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Marine Conservation in the Arctic: A Regional Perspective

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IASS POTSDAM

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Cover Graphic

Exclusive economic zones of the coastal states in the Arctic on the map of the Arctic region: Canada (green), Greenland (orange), Norway (purple), Russian Federation (blue), and the United States (yellow). The blue line indicates the Arctic circle. IASS visualisation based on Flanders Marine Institute (2019), GRID-Arendal (2019).

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Note on Covid-19

This report was mainly prepared and written in 2020 and 2021 when the Covid-19 pandemic was spreading across the world, also affecting Arctic communities and economies.

Covid-19 affected the Arctic blue economy in several ways. The pandemic initially limited ship-ping, and with it imports of fuel, food, and equipment as well as exports of oil, natural gas, miner-als, and fish (Arctic Council, 2020). After this initial phase, the cargo transportation corridors con-tinued operations and shipments through the Northern Sea Route actually saw an increase of 2.9% in the first 10 months of 2020 compared to the same period in 2019 (Staalesen, 2020a). However, tourist vessels and especially cruise ships were mainly absent from Arctic waters in 2020, and it is expected to take several years for the tourism and gastronomic industries in the Arctic to return to 2019 levels (Arctic Council, 2020). In a similar manner, most marine research expeditions were either cancelled or reduced in 2020. While remote data collection could continue, pandemic-related cancellations of polar research expeditions have interfered with research typically carried out dur-ing the summer Arctic surveys (Alaska Fisheries Science Center, 2020).

In the fisheries sector, labour shortages as well as Covid-19-related safety measures on board fish-ing vessels created new challenges and costs. At the same time, the role of hunting and fishing activities has increased in some areas and engagement in subsistence expanded because of the pandemic (Arctic Council, 2020). Finally, the downturn in oil prices led to a reduction of oil and natural gas production in the Arctic. In Norway for example, the government decided to lower Norwegian oil production through June to December 2020 (Norwegian Ministry of Petroleum and Energy, 2020).

While some of the impacts can now be detected, much uncertainty remains regarding how exten-sive the economic downturn due to Covid-19 will be and how fast the different sectors will recover. What is becoming clear already is that the decreases in vessel traffic led to a significant decrease in shipping noise during the first half of 2020. In addition, pandemic-related safety concerns and economic slowdowns also decreased a multitude of other activities that generate ocean noise and other impacts, including fishing, aquaculture, seismic exploration, oil drilling, military exercises, offshore construction, and dredging activity for at least some portion of the pandemic (Carr, 2021)

Zusammenfassung

Die Arktis erwärmt sich substanziell schneller als der globale Durchschnitt. Der rasche Temperaturanstieg verändert die Arktis bereits tiefgreifend - und wird dies auch weiterhin tun - mit noch unbekannten Folgen für die Region und die ganze Welt. Gleichzeitig mit dem Rückgang des Meereises und der sich verändernden Verteilung der lebenden Meeresressourcen hat eine Zunahme des wirtschaftlichen Interesses an der Region zu Bedenken hinsichtlich der Nachhaltigkeit der wirtschaftlichen Aktivitäten in der Arktis geführt.

Um Wege zu finden, wie der Schutz und die nachhaltige Nutzung der arktischen Meeresumwelt gewährleistet werden können, ist ein umfassendes Verständnis der Meeresumwelt, der sie beeinflussenden Belastungen und der relevanten Regulierungen und Managementmaßnahmen erforderlich. Das Ecologic Institut und das Institute for Advanced Sustainability Studies haben sich zum Ziel gesetzt, durch eine Reihe von Berichten zum Meeresschutz in der Arktis einen Überblick über die relevanten Informationen zu geben. Die Berichte konzentrieren sich auf die fünf arktischen Anrainerstaaten: Kanada, Dänemark (durch Grönland), Norwegen, die Russische Föderation und die Vereinigten Staaten. Darüber hinaus gibt ein regionaler Bericht einen umfassenden Überblick und fasst die einschlägigen internationalen und regionalen Vorschriften zusammen.

Der vorliegende Bericht gibt einen Überblick über Informationen, die für den Meeresschutz in der Arktis relevant sind. Der Bericht deckt vier Hauptthemen ab: Er beginnt mit der Beschreibung der wichtigsten Merkmale der arktischen Meeresumwelt. Anschließend werden wesentliche Belastungen untersucht, die sich auf die marine Biodiversität in der Region auswirken, gefolgt von einer Untersuchung der soziokulturellen und wirtschaftlichen Rolle sowie der Umweltauswirkungen der wichtigsten meeresbezogenen menschlichen Aktivitäten in der Arktis. Der letzte Teil des Berichts gibt einen Überblick über die relevanten internationalen und regionalen Vereinbarungen und Rahmenwerke sowie über Regulierungen, Vorschriften und Instrumente, die zum Schutz der arktischen Meeresbiodiversität und zur Gewährleistung ihrer nachhaltigen Nutzung eingesetzt werden oder eingesetzt werden könnten.

Hinweis: Die in diesem Bericht präsentierten Informationen wurden hauptsächlich während der weltweiten Covid-19-Pandemie und vor dem russischen Einmarsch in die Ukraine im Jahr 2022 zusammengetragen. Die (weiteren) politischen und wirtschaftlichen Auswirkungen dieser Ereignisse und die sich daraus ergebenden Veränderungen in der Arktis-Governance sind zum jetzigen Zeitpunkt nicht absehbar, und es ist zu erwarten, dass sich einige der in diesem Bericht dargestellten Entwicklungen und Trends erheblich ändern werden.

Die Kernbotschaften des Berichts finden sich unter der folgenden englischen Zusammenfassung.

Summary

The Arctic is warming three times faster than the global average. These rapidly increasing temperatures are already profoundly changing the Arctic – and will continue to do so – with yet unknown consequences for the region as well as worldwide. The diminishing sea ice extent and the changing distribution of marine living resources have led to an increase in economic interest in the region as well as concerns about the sustainability of economic activities in the Arctic.

In order to identify ways in which conservation and sustainable use of the Arctic marine environment can be ensured, a broad understanding of the marine environment, the pressures affecting it, and the relevant regulations is needed. Ecologic Institute and the Institute for Advanced Sustainability Studies aim to provide an overview of relevant information through a series of reports on marine conservation in the Arctic. The reports focus on the five Arctic coastal states: Canada, Denmark (by virtue of Greenland), Norway, the Russian Federation, and the United States. In addition, a regional report is providing a broader overview and summarises relevant international and regional regulations.

This current report presents an overview of information relevant to marine conservation in the Arctic. The report covers four main issues: it starts with the description of the key characteristics of the Arctic marine environment. Then it examines significant pressures impacting marine biodiversity in the region, followed by exploring the socio-cultural and economic role as well as the environmental impact of the main sea-based human activities in the Arctic. The last part of the report provides an overview of relevant international and regional agreements and frameworks as well as rules, regulations and tools which are, or could be, employed to protect the Arctic marine biodiversity and ensure its sustainable use.

NB: The information presented in this report was mainly collated during the global Covid-19 pandemic and prior to the 2022 Russian invasion of Ukraine. The (further) political and economic impacts of these events and resulting changes in Arctic governance cannot be foreseen at this point in time and it can be expected that some of the developments and trends presented in this report may change substantially.

The following key messages are derived from the assessment:

The Arctic Marine Environment

- Marine ecosystems in the Arctic are uniquely adapted to the harsh climatic conditions in the region, including ice cover and strong seasonality.
- Endemic species are prevalent across pelagic, benthic and sea ice realms as well as among seabirds.
- Species diversity in the Arctic tends to be highest where warmer water from the Pacific and Atlantic enters the Arctic.
- Additional biodiversity hotspots are coastal zones, river mouths and estuaries, as well as areas where sea and sea ice interact, which is the case where polynyas exist and in the marginal ice zone.
- Species diversity and abundance is especially high during the summer as many species of birds and marine mammals migrate to the Arctic to breed and feed.
- The Arctic marine environment is increasingly under pressure from the effects of climate change and pollution as well as impacts of increasing human activities.

Climate Change and Pollution: Key Pressures Affecting the Arctic Marine Environment

- The Arctic warms at a rate more than three times the global average, leading to a continuous reduction in both the extent and thickness of sea ice.
- According to modelling scenarios, the Arctic may be seasonally ice-free as early as by 2030.
- While much uncertainty remains about how exactly climate change affects marine organisms, northward range shifts and an influx of species from more southern waters can already be observed.
- Research suggests that Arctic marine ecosystems will experience a regime shift that will challenge both the integrity of the ecosystems and the livelihoods and cultures of Indigenous communities whose lifestyles are closely interlinked with the marine environment.
- The Arctic Ocean acts as a sink for chemicals, heavy metals and plastics stemming predominantly from outside the Arctic.
- Many of these pollutants persist in the Arctic marine environment for long periods, posing health risks to marine species and humans alike.

Sea-based Human Activities in the Arctic

- The Arctic Ocean and its natural resources support a range of human activities, including fishing, shipping, oil and gas production, tourism, aquaculture, and hunting.
- The intensity of sea-based human activities in the Arctic varies greatly across the region.
- As an overall trend, an increase in human activities in the Arctic can be observed. This trend can be related to the diminishing sea ice opening up new areas to human activities and other factors.
- Fishing has been an important pillar of Arctic economies for centuries and continues to provide income and food for the local population in all Arctic coastal states.
- Globally important commercial fisheries for different species of cod, halibut, capelin, pollock, salmon, herring, and crustaceans exist in the Norwegian Sea, the Bering Sea, and the Barents Sea.
- Shipping is crucial for the development of various economic activities in the Arctic and as the main means of transportation for people and goods.
- In 2019, fishing vessels made up the largest share of all vessels in the region, followed by general cargo ships and bulk carriers transporting natural resources from the Arctic or delivering general cargo and supplies to the Arctic.
- The areas with the greatest shipping intensity are located along the Norwegian coast, in the Southwest of Greenland, as well as in the Barents Sea and the Bering Sea.
- Offshore oil and gas exploitation currently takes place in the Arctic waters of Norway, the Russian Federation, and the United States. Exploration activities have been carried out by all Arctic coastal states.
- The main areas for tourism vessels in the Arctic are around the archipelago of Svalbard as well as along the Norwegian coast. Other areas frequented by tourist vessels are the southwest of Greenland as well as the Canadian Arctic. In the Russian Arctic, the main destinations for tourism vessels are Franz Josef Land, the archipelago of Novaya Zemlya and Wrangel Island.
- Hunting of marine mammals and seabirds is fundamental to many regions of the Arctic and is intimately linked with the history of human settlement in several regions.
- The species hunted vary among the region and the communities and include seals, polar bears, whales, seabirds and waterfowl.
- In most Arctic countries, hunting levels have declined in recent years.
- The future pace and scale of the blue economy in the Arctic remains an open question, especially since the impacts of the COVID-19 pandemic and the Russian invasion of Ukraine cannot be foreseen at the moment.

Governance of the Arctic Marine Environment

- A plethora of institutions and agreements were established internationally, regionally and nationally to ensure the sustainable use and conservation of marine biodiversity in the Arctic.
- The Arctic Council is the leading body for the cooperation and coordination among the Arctic States, Arctic Indigenous Peoples, and other relevant actors on issues related to sustainable development and environmental protection in the Arctic.
- International and regional organisations capable of addressing the effects of specific human activities include the International Maritime Organisation (IMO) and regional fisheries bodies. Options exist, for example, to designate Particularly Sensitive Sea Areas (PSSAs) and Special Areas under the IMO, and Vulnerable Marine Ecosystems (VMEs) under the Northwest Atlantic Fisheries Organization (NAFO) and the North East Atlantic Fisheries Commission (NEAFC).
- Ongoing multilateral processes relevant to marine conservation in the Arctic are the development of the 'post-2020 Global Biodiversity Framework' within the context of the United Nations Convention on Biological Diversity (CBD) and the development of an international legally binding instrument on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ) under the United Nations Convention on the Law of Sea (UNCLOS).

