022–2029</u> |
| International Commission for the Conservation of Atlantic Tunas (ICCAT) | <p>Regional Fisheries Management Organisation managing fisheries for highly migratory species such as tuna and some shark species. Website: https://www.iccat.int/en/</p> <p><i>Selected relevant instruments:</i></p> <ul style="list-style-type: none"> • <u>ICCAT Convention</u> • <u>Fisheries management recommendations and resolutions</u> |
| International Council for the Exploration of the Sea (ICES) | <p>The International Council for the Exploration of the Sea (ICES) aims to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. Website: https://www.ices.dk/Pages/default.aspx</p> <p><i>Selected relevant document:</i></p> <ul style="list-style-type: none"> • <u>ICES Strategic Plan</u> <p><i>Selected relevant working groups:</i></p> <p><u>Arctic Fisheries Working Group (AFWG)</u></p> <p><u>ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (WGICA)</u></p> <p><u>Working Group on the Integrated Assessments of the Barents Sea (WGIBAR)</u></p> <p><u>Working Group on the Integrated Assessments of the Norwegian Sea (WGINOR)</u></p> <p><u>Working Group on the Integrated Ecosystem Assessment of the Greenland Sea (WGIEAGS)</u></p> <p><u>ICES/NAFO/NAMMCO Working Group on Harp and Hooded seals (WGHARP)</u></p> |
| International Labour Organisation (ILO) | <p>UN agency working to set labour standards, develop policies and devise programmes promoting decent work for all women and men. Website: https://www.ilo.org/global/lang--en/index.htm</p> |

| | |
|--|--|
| | <p><i>Selected relevant instruments:</i></p> <p><u>ILO Constitution</u></p> <p><u>ILO Declarations</u></p> |
| International Maritime Organization (IMO) | <p>United Nations specialised agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. Website: https://www.imo.org/</p> <p><i>Selected relevant instruments:</i></p> <p><u>Convention on the International Maritime Organization</u></p> <p>International Convention for the Safety of Life at Sea (<u>SOLAS</u>), 1974, as amended.</p> <p>International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 (<u>MARPOL</u>)</p> <p>International Convention on Maritime <u>Search and Rescue</u> (SAR), 1979</p> <p>Convention on the Prevention of Marine Pollution by <u>Dumping of Wastes and Other Matter</u>(LC), 1972 (and the 1996 London Protocol)</p> <p>International Convention on <u>Oil Pollution Preparedness, Response and Co-operation</u> (OPRC), 1990</p> <p>International Convention for the Control and Management of <u>Ships' Ballast Water and Sediments</u>, 2004</p> <p><u>Polar Code</u>, in force 2017</p> <p>Other <u>IMO documents</u></p> |
| International Seabed Authority (ISA) | <p>International organization through which States Parties to the UN Convention on the Law of the Sea organise and control all mineral-resources-related activities in the Area for the benefit of humankind as a whole. Website: https://www.isa.org.jm/</p> <p><i>Selected relevant instrument:</i></p> <p><u>Mining Code</u></p> |
| Nordic Council of Ministers | <p>The official body for inter-governmental co-operation in the Nordic Region. Website: https://www.norden.org/en/nordic-council-ministers</p> <p><i>Selected relevant instrument:</i></p> <p><u>The Helsinki Treaty</u></p> |
| North Atlantic Marine Mammal Commission (NAMMCO) | <p>Mechanism for cooperation on conservation and management for all species of cetaceans and pinnipeds in the North Atlantic Ocean. Website: https://nammco.no/</p> <p><i>Selected relevant instrument:</i></p> <p><u>1992 NAMMCO Agreement</u></p> |
| North Atlantic Salmon Conservation | <p>Organisation mandated to conserve, restore, enhance and rationally manage Atlantic salmon through international cooperation taking account of the best available scientific information. Website: https://nasco.int/</p> |