Contents

List of Abbreviations

ABMT	Area Based Management Tools
ABNJ	Areas Beyond National Jurisdiction
AECO	Association of Arctic Expedition Cruise Operators
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
ALDFG	Abandoned, Lost or Otherwise Discarded Fishing Gear
AMAP	Arctic Monitoring and Assessment Programme (Arctic Council Working Group)
AMSA	Arctic Marine Shipping Assessment
APEI	Area of Particular Environmental Interest
ATBA	Area To Be Avoided
Basel Convention	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
BBNJ	Biodiversity Beyond National Jurisdiction
BMW Convention	International Convention for the Control and Management of Ships' Ballast Water and Sediments
CAFF	Conservation of Arctic Flora and Fauna (Arctic Council Working Group)
CAO	Central Arctic Ocean
CAO Fisheries Agreement	Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean
CBD	Convention on Biological Diversity
CBMP	Circumpolar Biodiversity Monitoring Programme (CAFF)
CCBSP	Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea
CEMs	Conservation and Enforcement Measures
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
Compliance Agreement	Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas
COP	Conference of the Parties
EBSA	Ecologically and Biologically Sensitive Areas
ECA	Emission Control Areas
EEZ	Exclusive Economic Zone
EPPR	Emergency Preparedness, Prevention and Response (Arctic Council Working Group)
FAO	Food and Agriculture Organization
GBF	Global Biodiversity Framework (CBD)
ICC	Inuit Circumpolar Council
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
ICRW	International Convention for the Regulation of Whaling
IEA	Integrated Ecosystem Assessment
IIBA	Inuit Impact Benefit Agreement
ILBI	International Legally Binding Instrument
IMO	International Maritime Organization
IOC-UNESCO	Intergovernmental Oceanographic Commission of UNESCO

IPHC	International Pacific Halibut Commission
IPOA-IUU	International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
IPOA-Seabirds	International Plan of Action for Reducing Incidental Catch of Seabirds in Long-line Fisheries
ISA	International Seabed Authority
IUCN	International Union for Conservation of Nature
IUU	Illegal, Unreported and Unregulated (Fishing)
IWC	International Whaling Commission
JCNB	Canada-Greenland Joint Commission on Beluga and Narwhal
JNRFC	Joint Norwegian-Russian Fisheries Commission
LNG	Liquefied Natural Gas
London Convention	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee (IMO)
Minamata Convention	Minamata Convention on Mercury
MPA	Marine Protected Area
MSC	Maritime Safety Committee (IMO)
NAFO	Northwest Atlantic Fisheries Organization
NAMMCO	North Atlantic Marine Mammal Commission
NASCO	North Atlantic Salmon Conservation Organization
NDC	Nationally Determined Contribution
NEAFC	The North East Atlantic Fisheries Commission
NEP	Northeast Passage
NGO	Non-Governmental Organisation
NMCA	National Marine Conservation Area
NPAFC	North Pacific Anadromous Fish Commission
NRDC	Natural Resources Defense Council
OSPAR Convention	Convention for the Protection of the Marine Environment of the North-East Atlantic
OUV	Outstanding Universal Value
PAME	Protection of the Arctic Marine Environment (Arctic Council Working Group)
PICES	North Pacific Marine Science Organization
Polar Code	International Code for Ships Operating in Polar Waters
POP	Persistent Organic Pollutant
PRZ	Preservation Reference Zones
PSMA	Agreement on Port State Measures
PSSA	Particularly Sensitive Sea Area
QIA	Qikiqtani Inuit Association
Range States Agreement	Agreement on the Conservation of Polar Bears
REMP	Regional Environmental Management Plan
Rotterdam Convention	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
SOLAS	International Convention for the Safety of Life at Sea

Stockholm Convention	Stockholm Convention on Persistent Organic Pollutants
TFAMC	Task Force on Arctic Marine Cooperation (Arctic Council)
UN CLCS	UN Commission on the Limits of the Continental Shelf
UN FSA	Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USGS	United States Geological Survey
VME	Vulnerable Marine Ecosystems
WCPFC	Western and Central Pacific Fisheries Commission

1 Introduction

Global interest and activity in the Arctic have increased greatly in recent decades. The Arctic is warming three times faster than the global average. These rapidly increasing temperatures are already profoundly changing – and will continue to change – the Arctic, with yet unknown consequences for the people, environment, and economy in the region as well as worldwide (SDWG, 2021).

The diminishing sea ice extent and the changing distribution of marine living resources have led to an increase in economic interest in the region as well as concerns about the sustainability of economic activities in the Arctic (Raspotnik et al., 2021). The challenge now is to identify development pathways that can ensure the sustainable use and conservation of the Arctic marine environment (SDWG, 2021).

In order to identify ways in which conservation and sustainable use of the Arctic marine environment can be ensured, a broad understanding of the marine environment, the pressures affecting it, and the relevant regulations is needed.

Ecologic Institute and the Institute for Advanced Sustainability Studies aim to provide an overview of relevant information through a series of reports on marine conservation in the Arctic. The reports focus on the five Arctic coastal states: Canada, Denmark (by virtue of Greenland), Norway, the Russian Federation, and the United States. In addition, a regional report is providing a broader overview and summarises relevant international and regional regulations. The reports were published in 2022 and are available for download on the websites of the Ecologic Institute and the Institute for Advanced Sustainability Studies.

This current report presents an overview of information relevant to marine conservation in the Arctic. There is no single, clear definition of the Arctic. The most basic definition defines the region as the land and sea area north of the Arctic Circle (or Polar Circle). Other definitions are grounded in various aspects, including the average temperature, the northern tree line, the extent of permafrost on land, or jurisdictional or administrative boundaries (O'Rourke et al., 2021). While this report does not define a fixed study area, its attention is roughly focused on the Arctic marine waters north of the Arctic Circle. As it is challenging to access and compile data specifically for this area, this report partly presents broader data and provides more detailed information for the Arctic marine waters whenever feasible.

The report covers four main issues: it starts with the description of the key characteristics of the Arctic marine environment. Then it examines significant pressures impacting marine biodiversity in the region, followed by an exploration of the socio-cultural and economic role as well as the environmental impact of the main sea-based human activities in the Arctic. The last part of the report provides an overview of relevant international and regional agreements and frameworks as well as rules, regulations and tools which are, or could be, employed to protect the Arctic marine biodiversity and ensure its sustainable use.

The content of this report is entirely based on publicly available data, articles and reports. The information presented here was mainly collated during the global Covid-19 pandemic and prior to the 2022 Russian invasion of Ukraine. The (further) political and economic impacts of these events and resulting changes in Arctic governance cannot be foreseen at this point in time and it can be expected that some of the developments and trends presented in this report may change substantially.

Figure 1: Exclusive economic zones of the coastal states in the Arctic. IASS visualisation based on Flanders Marine Institute (2019) and GRID-Arendal (2019).

2 The Arctic Marine Environment

Figure 2: Main oceanic currents and sea ice extent in the Arctic. IASS visualisation based on Copernicus Climate Change Service/ECMWF (2021a, 2021b), GRID-Arendal (2019), Hunt et al. (2016).

The Arctic marine environment is governed by the dynamics of sea ice and variations in temperature and light (Figure 2). Seasonality is very pronounced in the Arctic, where prolonged periods of darkness are followed by extended periods of light. During the latter, in spring and summer, the melting of parts of the sea ice is accompanied by a sharp increase in the growth of phytoplankton in the ocean. This ‘ice edge bloom’ supports large populations of fish, marine mammals and birds (Government of Greenland, 2010). Marine life present in the region is uniquely adapted to these conditions. Many of the fish, mammals, seabirds and benthic species inhabiting the Arctic are endemic to the region and it is likely that many more have not been discovered yet (Speer et al., 2017).

Species diversity in the Arctic generally tends to be highest in the areas where cold Arctic and warm Atlantic or Pacific waters meet, the so-called frontal zones (Figure 2). In these areas, the transfer of nutrients leads to favourable feeding conditions and supports a rich diversity of organisms, from phyto- and zooplankton to seabirds and marine mammals (Hunt et al., 2016; Spiridonov et al., 2020; WWF Russia, 2011). As a result, the Barents and Bering Seas are among the world's most productive marine ecosystems (CAFF, 2013).

Coastal areas, river mouths, and estuaries as well as polynyas and the marginal ice zones are particularly significant areas for biodiversity in the Arctic. Polynyas are areas of open water surrounded by sea ice (Figure 3). They are especially important because they provide winter habitat for many resident species, such as seabirds and ice-associated marine mammals. In spring, polynyas support widespread phytoplankton blooms, which are the basis of the high biological productivity needed to support migratory species (Speer et al., 2017).

Figure 3: Circumpolar map of known polynyas and ice conditions in the Arctic. IASS visualisation based on: Copernicus Climate Change Service/ECMWF (2021b), GRID-Arendal (2019) and Meltofte (2013).

Generally, the Artic marine ecosystem features low species richness at higher trophic levels when compared to other marine regions at lower latitudes, while the diversity of marine benthic invertebrates, crustaceans, phytoplankton, microalgae, and other organisms may be comparable to or even exceed that of ecosystems at lower latitudes (Speer et al., 2017).

Assessing the status of living marine resources in the Arctic is challenging since numerous gaps remain in basic information on population sizes and distributions. However, assessments carried out by the Arctic Council Working Group on Conservation of Arctic Flora and Fauna (CAFF) offer insights into regional trends, such as declining seabird populations in the Atlantic Arctic (CAFF, 2017).

Fish

High primary productivity in the Barents and Bering Seas supports some of the greatest fish stocks and largest commercial fisheries in the world (CAFF, 2013). Polar cod, capelin, and Alaska pollock are key fish species in the Arctic. Polar cod is widespread throughout the Arctic, living even inside the Arctic pack ice (CAFF, 2013; Hunt et al., 2016; PAME, 2018c, 2018d, 2018e). In the Barents Sea, capelin is a key species (Hop & Gjøsæter, 2013). Alaska pollock is an important component of the Bering Sea ecosystem (PAME, 2018b).

Reporting from Bering and Barents Sea fisheries indicates a northerly shift in the distribution of Arctic fish species. This trend is attributed to the changes in bottom water temperature and loss of sea ice (Thorson et al., 2019).

Marine mammals

The Arctic provides globally important breeding and feeding areas for many species of marine mammals. According to the International Union for Conservation of Nature (IUCN) Red List, 18 species of marine mammals exist in the Arctic Sea area, four of which are globally recognised as vulnerable or endangered (IUCN, 2022; Annex 1, Table 1). Of the 18 species, seven are endemic to the Arctic: polar bear, narwhal, beluga, bowhead whales, walrus, ringed seal and bearded seal. The behavioural patterns of these species are tightly linked to the sea ice (Speer et al., 2017). The Barents and Bering Seas are the areas with the greatest diversity of marine mammals in the Arctic (CAFF, 2013).

Seabirds

The Arctic provides globally important breeding and feeding areas for 44 species of seabirds. 25 of these species are mostly restricted to Arctic and sub-Arctic regions and four are endemic to the Arctic: Little Auk, Ivory Gull, Sabine's Gull, and Ross's Gull (Gaston, 2011).

Many Arctic seabird species have large populations numbering in the millions. Seabird colonies typically concentrate along the coast or near the ice edge and polynya systems, where they feed on crustaceans and small fish. The species diversity is highest in the Low Arctic of the Pacific Basin (Chukchi and Bering Seas). Other biodiversity hotspots are found in the Barents Sea, West Greenland, the eastern Canadian Arctic, and Iceland (Gaston, 2011). In the other regions, due to severe climate conditions and lower pelagic productivity, the diversity and numbers of individuals are significantly lower and largely consist of migratory birds (PAME, 2018d, 2018e, 2018f, 2018c; WWF Russia, 2011).

Benthic Species

Common benthic species in the Arctic include polychaetes, crustaceans, bivalves, sponges, cnidarians, tunicates, and echinoderms (Piepenburg, 2005). The distribution of benthic species in the Arctic follows a similar pattern to other animals: the Barents and Bering Seas have the highest diversity. The number of known established benthic alien species in the Arctic is considered low, although the lack of data (both past and current) makes assessments highly uncertain (Chan et al., 2019). Two prominent invasive benthic organisms which have been spreading in the Barents Sea are the king crab and the snow crab. While the red king crab population has declined since 2004, the population of snow crab has grown, raising concern that this species may have a significant impact on the benthic ecosystem in the Barents Sea (Norwegian Ministry of Climate and Environment, 2016).

Changes in seawater temperatures are causing northward expansion of boreal benthic species and a retreat of Arctic benthic species, especially in the shelf regions of the Barents and Bering Seas, where warmer currents have a strong influence (Hunt et al., 2016; Spiridonov et al., 2020).

3 Climate Change and Pollution: Key Pressures Affecting the Arctic Marine Environment

3.1 Climate Change

Figure 4: Minimum Arctic sea ice extent. IASS visualisation based on GRID-Arendal (2019), NSIDC (2020).

Status

In the Fairbanks Declaration, signed at the Arctic Council's 2017 Ministerial Meeting, the Arctic Council Member States highlighted climate change as the most important threat to Arctic biodiversity (UN Environment & GRID Arendal, 2019). Warming Arctic waters, coupled with acidification and the decreasing extent of Arctic sea ice challenge the health and functionality of Arctic ecosystems and affect the Indigenous Peoples and local communities that depend on them.

Scientific assessments of climate change impacts in the Arctic paint a clear picture: the Arctic is warming at a rate more than three times the global average, leading to reduced sea ice extent and thickness, as well as rapid loss of ice sheets and increased glacial meltwater runoff (AMAP, 2021c; Nuttall, 2019; Meredith et al., 2019; Figure 4).

Although warming is occurring everywhere in the Arctic, it is most pronounced along the frontal zones due to an increase in heat input from the Atlantic and Pacific waters (Spiridonov et al., 2020). Importantly, polynyas have also become increasingly unstable over the last two decades. The ice arch of the North Water Polynya (*Pikialasorsuaq*) occurring in the northern part of Baffin Bay, for instance, is breaking up earlier, leading to increased ice drift from the Arctic Ocean into the Baffin Bay (*Avannaata Imaa*) as well as increased melting in the North Water region (Ribeiro et al., 2021).

In addition, ocean acidification is more prominent at higher latitudes due to cold waters and naturally low carbonate saturation levels (O'Rourke et al., 2021).

Related Impacts

Climate change impacts will affect various parameters of marine life in the Arctic, including home ranges, distribution, survival, and productivity. This will have profound consequences for the marine ecosystems in the region, e.g. altering the food web, carbon and nutrient cycling and the overall integrity and composition of Arctic ecological communities (O'Rourke et al., 2021; Solan et al., 2020).

While the overall impacts are hard to assess and predict given the complexity of the ecosystems and the interactions between the ocean, the cryosphere and the atmosphere, some general trends can be identified.

Observed changes in the distribution of various fish species and other taxa in the Arctic show that core distributions shift northwards or into deeper waters as a result of warming water temperatures (PAME, 2021c). Species of lower latitudes are already increasingly moving into Arctic waters, leading to a so-called 'borealization' of the Arctic ecosystem (PAME, 2021b). For example, in the northeast of the Bering Sea, the seasonal cold-water area that defines the boundary between the Arctic and Sub-Arctic communities has moved 230 kilometres to the north in the period between 1986 and 2006. The distribution of fish and invertebrates in those communities have shifted accordingly. The shifts are especially pronounced in summer, while the extreme winter conditions are still a limiting factor for the long-term survival of sub-arctic and boreal species in the area (Spiridonov et al., 2020).

Warming waters and changing ice conditions have furthermore led to changing migration routes of fish such as halibut and cod as well as of marine mammals and have led to adaptations in the ranges of some seabirds (Nuttall, 2020; Boertmann & Mosbech, 2017). Locally, loss of sea ice may lead to a reduction of available food sources, thus forcing individuals to expend more energy to feed further away. In the case of seabirds, lower breeding success for some species has already been reported to be connected to sea ice loss (PAME, 2021c).

Trends

While the responses of marine organisms to climate change-induced changes within their habitats and ecosystems vary greatly and much uncertainty remains about the exact effects, research suggests that Arctic marine ecosystems will experience a regime shift that will challenge both the integrity of the ecosystems and the livelihoods and cultures of Indigenous communities, which are closely interlinked with the marine environment (AMAP, 2018).

As the sea ice extent continues to decline, Arctic sea-ice-dependent species will face increasingly more extreme levels of habitat change, likely leading to dramatic reductions in population sizes (CAFF, 2017).

Large-scale oceanographic changes may include geographic shifts in the locations of the frontal and upwelling areas. These changes would in turn lead to changes in the distribution of migratory species as well as northward range shifts and the influx of species from more southern waters (Boertmann & Mosbech, 2017; Fredston-Hermann et al., 2018). The warming Arctic waters also bring about the risk of invasive alien species becoming more proliferate in the Arctic. The adverse impacts invasive alien species can cause are already recognised as among the most significant stressors to Arctic biodiversity (CAFF, 2017). Some of these invasive species may replace Arctic endemics, causing unknown consequences for the ecosystems of the region (PAME, 2021c).

3.2 Pollution

Status

Geographical attributes and the cold climate of the region render the Arctic Ocean a sink for pollutants. While local sources of pollution exist, the majority of pollutants stem from lower latitudes and most are carried into the Arctic Ocean by currents and winds, through so-called long-range transport (UN Environment & GRID Arendal, 2019; AMAP, 2021a). Among the pollutants raising concerns are Persistent Organic Pollutants (POPs), heavy metals, and more recently, plastics.

POPs comprise various pesticides and industrial chemicals, as well as their by-products, and are listed under the Stockholm Convention due to characteristics such as environmental persistence, bioaccumulation, long-range transport, and toxicity (AMAP, 2021a). As a result of internationally agreed restrictions on the production and use of POPs, the contamination levels of many POPs are declining in the Arctic (AMAP, 2021a). However, new POPs, such as brominated flame retardants and perflouronated chemicals, are being used now (Boertmann & Mosbech, 2017).

Heavy metals such as mercury, cadmium, and lead are released into the environment from both anthropogenic sources such as coal burning and mining, as well as from natural sources such as the weathering of rocks (Bradl, 2005). The pathways of heavy metal pollution in the Arctic vary. While, for example, in Russia heavy metals are transported to the northern seas mainly by river runoff (Vinogradova & Kotova, 2019), in Greenland the main sources are winds and ocean currents (Aastrup et al., 2016). Concentrations in marine organisms vary depending on the region. Notably, marine mammal populations from Northwest Greenland are reported to be among those with the highest cadmium and mercury concentrations in the entire Arctic (Boertmann & Mosbech, 2017).

Plastics are emerging as a new contaminant in the region. Microplastics have been discovered in the Arctic sea ice, water, and seafloor and share similarities with POPs when it comes to their potentially harmful effects, persistence in the environment, and mobility (UN Environment & GRID Arendal, 2019). Sources of plastic litter include both sea-based sources (such as fisheries, ship paint, and aquaculture installations) and land-based sources (e.g., consumer waste). While it is generally very uncertain how much marine litter enters the marine environment from these different sources, more detailed research exists for some Arctic regions. For example, recordings of litter along the Norwegian mainland coast and the coast of Svalbard indicate that consumer waste is the main source of litter in the southern part of Norway, while sea-based sources are predominant further north and around Svalbard (Norwegian Ministry of Climate and Environment, 2020).

Arctic Council working groups are conducting assessments about the current state of knowledge and impacts on ecosystems to gain a better understanding of the abundance, composition, and distribution of plastic pollution in the Arctic as well as the impact of microplastics on the environment and people in the Arctic. In addition, a Regional Action Plan on Marine Litter in the Arctic has been developed by the Arctic Council Working Group on Protection of the Arctic Marine Environment (PAME) to promote targeted and collective action towards addressing land- and sea-based sources of marine litter in the region (PAME, 2021f).

Related Impacts

Persistent Organic Pollutants (POPs), mercury, and heavy metals accumulate throughout the food chain and can pose a serious threat to the health of some populations of birds as well as long-lived marine mammals such as polar bears, pilot whales, narwhals, beluga and hooded seals.

While atmospheric levels of mercury are generally decreasing in the Arctic, both increasing and decreasing trends of mercury in Arctic biota have been observed over the last two decades. Work conducted by the Arctic Council Working Group Arctic Monitoring and Assessment Programme (AMAP) indicates that levels of mercury and POPs exceed the threshold for biological effects in top predators in the areas of Davis Strait-Baffin Bay, East Greenland, and Svalbard (CAFF, 2017). In Arctic communities where these species are integral to the diet their consumption may lead to adverse health effects related to dietary exposures to mercury, including neurological and cardiovascular impairments (AMAP, 2021b).

In addition, research suggests that industrial pollution resulting from natural resources extraction with little or no environmental safeguards may be a major cause behind the strong decline of fisheries catches in the Russian Arctic (Zeller et al., 2011). Elevated levels of heavy metals were detected in fish caught in the Russian northern seas, especially in the Barents Sea. Cod showcased higher levels of arsenic, while salmon showcased elevated levels of lead (1.5 times higher than the norm) and cadmium (2 times higher than the norm) (Regnum, 2019).

Microplastics can potentially cause significant harm if ingested by marine life, especially seabirds. In addition to that, plastic can be a source of chemical contaminants, either by leaching additives or by absorbing and transporting chemicals (AMAP, 2017b; Royer et al., 2018; UN Environment & GRID Arendal, 2019).

Trends

At present, it is not possible to predict how POP concentrations in marine biota will develop, as these vary depending on the species, ecosystem and area (AMAP, 2021a). Expanding human activities in the Arctic as well as climate-related environmental changes may lead to increased local releases of contaminants to local and coastal waterways (AMAP, 2021a).

Legacy POPs subject to national and international regulations are expected to further decline (CAFF, 2017).

With regards to mercury concentration, predictions are hard to make as future mercury concentrations will depend on changes in levels of pollution as well as the Arctic climate and environment. Climate change, for example, changes the way mercury is transported, accumulated, and cycled in the Arctic environment and affects several processes that influence mercury concentrations. The thawing of permafrost, for example, could lead to the release of vast amounts of mercury, though it remains unclear how, when, and if this will occur (AMAP, 2021b).

Concentrations of microplastics are expected to increase, following a global trend in which marine plastic pollution is expected to increase. This trend may be accelerated by increased shipping and fishing activities in the Arctic and related pollution with plastics (Baak et al, 2021).

4 Sea-based Human Activities in the Arctic

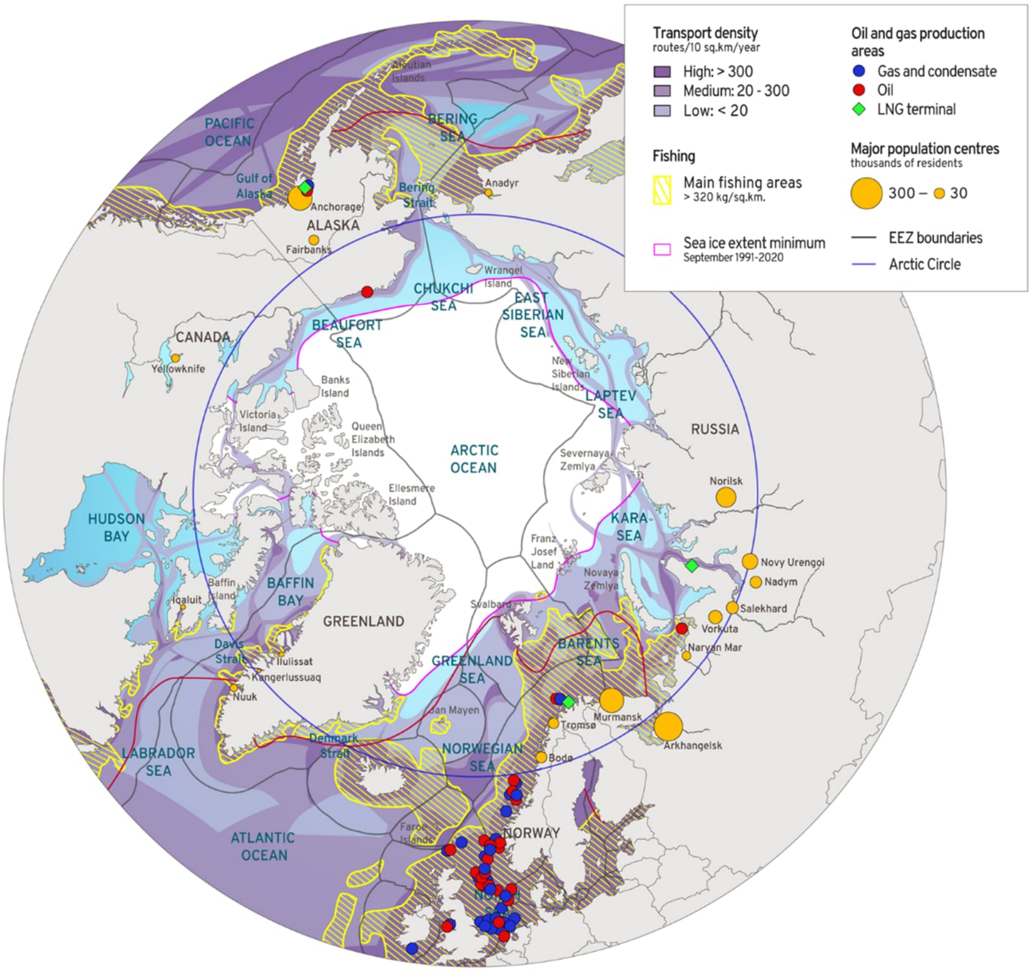

Figure 5: Overview of the major sea-based human activities in the Arctic (except tourism). IASS visualisation based on Copernicus Climate Change Service/ECMWF (2021a, 2021b), Flanders Marine Institute (2019), Gazprom (2019), Government of Newfoundland and Labrador (2021), GRID-Arendal (2019), Löschke & Lehmköster (2019), MarineTraffic (2021), Pauly et al. (2020), State of Alaska, Department of Natural Resources, Division of Oil and Gas (2013).

Around four million people live in the Arctic. About 70% of this population live in the Russian Arctic and around 10% are indigenous to the Arctic (Glomsrød et al., 2017). The Arctic Ocean and the living and non-living marine resources it contains support a range of human activities, including fishing, hunting, shipping, oil and gas production, and tourism (Figure 5). Several of these activities are essential for local livelihoods and to the generation of income and employment in coastal communities in the Arctic (SDWG, 2021).

In some places in the Arctic, Indigenous Peoples have been interacting with the Arctic marine environment for millennia. This interaction continues to underpin and shape Arctic Indigenous cultures. Many Arctic Indigenous communities depend on traditional foods obtained through hunting, fishing, and herding (O'Rourke et al., 2021). Over the past decades, Indigenous populations experienced a substantial change in their traditional lifestyles, and, with the exception of Greenland and Canada, Indigenous Peoples have become minorities in the Arctic areas of the Arctic States (O'Rourke et al., 2021).