| | |
|--|---|
| Organisation (NASCO) | <p><i>Selected relevant instruments:</i></p> <p><u>1984 Convention for the Conservation of Salmon in the North Atlantic Ocean</u></p> <p><u>Resolutions, agreements, and guidelines</u></p> |
| North-East Atlantic Fisheries Commission (NEAFC) | <p>Regional Fisheries Management Organisation working on the long-term conservation and optimum utilisation of the fishery resources in the North-East Atlantic. Website: https://www.neafc.org/</p> <p><i>Selected relevant instruments:</i></p> <p><u>NEAFC Convention</u></p> <p><u>2014 Collective Arrangement between competent international organisations on cooperation and coordination regarding selected areas beyond national jurisdiction in the North-East Atlantic</u></p> <p><u>Fisheries management measures</u></p> |
| OSPAR Commission (OSPAR) | <p>Organisation with a legal mandate to protect the marine environment of the North-East Atlantic. Website: https://www.ospar.org/</p> <p><i>Selected relevant instruments:</i></p> <p><u>1992 OSPAR Convention</u></p> <p><u>2014 Collective Arrangement between competent international organisations on cooperation and coordination regarding selected areas beyond national jurisdiction in the North-East Atlantic</u></p> <p><u>OSPAR Decisions, Recommendations, and Agreements</u></p> |
| UN DOALOS | <p>The United Nations Division for Ocean Affairs and the Law of the Sea (UN DOALOS) of the Office of Legal Affairs of the United Nations serves as the secretariat of the Convention on the Law of the Sea and provides information, advice and assistance to States with a view to providing a better understanding of the Convention and the related Agreements, their wider acceptance, uniform and consistent application and effective implementation. Website: https://www.un.org/depts/los/index.htm</p> <p><i>Selected relevant instruments:</i></p> <p><u>1982 United Nations Convention on the Law of the Sea</u></p> <p><u>1994 Agreement relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea</u></p> <p><u>1995 United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA)</u></p> <p><u>2023 Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement) (not yet in force)</u></p> |

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|--|--|
| United Nations Environment Programme (UNEP) | <p>Leading global authority on the environment. Website: https://www.unep.org/</p> <p><i>Selected relevant instrument:</i></p> <p>Global Plastics Treaty (under negotiations – see: Intergovernmental Negotiating Committee on Plastic Pollution)</p> |
| MEA | Information and documents |
| Agreement on the Conservation of Polar Bears | <p>The Polar Bear Range States cooperate on polar bear conservation.</p> <p><i>Selected relevant instruments:</i></p> <p>1973 Agreement on the Conservation of Polar Bears</p> <p>Circumpolar Action Plan</p> |
| Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean | <p>This Agreement aims to prevent unregulated fishing in the high seas of the Central Arctic Ocean.</p> <p><i>Selected relevant instrument:</i></p> <p>Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean</p> |
| Basel, Rotterdam, Stockholm, and Minamata Conventions | <p>Agreements with the objectives to protect human health and the environment from hazardous chemicals and wastes.</p> <p><i>Selected relevant instruments:</i></p> <p>Basel Convention</p> <p>Rotterdam Convention</p> <p>Stockholm Convention</p> <p>Minamata Convention</p> |
| Convention on Biological Diversity (CBD) | <p>The Convention on Biological Diversity has for objectives the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. Website: https://www.cbd.int/</p> <p><i>Selected relevant instruments:</i></p> <p>1992 Convention on Biodiversity (CBD)</p> <p>2022 Kunming-Montreal Global Biodiversity Framework (GBF)</p> |
| Convention on Migratory Species of Wild Animals (CMS) | <p>Global platform for the conservation and sustainable use of migratory animals and their habitats. Website: https://www.cms.int/</p> <p><i>Selected relevant instrument:</i></p> <p>Convention on the Conservation of Migratory Species of Wild Animals</p> |
| United Nations Framework Convention on Climate Change (UNFCCC) | <p>The United Nations Framework Convention on Climate Change (UNFCCC) aims to prevent “dangerous” human interference with the climate system. Website: https://unfccc.int/</p> <p><i>Selected relevant instruments:</i></p> <p>1992 United Nations Framework Convention on Climate Change</p> <p>1997 Kyoto Protocol</p> |

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|--|-----------------------------|
| | <u>2015 Paris Agreement</u> |
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Arctic Council

The Arctic Council is the leading intergovernmental forum for promoting cooperation in the Arctic. Arctic Council activities are primarily conducted in six Working Groups and one expert group.