While the intensity of sea-based human activities in the Arctic varies greatly across the region, depending, inter alia, on factors such as geology, currents, and politics (Raspotnik et al., 2021), an overall trend towards increased human activities in the Arctic can be observed (O'Rourke et al., 2021).

A strong interest in the economic development of the region exists and new initiatives such as the Arctic Economic Council were established by the Arctic States in order to facilitate dialogue and cooperation amongst private companies engaged in the Arctic and to attract investments (Sfraga et al., 2020).

While most stakeholders and rights holders in the region and beyond agree on the need for sustainable development of the region, the future pace and scale of the new economy in the Arctic remains an open question (SKOLKOVO Institute for Emerging Market Studies, 2021). Tensions remain both regionally and on national levels between actors favouring a conservation-oriented approach and those who support large-scale Arctic economic development as part of a sustainable development strategy (Sfraga et al., 2020).

Civil society groups and NGOs especially point to the increasing risk of oil pollution incidents due to the growth of oil and gas exploitation and shipping activities in the Arctic. In addition, it is expected that the declining sea ice extent will expose vulnerable areas which were previously inaccessible to resource exploration activities and shipping. However, the speed of such changes is difficult to predict and the region will continue to present logistical challenges that hamper human activities (O'Rourke et al., 2021).

In this chapter, a regional overview of the main sea-based human activities carried out in the Arctic as well as their socioeconomic importance and related impacts is provided. The national rules and regulations governing these sectoral activities as well as a detailed analysis of the contribution of these activities to the national economies is provided in the national case studies.

4.1 Fishing

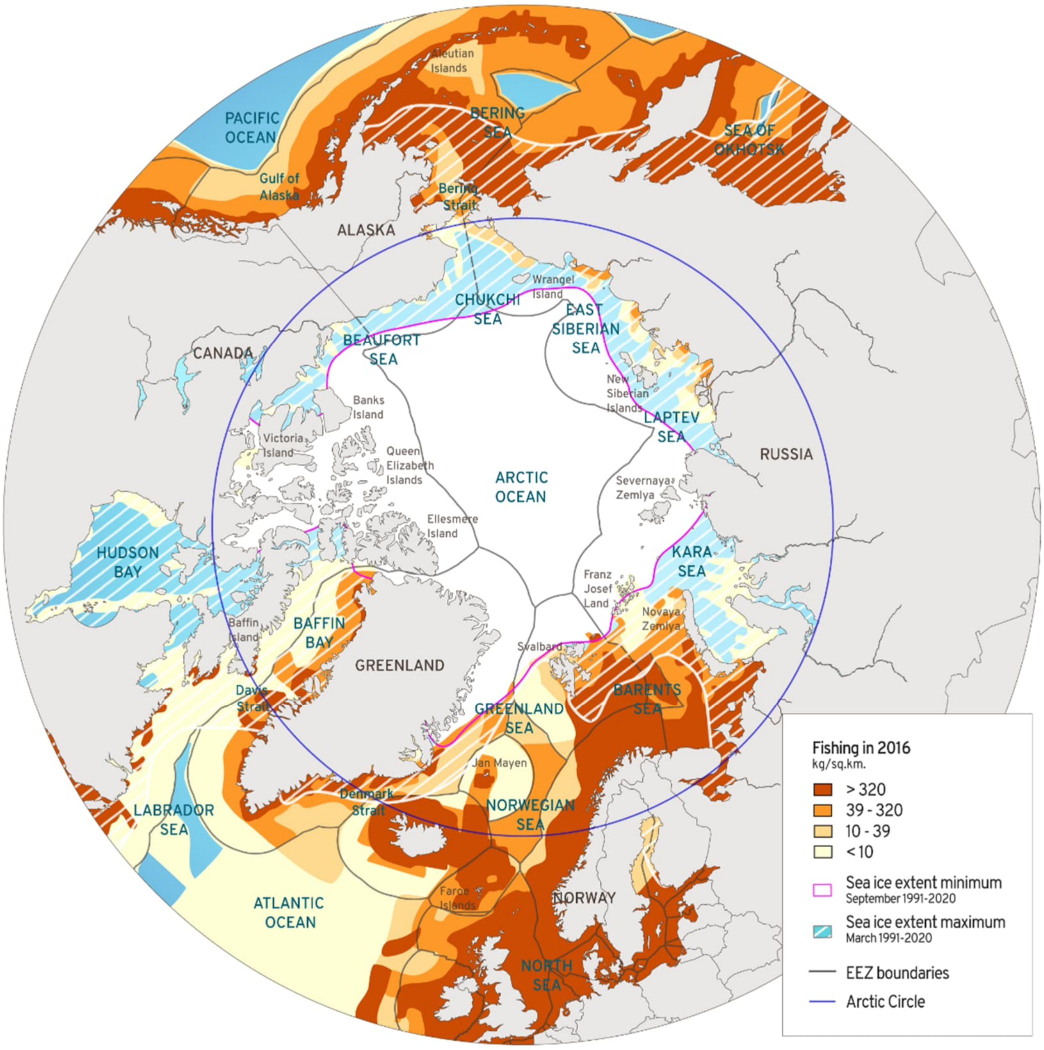

Figure 6: Assessment of the fishing effort in the Arctic waters. IASS visualisation based on Copernicus Climate Change Service/ECMWF (2021a, 2021b), Flanders Marine Institute (2019), GRID-Arendal (2019) and Pauly et al. (2020).

Socio-Cultural and Economic Relevance

Fishing has been an important pillar of Arctic economies for centuries (UN Environment & GRID Arendal, 2019; SDWG, 2021). Small-scale fisheries are an important source of income and food for coastal residents in all Arctic coastal states (Statistics Greenland, 2020; Neimi et al. 2019; McDowell Group, 2017; Hoel, 2009; Østhagen et al., 2022; Taconet et al., 2019).

Globally important commercial fisheries for different species of cod, halibut, capelin, pollock, salmon, herring, and crustaceans exist in the Arctic (Silber & Adams, 2019; McDowell Group, 2017). Other major fisheries target northern prawn in the Canadian Eastern Arctic and West Greenland (Neimi et al. 2019; Statistics Greenland, 2020). Much of the fish products are exported (Natcher & Koivurova, 2021). In recent years, fisheries and aquaculture activities in the region have increased as Arctic fish stocks have expanded and global demand for fish products has risen (Raspotnik et al., 2021).

In the Central Arctic Ocean, commercial fishing is not currently taking place due to the prevailing sea ice and it is uncertain whether the present fisheries resources could support commercial fishery activities. Under the 2018 Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (CAO Fisheries Agreement), the main fisheries nations agreed to refrain from commercial fishing in the area before an international management regime is established to regulate the activity (O'Rourke et al., 2021; see chapter 5.2 on the main regional intergovernmental institutions and agreements for more details).

Main Areas

The main areas for commercial fishing are in sub-arctic and Low Arctic areas and along the frontal zones where cold Arctic water mixes with warm Atlantic/Pacific water masses and productivity is high. The highest fishing efforts can be observed in the Norwegian Sea, the Barents Sea, and the Bering Sea. Other important fishing areas include the Central North Atlantic off Greenland and Iceland and the Newfoundland and Labrador Seas in the Northeast of Canada (O'Rourke et al., 2021; Figure 6).

Related Impacts

The main direct impact of fishing is the mortality of the target species (CAFF, 2017), i.e. the reduction of the stock of the targeted fish and the related (potential) consequences for the ecosystem. In addition, cases of overfishing have been documented in the past, for example in the Bering Sea, the Barents Sea, and off Greenland (Government of Greenland, 2020; FAO, 2022a; Booth & Knip, 2014; Østhagen, 2018; Sfraga et al., 2020).

The indirect impacts of fishing activities depend greatly on the species targeted and the gear employed. Major impacts include bycatch, habitat loss, and seabed disturbance.

Incidental bycatch is believed to be widespread in Arctic fisheries, although it is not well monitored. High bycatch rates have been documented for fishing activities near seabird breeding colonies in the Davis Strait-Baffin Bay region during summer and autumn. Furthermore, it is expected that even fisheries with generally low bycatch rates may have significant bycatch if they are being conducted in big areas and for a long time, such as the Atlantic cod fishery in Norway (CAFF, 2017). Apart from seabirds, bycatch of threatened or endangered species including European eel, blue ling, golden redfish, and spiny dogfish as well as certain species of whales, sharks, seals, porpoises, skates and rays have been documented in Norway (Norway, 2018; Norwegian Ministry of Climate and Environment, 2017).

Seabed disturbance is closely related to the use of certain fishing techniques. Scallop scraping, for example, causes large-scale disturbance on the sea floor as it lifts large pebbles from the sediment and presumably damages the epifauna (Government of Greenland, 2010). In a similar manner, fisheries for prawns, offshore halibut, and cod employ deep-sea trawls. This technique harms or even destroys seabed fauna, presenting a particular threat to sedentary and long-lived organisms (Clare, 2018).

In addition, abandoned, lost or otherwise discarded fishing gear (ALDFG) is a major source of marine litter in the Arctic and can lead to entanglements of marine mammals and other marine vertebrates. While the effects of ingestion of marine litter and entanglement have been poorly studied and documented for the Arctic Ocean to date, research suggests that entanglement of seals may frequently cause their death while whales may be able to shed the gear on their own (PAME, 2019b).

Apart from these fisheries species impacts, fishing vessels, like all ships, contribute to underwater noise, are capable of fatally striking marine mammals, and may contribute to overall pollution through (small) fuel spills during routine operations or accidents (see chapter 4.2 on shipping impacts). While fishing vessels are usually smaller than large ships used for the transport of goods or passengers, the sheer size of the active fleet as well as the number of vessels supporting the fishing industry means that the impact of fishing vessels should be taken into account (Silber & Adams, 2019).

Trends

As larger areas in the Arctic are predicted to become ice-free and climate-induced range shifts of different fish species occur, commercial fishing activities are generally expected to increase in the Arctic (O'Rourke et al., 2021; Silber & Adams, 2019).

In recent years, the spatial distribution and abundance of some fish and shellfish stocks has changed because of warming sea temperatures (PAME, 2021c). In general, fish stocks are moving northwards, leading to changes in fishing practices (Sfraga et al., 2020; Silber & Adams, 2019).

It remains to be seen whether climate change impacts will benefit or threaten Arctic fisheries. While the melting ice opens opportunities for intensified fishing activities, it also leads to a reduction of plankton and primary productivity, which may in turn reduce the number of fish (Stupachenko, 2018). In addition, future changes in target species populations are uncertain for most species, as warming water temperatures may lead to the immigration of new fish species, while the abundance of previously existing target species may diminish as they move further north into colder waters (FAO, 2022a). These distributional shifts and the associated changes in wildlife populations may also mean that some local communities will be negatively affected as they will face serious threats to their food security (UN Environment & GRID Arendal, 2019).

With regards to the Central Arctic Ocean, it remains unclear if fish stocks in the area will be able to support sustainable commercial fisheries in the future (O'Rourke et al., 2021; Hoel, 2020).

4.2 Shipping

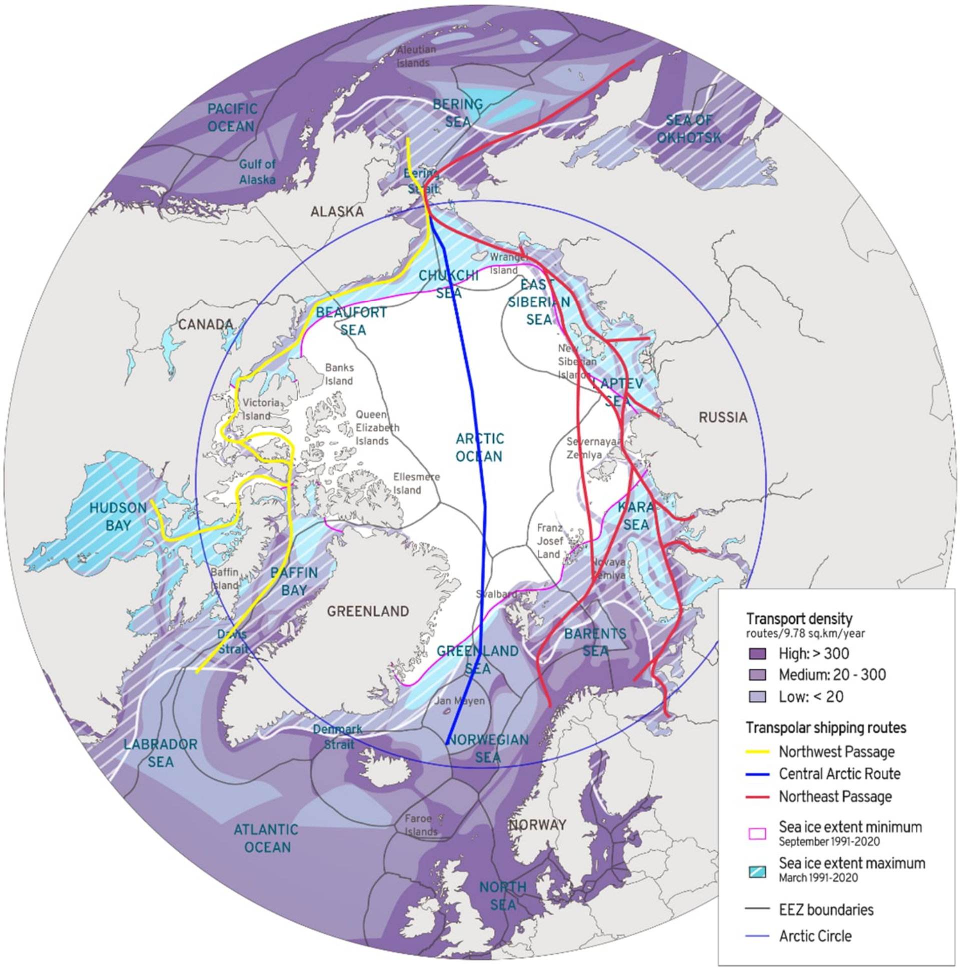

Figure 7: Transport density and main transpolar shipping routes. IASS visualisation based on Copernicus Climate Change Service/ECMWF (2021a, 2021b), Flanders Marine Institute (2019), GRID-Arendal (2019), and MarineTraffic (2021).