This section provides an overview and highlights some of the key Strategic Action Plans, projects and deliverables by some of the Working Groups that form an important basis for work by OSPAR in Arctic Waters. This is not a comprehensive list of all relevant Arctic Council strategies, projects and outputs.

The **Arctic Council Strategic Plan 2021-2030** (Arctic Council 2021) reflects the shared values and joint aspirations of the Arctic States and the Permanent Participants, to advance sustainable development, environmental protection, and good governance in the Arctic;

Goal 1 – Arctic Climate; supported by 7 strategic actions

Goal 2 – Healthy and Resilient Arctic Ecosystems; supported by 7 strategic actions

Goal 4 – Sustainable Social Development; supported by 9 strategic actions

Goal 5 – Sustainable Economic Development; supported by 7 strategic actions

Goal 6 – Knowledge and Communications; supported by 6 strategic

Goal 7 – Stronger Arctic Council; supported by 8 strategic.

Arctic Monitoring and Assessment Programme (AMAP)

The **AMAP Strategic Framework 2019+** provides strategic direction to the activities of the working group by setting strategic goals for monitoring and assessing the status of the Arctic region with respect to pollution and climate change issues (AMAP 2019). The strategic goals are:

1. Improved knowledge and understanding of Arctic change through collaborative assessment processes, for use in evidence-based decision-making;
2. A strong, sustained and coordinated circumpolar monitoring and observation network;
3. Enhanced understanding of Arctic change and its impacts through inclusive partnership with indigenous peoples and local residents;
4. Effective communication on Arctic challenges and global implications; and,
5. Support to relevant international processes

To implement the goals, ongoing AMAP projects include activities such as; preparing the first monitoring plan on microplastics and litter in the entire Arctic ecosystem; assessing mercury in the Arctic (AMAP 2021b), assessment of climate change implications for Arctic contamination by persistent organic pollutants (AMAP 2021c), sustaining Arctic observing networks (SAON), preparing an assessment on climate issues of concern in the Arctic and an assessment on radioactivity both to be published in 2023.

Protection of the Arctic Marine Environment (PAME)

The **Arctic Council Arctic Marine Strategic Plan 2015-2025** sets goals to improve knowledge of the Arctic environment, to conserve and protect ecosystems, to promote sustainable use of the marine environment and to enhance the well-being of Arctic inhabitants (PAME 2015a). The strategic goals are:

Goal 1: Improve knowledge of the Arctic marine environment, and continue to monitor and assess current and future impacts on Arctic marine ecosystems.

Goal 2: Conserve and protect ecosystem function and marine biodiversity to enhance resilience and the provision of ecosystem services.

Goal 3: Promote safe and sustainable use of the marine environment, taking into account cumulative environmental impacts.

Goal 4: Enhance the economic, social and cultural well-being of Arctic inhabitants, including Arctic indigenous peoples and strengthen their capacity to adapt to changes in the Arctic marine environment.

The Arctic Marine Strategic Plan defines nine principles of Arctic Ecosystem Based Management as a dynamic and adaptive approach that recognise transboundary partnerships, the dynamic nature of the environment and the use of indigenous, traditional and local knowledge (PAME 2019b).

The **Arctic Council Regional Action Plan on Marine Litter in the Arctic** sets out actions to be taken collectively and independently by Arctic States in the Arctic, and is designed to be complementary to and cooperative with efforts underway in other international and regional organisations and conventions (PAME 2021c).

To implement the strategic goals, ongoing PAME projects are:

- Marine Protected Areas projects; Modelling Arctic oceanographic connectivity, Other Effective Area-based Conservation Measures (OECM) in the Arctic marine environment, Different ways of knowing: applying indigenous local and scientific knowledge to Arctic conservation planning
- Resource exploration and development projects: Resource exploration and development, status of offshore oil and gas activities in the Arctic, Marine and coastal mineral extraction, Arctic offshore oil and gas regulatory resources, Systems safety management and safety Culture: avoiding major disasters in Arctic offshore oil and gas operations, Management of Arctic marine oil and gas associated noise, Arctic offshore oil and gas guidelines
- Arctic marine pollution projects: Arctic coastal cleanup, Fishing practice & gear inventory: enhancing understanding of abandoned lost or otherwise discarded fishing gear (ALDFG)
- Arctic shipping projects: Arctic port reception facilities inventory, Collaboration with the Arctic regional hydrographic commission, Interpretation of the Polar Code, New low sulphur fuels, fate and behaviour in cold water conditions, Raising awareness in the Arctic Council of the provisions of the 2012 Cape Town Agreement, Survey of selected wastewater discharges.