Socio-Cultural and Economic Relevance

Shipping is essential in the Arctic as it is among the main means of transportation for people and goods (Borch et al., 2016; Brigham, 2015). It is likely to play a crucial role in the future development of extractive industries as well as other local economic activities such as tourism and services in the region (SKOLKOVO Institute for Emerging Market Studies, 2021; Glomsrød et al., 2021).

In recent years, retreating sea ice, increased economic activity, and new technological developments, including specialised vessels, have led to an overall increase in (seasonal) shipping (Pew Charitable Trusts, 2016; Glomsrød et al., 2021).

In 2019, fishing vessels made up the largest portion of all unique vessels in the region, followed by general cargo ships and bulk carriers transporting natural resources from the Arctic or delivering general cargo and supplies to local communities and natural resource extraction facilities (Figure 8)[1]. Passenger transport and cruise ships are another important type of vessels in the Arctic (PAME, 2021e).

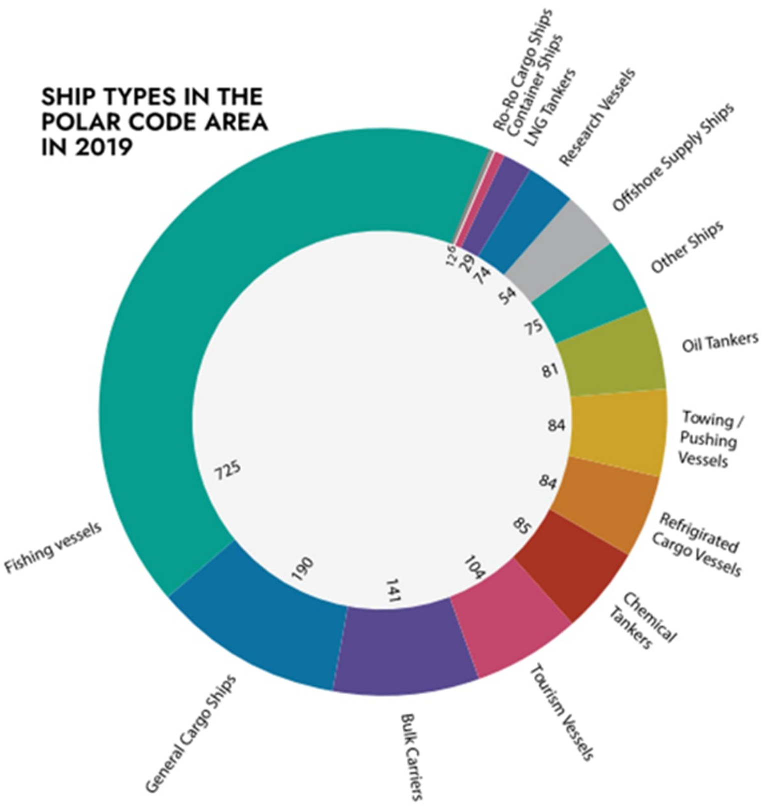

Figure 8: Ship types in the Polar Code area in 2019. Source: PAME (2021a)

For intercontinental transits through the Arctic, two principal shipping routes exist: the Northeast Passage (including the Northern Sea Route) and the Northwest Passage. Persistent ice cover prevents operations on an additional route through the Central Arctic Ocean (Figure 7).

The Northeast Passage passes along the Russian coast and connects the European and Far Eastern regions of the Russian Federation. The route was originally used for supplying Russia's northern territories and has recently seen growing, albeit incremental, commercial traffic. While the route is transcontinental, most activities are concentrated in its western part and related to the domestic shipping between Arctic cities and harbours, as well as the export of raw materials including timber, copper, nickel, and, more recently, LNG, from Siberia to Western Europe (Borch et al., 2016; Glomsrød et al., 2021). In 2017, Yamal LNG was finalised and the resulting increase in LNG cargo has been a key driver for the Northern Sea Route (CHNL & BIN, 2019; Spiridonov et al., 2020; Vavina & Toropkov,

[1] For the unique vessel count, vessels are counted only once regardless of the number of transits they make in the study area.

2020). The remaining part of the route is increasingly being used as retreating sea ice eases access (Glomsrød et al., 2021).

The Northwest Passage through the Canadian Arctic Islands comprises several potential routes. The southern route through Peel Sound in Nunavut has been ice-free in recent summers but imposes restrictions on shipping as some of its areas are shallow and narrow. The more northern route through McClure Strait is much more direct but more likely to be blocked by sea ice (O'Rourke et al., 2021).

The Northwest Passage is widely considered to be less commercially viable than the Northern Sea Route (O'Rourke et al., 2021) but sea ice decline has led to an increase in maritime transport: the number of voyages through the Northwest Passage has grown by 166% between 2004 and 2015 (to over 300 per year) and is expected to continue increasing as sea ice decline continues (Pew Charitable Trusts, 2016). While few cargo ship transits occurred in the area, an increase in destinational shipping connected to Arctic communities and resource extraction in the Canadian Arctic can be observed (Chircop et al., 2020).

Most ships navigating Arctic waters use several types of oil as fuel. In 2019, the fuel most commonly used in the Polar Code area was distillate marine fuel oil (Marine Gas Oils or Marine Diesel Oils). Different types of residual marine fuels are also common with heavy fuel oil being employed predominantly by bulk carriers, passenger ships, LNG tankers, and oil tankers within the Russian EEZ (PAME, 2020). Between 2015 and 2019, heavy fuel oil use in Arctic waters increased by 75% (Comer et al., 2020). LNG tankers are the biggest contributor to fuel consumption and account for 28% of the fuel combusted by ships in the Arctic Polar Code area (PAME, 2020).

Alternatives to oil-based fuels are increasingly evolving in the Arctic with a small number of vessels operating with LNG, biofuels, methanol, and nuclear power as energy sources (PAME, 2019a). While most LNG is loaded onto tankers and shipped to its destination, some is used as a marine fuel. In 2019, three ships in the Polar Code area used LNG as fuel (PAME, 2020). In addition, some fully electric vessels are in use, particularly in the Norwegian ferry sector (PAME, 2019a).

Main Areas

While a general increase in shipping can be observed in the Arctic, growth tends to be seasonal and localised (PAME, 2021c). The areas with the greatest shipping intensity are located along the Norwegian coast, in the southwest of Greenland, as well as in the Barents Sea and the Bering Sea (Figure 7).

Related Impacts

Maritime transport produces multiple environmental pressures including pollution to air and water, underwater noise, and the introduction of invasive species. In addition, port infrastructure creates noise and seabed disturbances, as well as litter and other pollution and contaminants (Council of Canadian Academies, 2017).

Oil spills are the main threat related to shipping in the Arctic. The slow rate of degradation, very limited evaporation and limited dispersion into the water column mean that an oil spill in the Arctic could have very serious impacts on the marine environment and marine life and could endanger the food security and livelihoods of local Arctic communities. Currently, most vessels operating in polar waters use several types of oil as fuel. Among the oils in use, heavy fuel oil has the highest viscosity. Due to its characteristics, spilled heavy fuel oil may turn solid and sink or float in cold waters. In ice-covered waters, it may become trapped in and under sea ice, causing the oil to remain for several weeks and to spread over large distances (PAME, 2020). Alternatives to oil fuels include LNG and ships powered by batteries, hydrogen, or nuclear power. These alternatives would reduce the risk of pollution but are still not common in the region (PAME, 2020).

Further increasing the risk of adverse impacts of an oil spill in the Arctic is the fact that oil spill response in the Arctic is often more challenging than in other regions due to long distances, severe weather conditions, a poor communications network, lack of infrastructure and lack of emergency preparedness capabilities in certain parts of the Arctic. In addition, no effective strategies and techniques for cleaning up oil spills in ice-covered waters have been developed as of now (O'Rourke et al., 2021; Tarantola et al., 2019; Norwegian Ministry of Climate and Environment, 2016; Elgsaas & Offerdal, 2018; Borch et al., 2016).

Up to now, no large-scale oil spill event has occurred in the Arctic Ocean but accidents such as the 2010 collision of two Russian oil tankers and the 2017 collision of a Danish bulk carrier with a nuclear icebreaker show that the risk is real (Humpert, 2020). Increasing maritime traffic brings with it an increased risk of accidents, highlighting the need for a sound system for oil spill preparedness and response (Borch et al., 2016). This is all the more important in areas where sea ice is present, since practical experience with oil spill response operations has shown a lack of effective response methods in waters where ice is present (Norwegian Ministry of Climate and Environment, 2016).

In addition to the threats posed by oil spills, potential environmental impacts common to all shipping activities are toxic emissions, chemical discharges, habitat damage, collisions with marine mammals, the introduction of invasive species, and underwater noise (Chircop et al., 2020; CAFF, 2017; PAME, 2021e).

Shipping-related sources of underwater noise are related to propellers, ice-breaking, and sonar equipment. The propeller noise lies within the frequency range that can be heard by both fish and marine mammals. Sonar equipment emits intense sound pulses that are within the hearing range of marine mammals but less audible to fish (Norwegian Ministry of Climate and Environment, 2017).

With regards to the impacts of underwater noise in the Arctic, a recent report by PAME presented the first long-term basin-scale shipping noise model. According to the report, underwater noise related to shipping increased significantly in several locations across the Arctic from 2013 – 2019. Excess noise levels were measured in three regions characterised by high densities of marine mammals: the Bering Sea, the Barents Sea and the Baffin Bay/Davis Strait (PAME, 2021e).

There are concerns that excessive noise may mask the communication of marine mammals (PAME, 2021e). This is an issue because beluga whales and narwhals, for example, use echolocation clicks as sonar systems to find prey. Also, bowhead whales are known to produce sounds to maintain contact with other individuals as they migrate in ice-covered waters and when mating (Stafford, 2013). In addition to the impacts on marine mammals, existing research indicates that most species react to underwater noise in one or another way. Studies conducted on Arctic cod and Shorthorn Sculpin, for example, indicated that they adjust their ranges and movement behaviours in response to noise from vessels (PAME, 2019a).

Overall, numerous knowledge gaps remain regarding the specific impacts of underwater noise from shipping in the Arctic as there are large geographic areas where no studies have been conducted and the impacts have only been studied for a few species (PAME, 2019a). Results from other regions suggest, however, that underwater noise may cause increased stress in marine mammal populations and may present challenges for communication, navigation, feeding, and calf protection (PAME, 2021e). Collisions between marine mammals (most likely whales) and ships may occur when the former are not able to locate and avoid vessels due to masking, or interference, created by the underwater noise (Stafford, 2013). In addition, icebreakers may directly collide with ice-breeding seals during pupping and lactation periods (Wilson et al., 2017).

The introduction of invasive species through shipping has so far been considered a relatively rare event, probably due to the climatic conditions (Gustavson et al., 2020). However, scarce data exists for many Arctic regions (Chan et al., 2019). Among the known marine invasions in the Arctic, almost half have been caused by shipping activities acting as means of transport for alien species (Chan et al., 2019). Regions of the Arctic which could be more vulnerable to future invasions were identified to be Hudson Bay, Northern Grand Banks/Labrador, the Chukchi/Eastern Bering seas and the Barents/White seas (Goldsmit et al., 2020).

Trends

The decline of Arctic sea ice is generally expected to lead to increased commercial shipping along the Northeast Passage and the Northwest Passage in the coming years. According to climate predictions, the sea ice will diminish more rapidly along Russia's coast than in the Canadian archipelago, meaning that the Northeast Passage will most likely open sooner for trans-Arctic shipping than the Northwest Passage and will likely become an important gateway from the Pacific to the Atlantic in the future (O'Rourke et al., 2021; CAFF, 2017).

In a 2018 Presidential Decree Russian President, Vladimir Putin, said the Northern Sea Route would become "the key to the development of the Russian Arctic and Far East regions", and announced the objective of increasing the volume of cargo transported along the Northern Sea Route to 80 million tons by 2024 (SKOLKOVO Institute for Emerging Market Studies, 2021). This ambition is also shared by China, which has started a special programme for Arctic shipping as part of the Arctic Silk Road (Glomsrød et al., 2021).

Despite these political ambitions, the rate at which traffic will increase remains highly uncertain as growth will be driven by the pace and extent of natural resource development in the region as well as by factors outside the Arctic, such as plans to deepen the Panama and Suez canals (Spohr et al., 2021; CAFF, 2017). In light of Russia's invasion of Ukraine and the associated political consequences, further infrastructure and fleet development may face serious hurdles and their prospects are currently unclear.

Navigation in Arctic waters will remain challenging for the foreseeable future. While the sea ice will diminish, it will still be present for most of the year and icebergs may emerge as a significant obstacle to Arctic shipping since their flow patterns are difficult to predict (O'Rourke et al., 2021; Chircop et al., 2020). Remoteness and the lack of adequate infrastructure and services add to the current and future challenges associated with Arctic shipping, especially along the Northwest Passage (Chircop et al., 2020; McGee, 2020; Tugushev, 2020). In addition, sea level rise, the increasing frequency of storms, and the thawing of permafrost pose the risk of erosion and damages to infrastructure as well as key ports and terminals in the long-term (McGee, 2020).

With regards to the fuels used in Arctic shipping, a shift towards alternatives to oil-based fuels is expected to happen in the future as a result of more stringent regulations by the IMO (PAME, 2020). Recently approved amendments to MARPOL Annex I introduced a prohibition on the use and carriage for use as fuel of heavy fuel oil by ships in Arctic waters from 1 July 2024. The regulation has been criticised for not being strict enough as it includes several waivers and exceptions which, if applied fully, would only reduce the use of heavy fuel oil by 16% (based on 2019 shipping data) (Comer et al., 2020).

In the more distant future, transpolar routes through the Central Arctic Ocean may be organised. This route has so far not been tested by commercial shipping though and experts anticipate that it will not be viable for several more decades (Chircop et al., 2020).

4.3 Offshore Oil and Gas Exploration

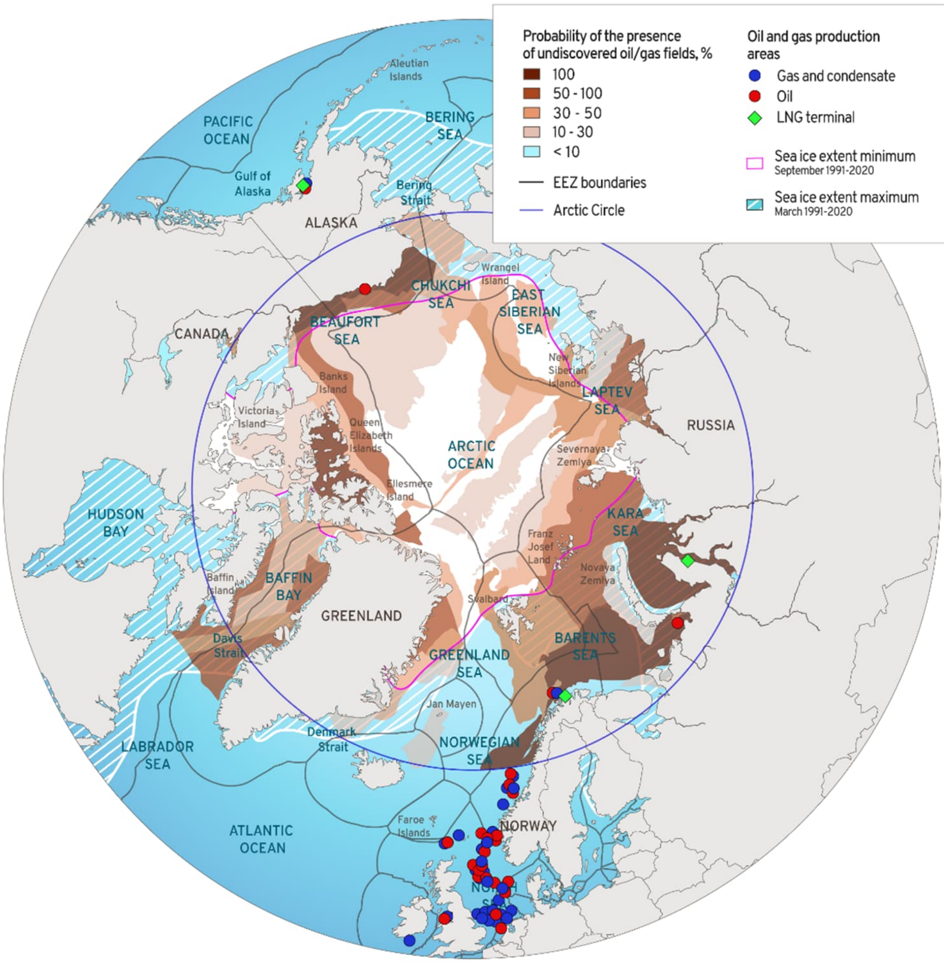

Figure 9: Current oil and gas production areas and probability of the presence of at least one undiscovered oil and/or gas field with recoverable resources greater than 50 million barrels of oil equivalent according to USGS 2009 survey results. IASS visualisation based on Copernicus Climate Change Service/ECMWF (2021a, 2021b), Flanders Marine Institute (2019), Gazprom (2019), Government of Newfoundland and Labrador (2021), GRID-Arendal (2019), Löschke & Lehmköster (2019), State of Alaska, Department of Natural Resources, Division of Oil and Gas (2013), and Bird et al. (2008).

Socio-Cultural and Economic Relevance

Exploitation of Arctic oil and gas resources began in the 1920s with onshore production, with offshore drilling activities commencing significantly later in the 1970s (Tarantola et al., 2019). The first offshore field in Alaska's Prudhoe Bay field started producing in 1977 (Strategic Assessment of Development of the Arctic, 2014). Due to the extreme conditions, offshore exploration and exploitation in the Arctic are both costly and risky. This explains the slower pace of offshore development. Up to now, few fields have entered production and offshore oil and gas activities in the region have fluctuated in the past because of changing oil prices, development costs, and regulations (O'Rourke et al., 2021). Several of the producing fields have faced cost overruns and time delays, indicating the difficulties of offshore production in Arctic waters. The Goliat field in Norway, for example, started production two years behind schedule and significantly over its original budget, while the Shtokman field in Russia has been postponed indefinitely due to technical issues and changing market conditions (Henderson & Loe, 2016).

The growing extent of ice-free ocean areas in the Arctic as well as the estimates of the first extensive assessment of Arctic oil and gas resources by the United States Geological Survey (USGS) in 2008 increased interest in exploring offshore oil and gas resources in the Arctic (O'Rourke et al., 2021; Spohr et al., 2021). The USGS assessment suggested that the area north of the Arctic Circle holds as much as 30% of the globally undiscovered but recoverable gas and 13% of the oil reserves (Tarantola et al., 2019; Figure 9). While this assessment is based on many presumptions due to a lack of information (Henderson & Loe, 2016), it has fuelled interest in Arctic offshore hydrocarbon resources and sparked questions of territory and ownership (Spohr et al., 2021).

To date, there is no consensus as to whether hydrocarbon reserves should be further explored and exploited or left untouched. On the one hand, offshore oil and gas production activities may be important for generating income and building and sustaining economies in the High North. This is, for example, the case for 'mature' oil and gas nations such as Norway and the Russian Federation, which are looking to exploit offshore resources in the Arctic to balance the declining output of more easily accessible fields further south.

On the other hand, environmental NGOs and local communities in many regions have campaigned to halt oil and gas extraction due to the environmental risks associated with operations in the Arctic. Two recent examples are the lawsuit brought against the Norwegian government by Greenpeace, Friends of the Earth Norway, the Grandparents Climate Campaign and Young Friends of the Earth to prevent drilling in the Barents Sea (SKOLKOVO Institute for Emerging Market Studies, 2021) and the appeal initiated by the Center for Biological Diversity, Defenders of Wildlife, Friends of the Earth, Greenpeace USA and Pacific Environment, which overturned the approval for the Liberty production facility in the Beaufort Sea (Ruskin, 2020).

In 2016, the governments of Canada and the United States announced a moratorium on new offshore oil and gas licences in their Arctic waters in the US-Canada Joint Arctic Leaders' Statement. Under President Trump, the United States government overturned the decision, but the moratorium has been upheld by Canada. Under the moratorium, the Canadian government works with northern partners to co-develop a new governance framework for oil and gas exploration and exploitation in the Beaufort Sea, including a revenue-sharing agreement with the governments of the Northwest Territories and Yukon, and the Inuvialuit Regional Corporation. The moratorium is to be reviewed every five years through a science-based life-cycle impact assessment review taking into account marine and climate change science (PAME, 2021d).

Under President Biden, the United States administration paused new oil and natural gas developments on public lands and offshore by an Executive Order in January 2021 until a comprehensive review of permitting and leasing practices, including potential climate and other impacts associated with oil and gas activities is completed (PAME, 2021c).

In Greenland, the government showed much interest in exploring and exploiting subsurface hydrocarbons in order to attain the long-term goal of becoming economically independent from Denmark (Poppel, 2018). However, an extended slump in the price of crude oil led the petroleum industry to reconsider its prospects there in recent years. In 2021, the government of Greenland took the decision to not issue any further licences for oil and gas exploration in Greenland, due to economic calculations as well as the potential impact on climate and the environment (Government of Greenland, 2021; Poppel, 2018). Currently, one offshore oil and gas exploration and exploitation licence in Greenland remains active west of Nuuk (Nunaoil, 2022).

Main Areas

Exploration activities including seismic surveys and the drilling of exploratory wells have been carried out by all Arctic coastal states and are currently being actively pursued in the Arctic waters of Norway and the Russian Federation. Offshore oil and gas production on the Arctic shelves are currently being conducted by Norway, the Russian Federation, and the United States (Figure 9).

Norway has two active offshore production facilities in the Arctic: the Goliat oil field and the Snøhvit gas field, both of which are in the Barents Sea. Natural gas from the Snøhvit field is turned into liquefied natural gas on the island of Melkøya and then loaded onto tankers. A fire in September 2020 caused severe damages to the LNG plant and halted production. After extensive repairs, production restarted in June 2022 (Pekic, 2022). A third field, Johan Castberg, also located in the Barents Sea, is expected to commence oil production by 2024 (Norwegian Petroleum, 2021). No other country in the circumpolar Arctic has allowed for oil drilling further north than Norway (Nilsen, 2020).

The United States is currently producing oil in the Beaufort Sea. Production facilities include the Northstar production complex, located northwest of Prudhoe Bay on the artificial Northstar Island, and the Nikaitchuq oil field, lying at three metres depth off the shore of the North Slope (PAME, 2021d). A third production facility in the Beaufort Sea, Liberty, was approved by the Bureau of Ocean Energy Management in 2018 but a federal appeals court overturned this decision in 2020 when environmental groups brought a case arguing that the project review was inadequate (Ruskin, 2020).

The Russian Federation currently has one active offshore production site, the Prirazlomnoye oil field, which is located at 20 metres depth in the Pechora Sea (Glomsrød et al., 2021).

Related Impacts

Oil and gas exploration and exploitation affects marine environments by posing the risk of massive oil leaks, as well as noise and hydrocarbon pollution from drilling, and habitat disturbance. The impacts depend on the activities being carried out during the main phases of exploration, production, and decommissioning. The actual extraction process is likely the single greatest human-induced contributor to pollution locally due to the release of toxic compounds and occasional accidents related to the production (CAFF, 2017).

The exploration phase involves several activities. Typically, seismic surveys are conducted as a starting point to understand the geology and identify potential hydrocarbon reservoirs. Impacts of seismic surveys include loud underwater sound and light emissions as well as increased vessel activity. While the sound levels of the seismic survey vary in intensity, some have been detected almost 4,000 kilometres away from survey vessels (Cordes et al., 2016). Impact assessments of acoustic disturbance have so far principally focused on marine mammals, with reported effects including disruption of normal behaviour related to feeding, breeding, resting, migration, masking of sounds, as well as hearing damage. The effects on fish and invertebrates are not well studied yet but may be considerable (Cordes et al., 2016). Concerns have been raised in Baffin Bay, where seismic site surveys carried out in 2012-2014 partially overlapped with a narwhal protection zone. Hunters from Melville Bay communities reported that narwhal behaviour had changed as a result of the seismic survey, negatively impacting local hunting activities (Poppel, 2018).

If promising reservoirs are detected, one or more exploration wells are drilled to gain insights into the nature of the reservoir. The drilling leads to the release and disposal of waste such as drill cuttings, excess cement, fluids (drilling mud), contaminated water, and other chemicals that may be damaging to the marine environment (Cordes et al., 2016).