The project Central Arctic Ocean Synthesis Report is currently developing a final report, anticipated to be published in early 2024, to describe the Central Arctic Ocean ecosystem, the status quo of the applicable government and management measures as well as ocean governance structures, and Indigenous Peoples relation to the Central Arctic Ocean. It builds on efforts by the ICES/PICES/PAME joint Working Group on Integrated Ecosystem Assessment for the Central Arctic Ocean (WGICA) which provides scientific advice on this remote and changing ecosystem (ICES 2023a). The group has produced a comprehensive description of the CAO ecosystem (Skjoldal 2022) as well as an ecosystem overview for the Central Arctic Ocean (ICES 2021).

Conservation of Arctic Flora and Fauna (CAFF)

The Actions for Arctic Biodiversity 2013-2021 action plan (extended to 2025) sets out the 17 recommendations of the Arctic Biodiversity Assessment (ABA), and is a living document that acts as an implementation plan (CAFF 2015a). When the ABA recommendations were first adopted based on the assessments in 2013, the Arctic Council Ministers instructed the Senior Arctic Officials to develop a plan to support their implementation and deliver a progress report to the next ministerial meeting. The ABA recommendations are;

1. Actively support international efforts addressing climate change, both reducing stressors and implementing adaptation measures, as an urgent matter.
2. Incorporate resilience and adaptation of biodiversity to climate change into plans for development in the Arctic.
3. Advance and advocate ecosystem-based management efforts in the Arctic as a framework for cooperation, planning and development.

4. Require the incorporation of biodiversity objectives and provisions into all Arctic Council work and encourage the same for on-going and future international standards, agreements, plans, operations and/ or other tools specific to development in the Arctic
5. Advance the protection of large areas of ecologically important marine, terrestrial and freshwater habitats, taking into account ecological resilience in a changing climate.
6. Develop guidelines and implement appropriate spatial and temporal measures where necessary to reduce human disturbance to areas critical for sensitive life stages of Arctic species that are outside protected areas, for example along transportation corridors.
7. Develop and implement mechanisms that best safeguard Arctic biodiversity under changing environmental conditions, such as loss of sea ice, glaciers and permafrost
8. Reduce stressors on migratory species range-wide, including habitat degradation and overharvesting on wintering and staging areas and along flyways and other migration routes.
9. Reduce the threat of invasive alien/non-native species to the Arctic by developing and implementing common measures for early detection and reporting, identifying and blocking pathways of introduction, and sharing best practices and techniques for monitoring, eradication and control.
10. Promote the sustainable management of the Arctic's living resources and their habitat.
11. Reduce the threat of pollutants to Arctic biodiversity.
12. Evaluate the range of services provided by Arctic biodiversity in order to determine the costs associated with biodiversity loss and the value of effective conservation in order to assess change and support improved decision making.
13. Increase and focus inventory, long-term monitoring and research efforts to address key gaps in scientific knowledge identified in this assessment to better facilitate the development and implementation of conservation and management strategies.
14. Recognize the value of traditional ecological knowledge and work to further integrate it into the assessment, planning and management of Arctic biodiversity.
15. Promote public training, education and community-based monitoring, where appropriate, as integral elements in conservation and management.
16. Research and monitor individual and cumulative effects of stressors and drivers of relevance to biodiversity, with a focus on stressors that are expected to have rapid and significant impacts and issues where knowledge is lacking.
17. Develop communication and outreach tools and methodologies to better convey the importance and value of Arctic biodiversity and the changes it is undergoing.