The actual production phase usually starts with the drilling of one or more appraisal wells. In continuation, several production wells and surface infrastructure, including floating production, storage, and offloading vessels as well as subsea infrastructure, including anchors, cables and pipelines are installed. The installation of infrastructure may have detrimental direct impacts on habitats and associated fauna by disturbing the seabed through physical impacts and smothering. This is especially concerning with regards to fragile habitats, such as those formed by corals and sponges, which have little resilience to physical forces. The substantial amounts of artificial light related to production may also affect ecological processes, especially in the upper water column. Risks of contamination or pollution related to leaks in pipelines or water extracted during oil and gas recovery and then discharged into the environment is another concern as increased hydrocarbon concentrations and metal abundance may alter biogeochemical processes and lead to community-level changes. The direct impacts of infrastructure installation typically occur within a radius of around 100 metres from the installation whereas discharges of drilling muds and produced water can spread over two kilometres (Cordes et al., 2016). Lastly, decommissioning can have direct impacts on the seafloor and may introduce contaminants to the environment (Cordes et al., 2016).

While these are all impacts of routine operations, the greatest risk to the marine environment is the uncontrolled release of hydrocarbons from a reservoir, known as a blowout (Cordes et al., 2016). Such incidents can result in the uncontrolled release of large amounts of crude oil over an extended period, leading to severe economic and environmental impacts (Tarantola et al., 2019). The exact impacts such oil spills may have in the Arctic are not well understood since information regarding the long-term effects of oil and its environmental persistence within the Arctic is limited (O'Rourke et al., 2021). What is clear though is that ice-covered waters, as well as comparatively short food chains, render the Arctic ecosystems more vulnerable to oil pollution than ecosystems in more temperate waters (Tarantola et al., 2019).

No major oil spill has happened in the Arctic so far, but the risk of such an accident arguably increases as oil and gas operations move into deeper waters and harsher marine environments characterised by strong winds, high waves, low temperatures, icing, icebergs, and poor visibility. Accidents at offshore installations in the Arctic or Sub-Arctic Seas have occurred despite the existing safety and environmental management systems. Examples are the sinking of the Kolskaya oil rig, which capsized in the Sea of Okhotsk in 2011, and the grounding of the Kulluk oil rig on a beach on Sitkalidak Island in 2013. Both accidents were related to the towing of drilling platforms to southern regions before the winter, a common practice for installations in Arctic Seas. In both cases, no environmental damage was reported but these accidents are nevertheless indicative of the risks associated with offshore operations in the High North (Tarantola et al., 2019).

The risk of adverse impacts on the marine environment in the Arctic is increased by the fact that oil spill response capability in the Arctic is a key concern. Available techniques are often less effective in remote and ice-covered Arctic waters than they are in more temperate waters. Moreover, the infrastructure and resources are estimated to be insufficient to respond to, contain, or clean spills in remote and hazardous sites (Tarantola et al., 2019) (Silber & Adams, 2019). In addition, the response gap where oil spill response activities would be unsafe or infeasible is expected to be extremely high in northern Arctic latitude when compared to other regions (O'Rourke et al., 2021).

Trends

While there may be a great potential for oil and gas discoveries in the Arctic, the operational difficulties as well as environmental and reputational risks associated with initiating production in the Arctic are considerable. Factors such as the remoteness of the region, the required technologies (such as specially constructed rigs that can resist ice flows and withstand harsh weather conditions), as well as the short drilling season make operations very costly. In the current market environment, only very large discoveries can justify such substantial investments (Henderson & Loe, 2016; Kay & Thorup, 2014). Indeed, plans for drillings and field developments have recently been delayed or even postponed due to the economic crisis spurred by the Covid-19 pandemic and growth in the sector is likely to be limited in the coming decade (AlaskaNor, 2020; Staalesen, 2020b).

Nonetheless, increased offshore production is being actively promoted in Norwegian and Russian Arctic waters. Offshore productions in these areas are seen as a way to compensate for falling production onshore as well as in the North and Norwegian seas (Henderson & Loe, 2016). Norway has concrete plans for new developments, including two oil fields in the Barents Sea: Johan Castberg, which is scheduled to start production in 2022, and Wisting, which is still in the planning phase (PAME, 2021d). Furthermore, the Norwegian government has issued several new production licences in the Barents Sea in both the previous and current year (Norwegian Ministry of Petroleum and Energy, 2021; Norwegian Petroleum Directorate, 2021; Fasoulis, 2021; Norwegian Ministry of Petroleum and Energy, 2022).

In the longer perspective, decreasing ice cover may change the conditions for oil, gas, and mineral exploration, and offshore extraction may become more economically viable in other parts of the Arctic as well once cheaper oil reserves are depleted and oil prices rise (Tarantola et al., 2019). But even with warmer temperatures, exploration and development in the Arctic will still be taking place in harsh conditions, especially in winter (O’Rourke et al., 2021).

4.4 Tourism

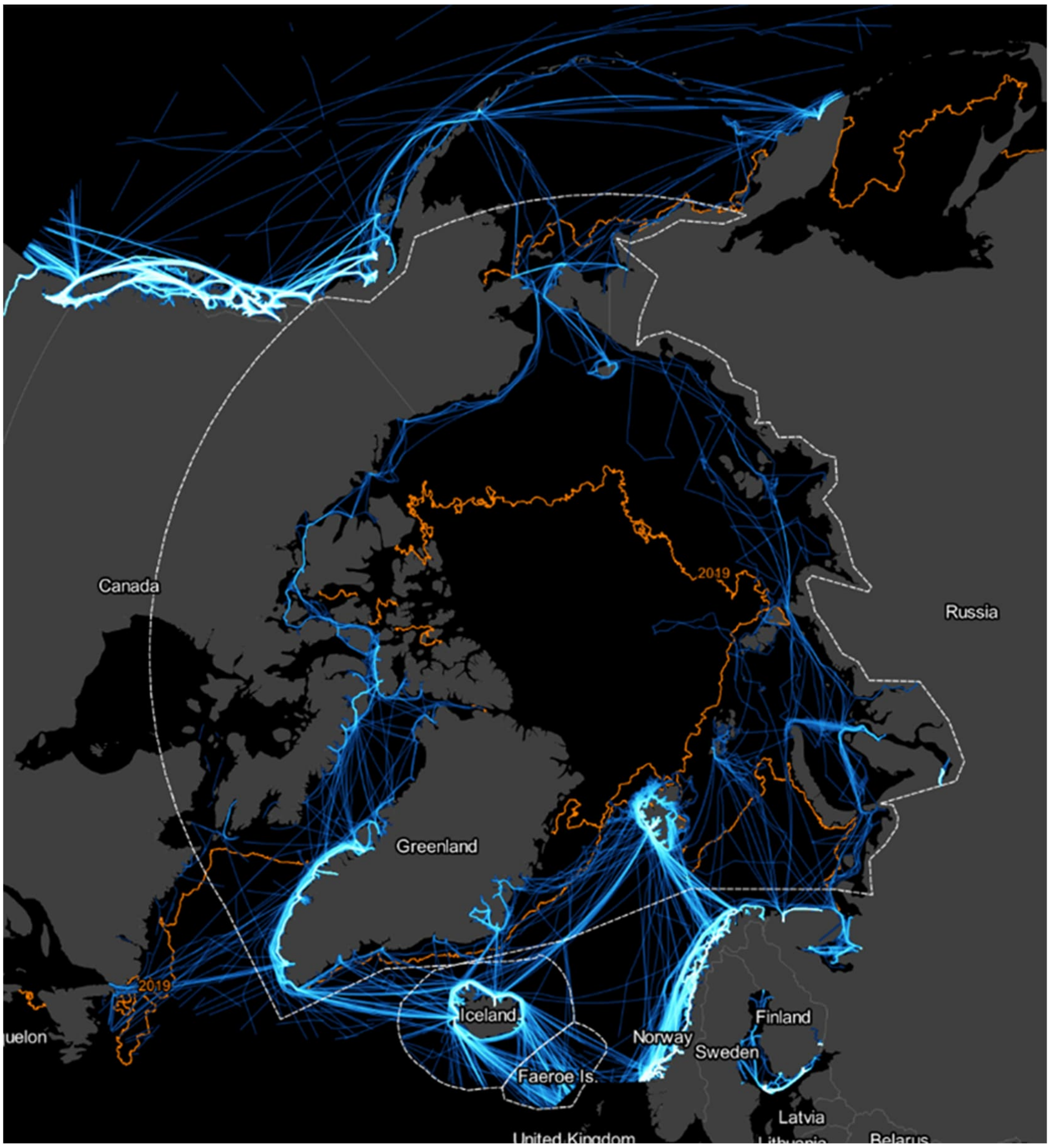

Figure 10: Tracks of tourism vessels in the Arctic in 2019. Source: PAME (2021a).

Socio-Cultural and Economic Relevance

Tourism activities have taken place in the Arctic for over two centuries and have been a cause for a major increase in human presence in the region in recent decades. Arctic tourism includes activities such as sport fishing, hunting, ecotourism, adventure tourism, culture and heritage tourism, animal watching, photography, and observing the northern lights, among others (Veijola & Strauss-Mazzullo, 2019).

Seaborne tourism is the fastest-developing area of tourism in the Arctic (Pasgaard et al., 2021). Passenger vessels engaged in tourism activities include a variety of vessels, including pleasure craft, expedition vessels, and cruise ships (PAME, 2021a). The number of individual passenger vessels operating in the Arctic as well as the size of the vessels and the overall passenger occupancy rates have gradually increased in recent years (PAME, 2021a). In addition, sea ice decline has extended operating seasons and eased access to remote destinations, such as the Canadian Arctic (Palma et al., 2019).

Cruise tourism has seen rapid growth over the past decades and the industry is the leading supplier of tourism in the Arctic (Pasgaard et al., 2021). Cruise passenger statistics from the Association of Arctic Expedition Cruise Operators (AECO) show a passenger increase of about 57% from 2008 to 2017, from 67,752 passengers in 2008 to 98,238 passengers in 2017 (Palma et al., 2019). Cruise passengers mainly visit Svalbard, followed by Greenland, Canada, Jan Mayen, and Franz Josef Land (Figure 11).

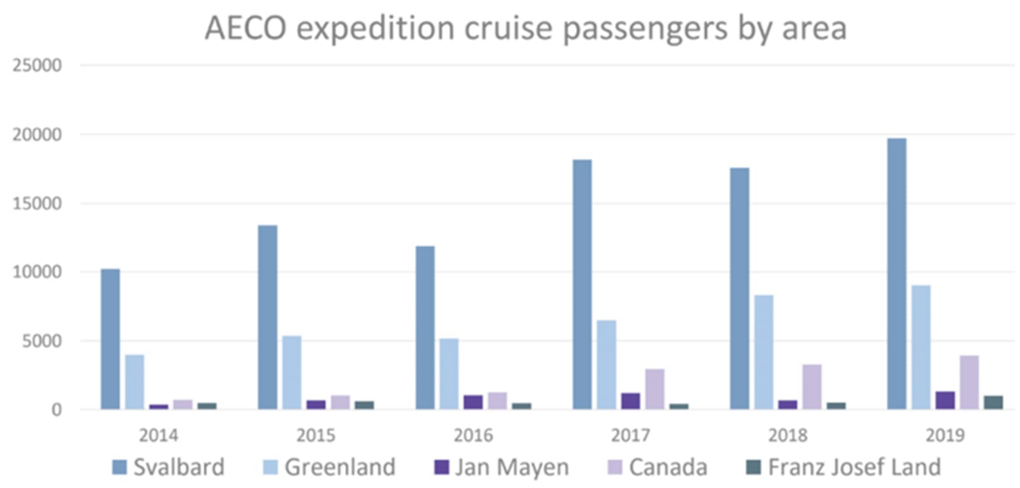

Figure 11: Expedition cruise passengers by area. Source: AECO (2019)[2].

The core attractions of cruises differ across the region but mainly focus on landscapes and wildlife. A so-called ‘last-chance tourism’ industry has developed in the Arctic, in which visitors are drawn to the region to observe iconic species such as the polar bear and landscapes such as icebergs and glaciers ‘before they are gone’ (Pasgaard et al., 2021).

Arctic tourism is generally considered to be a driver of economic development and to present opportunities for generating income and employment (Pasgaard et al., 2021; Lukina et al., 2020). The actual economic significance of tourism activities, the social and environmental impacts, as well as the societal acceptance of promoting certain areas as tourist destinations varies greatly across and within Arctic regions (Stephen, 2018). Indeed, many jobs in the tourism sector are only seasonal and are only low paid (Veijola & Strauss-Mazzullo, 2019) while the main economic benefits are reaped by big tour operators located mainly outside the Arctic (Stephen, 2018).

[2] Part of the growth shown in the chart is due to AECO’s membership increase in recent years, resulting in more operators now reporting their passenger numbers to AECO. Moreover, passengers who travel on so-called conventional cruises are not included in the AECO statistics.