CAFF has completed a the project to update the authoritative assessments of the State of the Arctic marine biodiversity report (CAFF 2017), and has followed up with further updates for seabirds (CAFF 2021c) and marine mammals (CAFF 2021b) with updates for other topics such as fish and pelagic ecosystems under development.

The **Circumpolar Biodiversity Monitoring Program Strategic Plan 2021-2025** aims to facilitate more rapid detection, understanding, prediction, communication, and response to the significant biodiversity-related trends and pressures in the Arctic (CAFF 2021e). The steps on monitoring and assessing the marine environment are actioned through the Circumpolar Biodiversity Monitoring Programmes (CBMPs) groups on the major ecosystems, marine, coastal, freshwater and terrestrial (CAFF 2023a). The CBMP has identified key elements, called Focal Ecosystem Components (FECs), of the Arctic region marine ecosystem that are used as indicators for the overall marine environment. The FECs are; microbes; phytoplankton; ice flora; ice fauna; macroalgae (coastal); zooplankton, benthic meio-, macro- and megafauna; benthic fish; pelagic fish; seabirds, marine mammals (CAFF 2011). A good example of co-production of knowledge comes from the 'coastal group' under CBMP that has developed a dedicated platform for this purpose, including a metadata base of monitoring and knowledge that includes Indigenous Knowledge for different coastscapes. The CBMP has been endorsed by the Arctic Council and the UN Convention on Biological Diversity and is the official Arctic Biodiversity Observation Network of the Group on Earth Observations Biodiversity Observation Network (GEOBON).

CAFF and PAME have developed the **Arctic Invasive Alien Species (ARIAS) Strategy and Action Plan** (CAFF and PAME 2017b) which sets out actions that focus on prevention of new introductions as the

most effective approach and is being implemented through a project that is anticipated to produce a report in 2025.

PAME and CAFF run a joint project 2021-2023, extended by default until 2025, to update and enhance the Pan-Arctic Network of Marine Protected Areas toolbox (PAME 2023 ongoing). The project will take into account potential updates of the Framework for a Pan-Arctic Network of marine Protected Areas (PAME 2015b) which sets out the vision, objectives and goals of the MPA work of the Arctic Council.

WG Emergency prevention, preparedness and response (EPPR)

The EPPR develops guidance and risk assessment methodologies, exchanges information on best practices, coordinates exercises and training in response to accidents and maintains operational guidelines for the agreements on search and rescue and cooperation on marine oil pollution and preparedness and response.

EPPR and PAME run a joint project, 2019-2025, 'New Low Sulphur Fuels, Fate and Behaviour in Cold Water Conditions' where EPPR focuses on describing why different fuels with the same viscosity and ISO class behave differently if spilled on a cold sea surface (PAME 2020b).

A project that has been outlined on aerial maritime surveillance would develop a baseline understanding of aerial surveillance resources and expertise.

WG Arctic Contaminants Action Programme (ACAP)

The ACAP workplan 2019-2021 included projects on topic areas; persistent organic pollutants and mercury, waste, short lived climate pollutants and the Indigenous Peoples Action Plan. ACAP has previously completed several projects to map local sources of pollution from waste dumpsites and clean up such sites(ACAP 2021).

ACAP has paid increasing attention to addressing solid waste management as a measure to reduce marine litter. ACAP and SDWG run a joint project, since 2020, to scale up best practices for solid waste management from households in remote areas. The project cooperates closely with the Indigenous Peoples Permanent Participants.

ACAP runs a project called Circumpolar Local Environmental Observer network (CLEO) that collects environmental information observations from local observers (ACAP 2023).

WG Sustainable Development (SDWG)

The Strategic Framework of the Arctic Council's Sustainable Development Working Group sets the context for SDWG activities for the period 2017-2023. The primary goal of SDWG is the building of self-sufficient, resilient and healthy Arctic communities for present and future generations, while protecting the environment and means of subsistence and creating conditions for the preservation and development of cultural traditions.

Expert Group in support of implementation of the framework for action on black carbon and methane (EGBCM)

The EGBCM assesses progress of implementation of the Arctic Council's Framework for Action on Black Carbon and Methane that was adopted in 2015. The expert group has identified six priority areas for reduction of black carbon and methane emissions; oil sand gas, residential combustion, solid waste, wildfires, agriculture and animal husbandry, mobile and stationary diesel-powered sources (EGBMC 2021).

Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean

The *Agreement to prevent unregulated high seas fisheries in the Central Arctic Ocean*⁷ (CAOFA) entered into force 25 June 2021, after all parties, namely Canada, the People's Republic of China, the Kingdom

⁷ Agreement available at <https://www.mofa.go.jp/files/000449233.pdf>

of Denmark in respect of the Faroe Islands and Greenland, Iceland, Japan, the Republic of Korea, the Kingdom of Norway, the Russian Federation, the United States of America and the European Union, had ratified the agreement. The CAOFA underlines the importance of cooperation and coordination with the North-East Atlantic Fisheries Commission (NEAFC) which has fisheries management competencies in one part of the CAO and expresses the view that it would be premature to establish any additional regional or subregional fisheries management organisations. The agreement will remain in force for an initial period of 16 years after its entry into force, i.e. until 2037. After this it will remain in force for successive five-year extension periods, unless a party objects, making provisions for an effective transition to any potential new instruments at a future date.

The current level of information about fish in CAO is considered insufficient, and modern monitoring approaches are called for to improve the knowledge base for sustainable management. The parties to the CAOFA shall establish a Joint Program of Scientific Research and Monitoring, within two years of the agreement entering into force, this took place at COP2 in June 2023. The aim of the programme is to facilitate cooperation on scientific activities to improve the understanding of the CAO ecosystem and to determine whether any of the fish stocks could support future commercial extractive activities. Three years after the agreement has entered into force, parties are to establish measures to manage exploratory fisheries in CAO.

Convention on Biodiversity

The UN Convention on Biodiversity (CBD) adopted the Kunming-Montreal Global Biodiversity Framework (GBF) in December 2022. The framework sets out four goals and 23 targets to be achieved by 2030, on the road to the global vision of a world living in harmony with nature by 2050. The implementation of the GBF is supported by a monitoring framework as well as frameworks for reporting and reviewing implementation. The Parties to the CBD committed to setting national targets to implement the GBF, while other actors have been invited to develop and communicate their commitments.

The CBD has identified Ecologically and Biologically Significant Areas (EBSA) in the Arctic region, the 'Multi-year ice of the Central Arctic Ocean' (CBD 2015a) and the 'Marginal Ice Zone and the Seasonal Ice-Cover Over the Deep Arctic Ocean' (CBD 2015b). The two EBSA records provide detailed information on the ecological and biological features. The process to designate the EBSAs had many steps. OSPAR, NEAFC and the CBD provided early input to the overall EBSA process by organising a workshop in September 2011 (OSPAR, NEAFC, CBD 2012). The proposed EBSAs underwent a scientific review by ICES that concluded on supporting the 'The Arctic ice habitat' (ICES 2013). The CBD convened an Arctic Regional EBSA Workshop in collaboration with the Arctic Council Working Group CAFF in March 2014 (CBD 2014). The workshop agreed to consider and complement the previously completed work where the spatial scope overlapped (CBD 2014). Applying EBSA criteria to the dynamic sea ice habitat was challenging since sea ice was seen as a general Arctic feature, and the criteria aimed to describe areas of enhanced biological significance within the Arctic, thus the proposed EBSAs were seen as a workable compromise in applying the criteria (CBD 2014).

UN Ocean Science Decade

The UN Oceans Science Decade has encouraged the development of regional action plans. The Ocean Decade Arctic Action Plan 2021 is intended to inspire the greater Ocean Decade community including Indigenous and local Peoples and other stakeholders to deliver transformative ocean science (Danish Centre for Marine Research 2021). The plan is built from a voluntary co-creation process that placed no formal restrictions on participants and has no formal ownership or legal mandate (Danish Centre for Marine Research 2021). An example of how the UN framework brings together the scientific community is the 'Challenger 150 – a decade to study deep-sea life' (www.challenger150.world) which also includes an Arctic working group.



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Our vision is a clean, healthy and biologically diverse North-East Atlantic Ocean, which is productive, used sustainably and resilient to climate change and ocean acidification.

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