Main Areas

The main areas for tourism vessels in the Arctic are around the archipelago of Svalbard and along the Norwegian coast. Other areas frequented by tourist vessels are the southwest of Greenland as well as the Canadian Arctic, especially along the southern route of the Northwest Passage and on the eastern side of Baffin Island. In the Russian Arctic, the main destinations for tourism vessels are Franz Josef Land, the archipelago of Novaya Zemlya and Wrangel Island (Figure 10). The Russian Federation is the only Arctic country offering tours to the North Pole.

Related Impacts

While the environmental impacts of tourist activities in the Arctic have not yet been systematically assessed (Pasgaard et al., 2021), certain effects of tourism are apparent, including the disturbance of wildlife, the introduction of invasive species, and increased pollution (Pasgaard et al., 2021; PAME, 2021c). Many of these actual and/or potential impacts are also associated with other vessels operating in the Arctic waters (see chapter 4.2 on impacts of shipping), but a few impacts are specific to tourism activities. For example, some cruise vessels tend to navigate in the marginal ice zone since the ice floes and icebergs as well as the associated wildlife are of primary interest to tourists. This may be problematic since the marginal ice zone is a challenging navigational environment with an associated increased risk of accidents and other emergencies (Palma et al., 2019). In addition, tourism activities may lead to increasing levels of pollution and waste in the most frequented areas and may cause the disturbance of wildlife (Stephen, 2018). Especially touristic activities that include the observations of wildlife such as polar bears and whales may have a more direct impact on these species than normal shipping activities. Research has shown that unregulated whale watching negatively impacted the number of new-born calves in gatherings of beluga whales off the Solovetsky Archipelago, for example (Spiridonov et al., 2012).

Trends

The development of tourism in the Arctic has been very diverse and it is expected that the industry will continue to grow, albeit at different speeds and in different directions (Veijola & Strauss-Mazzullo, 2019). In general, it seems likely that tourism activities will expand and will increasingly venture to the remotest places in order to commercialise pristine nature. This assessment is supported by the fact that more and more specially designed expedition vessels with higher ice class are being built to be able to offer tours that go deeper into the Arctic. Before the Covid-19 pandemic, it was expected that around 108 expedition ships will be sailing in the Arctic by 2022. Another new trend for cruise tourism in the Arctic could be winter voyages (Nilsen, 2018).

4.5 Hunting

Socio-Cultural and Economic Relevance

Hunting of marine mammals and seabirds is fundamental to many regions of the Arctic and is intimately linked with the history of human settlement in several regions. A distinction can generally be drawn between commercial, recreational/sports, and subsistence hunting, but the definition of these categories for regulatory purposes varies among the Arctic countries.

Commercial hunting of seabirds and marine mammals including polar bears, seals and whales took place in the past, but has now largely been banned. Notable exceptions include legislation in Greenland that allow the local selling of subsistence harvest of seabirds (Merkel, 2010) and Norway, which engages in commercial whaling of minke whales under an objection to the ban on commercial whaling established under the International Whaling Commission (IWC, 2022a).

Apart from these exceptions, several national, regional and international agreements and regulations largely limit the right to harvest seabirds and marine mammals to subsistence harvesting by Indigenous Peoples and certain northern communities.

The level of dependence on subsistence hunting differs among regions and is most significant in more rural Arctic communities (CAFF, 2019). Calculating the monetary value of subsistence-related hunting activities is challenging because these activities are mostly invisible in official statistics (with notable exceptions in Alaska and Greenland). According to official estimates, the formal and informal value of hunting accounts for less than 4% of Greenland's gross domestic product (GDP) (Government of Greenland, 2010).

Subsistence hunting activities are closely connected to the identities and traditions of coastal communities, meaning that their value goes far beyond their role in food security and individual health (Glomsrød et al., 2021; PAME, 2021b). Traditional foods of Indigenous communities are interwoven with self- and cultural identity. The hunting and harvesting of marine mammals and the preparing and sharing of food contributes to the perception of family and community and reinforces the relationship between Arctic Indigenous Peoples and the environment (PAME, 2021b).

The species hunted vary across Arctic communities and include seals, walrus, polar bears, whales, seabirds, and waterfowl.

Seabirds and waterfowl are hunted in every Arctic country (CAFF, 2019). The number of birds assumed to be harvested varies greatly between the Arctic nations. While the number of harvested individuals is estimated to be below 5,000 birds per year in Norway and Svalbard, Canada and Greenland were recently harvesting as many as 250,000 seabirds annually. In the Russian Arctic, waterfowl and some seabirds are hunted for both subsistence and recreational purposes (Spiridonov et al., 2020). The most common species harvested depend on traditions and distribution. In a circumpolar view, murres and eiders are harvested in the greatest numbers (Merkel, 2010).

The whales hunted vary across communities and include, inter alia, minke whales, gray whales, narwhals, belugas, harbour porpoises and dolphins. Chukotkan whaling activities traditionally target gray whales and bowhead whales (IWC, 2022a).

In addition, different species of seals and walrus are hunted across the Arctic (Spiridonov et al., 2020). Subsistance hunting for seals by Indigenous Peoples takes place in all Arctic coastal states. Commercial seal hunting is carried out in Canada, Norway and the Russian Federation. In Greenland, the seal hunt targets harp seal, as well as ringed and grey seals and has a strong commercial nature as around half of the seals hunted are sold commercially (Sellheim, 2015). Across the Arctic, around 798 polar bears are harvested annually, with the vast majority being harvested for subsistence, while around 6% are harvested for sport in Canada, and a minor proportion is killed in order to defend life and property. Most of the polar bears are harvested in Canada, where anyone can harvest a polar bear within a quota system managed by Inuit communities. In Alaska, polar bear harvest by the Inupiat is allowed and in Greenland, polar bears are harvested by professional Inuit hunters. Harvesting of polar bears is illegal in Norway and the Russian Federation, although concerns of poaching were raised in the Russian Federation (Peacock, 2017; Priemskaya, 2019).

Main Areas

The quantity and kinds of harvested species varies by region, culture, and community (PAME, 2021b). Data on catches is not readily available. Based on catch data reports submitted to IWC, NAMMCO and ICES, a rough idea of key sites emerges for the harvesting of some species. These main areas include West Greenland and areas around Newfoundland and St. Lawrence in Canada, where several species of whales and seals are harvested. Another area is the Chukchi Sea and Bering Sea where whales and seals are harvested by both Russian and Alaskan communities. Polar bears are primarily harvested in Canada (Merkel, 2010; IWC, 2021a; ICES, 2019; NAMMCO, 2021a; Peacock, 2017; Sellheim, 2015).

Related Impacts

The most direct impact of hunting is the death of the target species (CAFF, 2017). Since most of the harvested species of birds and marine mammals are migratory, they are exposed to subsistence, and, to a lesser extent, also recreational or commercial hunting, in several countries, including beyond the Arctic (CAFF, 2019).

Marine mammal species overexploited in the past include walruses, polar bears, whales, and seals. Walrus populations in the Canadian North Atlantic, Svalbard and Franz Josef Land decreased significantly from the sixteenth to the twentieth century due to industrial-scale hunting by commercial European and North American hunters and, to a far smaller extent, Indigenous communities (Keighley et al., 2019). Also, harvesting levels of polar bear populations in the Baffin Bay (Avannaata Imaa) and Kane Basin shared by Canada and Greenland were estimated to be non-sustainable in the early 2000s (Government of Greenland, 2010; PAME, 2012) and the current population size of bowhead whales is still reduced due to unsustainable hunting in the past (CAFF, 2017).

In most Arctic countries, hunting levels have declined in recent years though (CAFF, 2017). Quotas that are set based on scientific assessments regulate current harvest levels of most species. Several populations with known status are increasing or stable. Exceptions are decreasing populations of beluga whales in the White Sea, polar bears in the southern Beaufort Sea, and hooded seals in the Greenland Sea, which may struggle to recover due to climate change impacts (CAFF, 2017).

The impact of harvesting on seabird populations is often poorly documented in the Arctic but it is estimated that it plays an important role in the population dynamics of several species. Substantial declines in breeding populations caused by the over-harvesting of seabirds and eggs could, for example, be documented for common eiders in Greenland and Canada as well as thick-billed murres in Greenland (CAFF, 2017).

Trends

Indigenous communities expressed concern that changing ice conditions and wildlife migration patterns resulting from the rapidly changing climate in the North are rendering some traditional hunting methods and harvesting grounds increasingly unpredictable and insecure. The shorter snow cover season and the diminishing extent and thickness of sea ice, for example, affect the ability to travel to hunting grounds and thus change the access to some target species (PAME, 2021b).

4.6 Aquaculture

Socio-Cultural and Economic Relevance

Offshore aquaculture activities in Arctic waters are currently only being developed on a large scale in Norway. Aquaculture production in the Norwegian EEZ has grown significantly since the mid-1980s and has stabilised at a production level of around 1,300,000 tonnes from 2012 onwards. Today, it is a largely industrial, modern and highly competitive sector. Production is dominated by Atlantic salmon farmed in marine cages in coastal areas. Other important farmed species include rainbow trout and Atlantic cod (Centre for the Ocean and the Arctic, 2019; FAO, 2022c).

Pilot projects for offshore aquaculture exist in Russia, Greenland, Alaska, and Canada. In Alaskan waters, fish farming is prohibited but the farming of aquatic plants such as seaweeds and shellfish such as Pacific oysters, littleneck clams, and mussels has increased in recent years (Raspotnik et al., 2021). In Greenland, the government-owned seafood company Royal Greenland A/S conducted experiments with Atlantic cod, and the Greenland Institute of Natural Resources is exploring options for seaweed production. In addition, there have been efforts to farm char and blue mussels, but production proved unprofitable, partly because much of the land and surrounding water bodies are frozen or covered by ice during (parts of) the year (FAO, 2022a). In the Russian Arctic, very limited marine aquaculture production exists in the Barents Sea and the White Sea where Atlantic salmon and sea trout are farmed (Pauly et al, 2020). The federal government plans to introduce additional supporting measures to stimulate investments since the high initial price of sites is perceived to be one of the largest obstacles to further developing the sector (Stupachenko, 2020).

Main Areas

Currently, offshore aquaculture in the Arctic mainly happens in open cages in the Norwegian Arctic. In 2018, 393 aquaculture production sites were located in the two northernmost counties of Nordland and Troms og Finnmark (Centre for the Ocean and the Arctic, 2019a).

Related Impacts

The main issues associated with aquaculture facilities are the spread of sea lice; escapes of farmed fish and related genetic impacts on wild fish; and discharges of waste, including nutrients and organic material as well as hazardous substances, including copper and delousing agents (Norwegian Ministry of Climate and Environment, 2020).

Especially the impacts of sea lice infection, as well as the interbreeding of cultured and wild salmon have caused great concern about the environmental implications of further growth in salmon aquaculture (Østhagen et al., 2022). Salmon lice are parasitic crustaceans, which are found naturally in all sea areas in the northern hemisphere. Monitoring of salmon lice in Norway indicated that their numbers are growing and that they have become resistant to chemical treatment methods. New methods such as cleaner fish and freshwater or high-temperature bath treatments have been introduced to control the lice, but this issue continues to pose a significant challenge for further growth in offshore aquaculture in Norway as parasites can spread freely from farmed to wild fish (SDWG, 2021).

Furthermore, investigations are ongoing regarding the possible impact of the wear of feed pipes as a source of microplastic pollution (Centre for the Ocean and the Arctic, 2019a). These impacts are observed in coastal aquaculture activities and are expected to be similar in offshore aquaculture activities (Norwegian Ministry of Climate and Environment, 2020).

Trends

Most of the future growth in Norwegian aquaculture is expected to occur in the Norwegian Arctic. The cold water in the region is expected to reduce aquaculture production challenges related to sea lice and diseases and some companies have already started production in more exposed locations, applying marine construction technology developed by the offshore oil and gas and maritime industries (Centre for the Ocean and the Arctic, 2019; SalMar, 2021; McDonagh, 2021).

In addition, trials are being conducted in Norway for the farming of other species such as halibut, mussels, char, spotted catfish and cod and using new concepts (SDWG, 2021). The farming of macroalgae (seaweed and kelp) for instance is already becoming more widespread and there is also ongoing research on combining kelp and salmon farming since kelp can make use of dissolved nutrients from salmon production (Norwegian Ministry of Climate and Environment, 2020).

In Alaska, ambitions exist to expand mariculture (i.e. the growing of marine plants) production from its current level of less than one million US dollars to one billion US dollars within 30 years (Alaska-Nor, 2020).

4.7 Emerging Activities

4.7.1 Offshore wind

In many parts of the Arctic region offshore wind conditions are suitable for the development of wind energy (Mitko, 2020; Østhagen et al., 2022). To date, however, no power-generating installations exist in the Arctic waters.

Among the Arctic coastal countries, only Norway has concrete plans for the development of an offshore wind industry in the Arctic seas. In Norway, the government has identified suitable areas for offshore wind power, some of which are located in Arctic waters (Norwegian Ministry of Climate and Environment, 2017). In 2020, two of the identified areas were opened for licence applications. Both areas are located in the North Sea (Ministry of Petroleum and Energy, 2020).

In the Russian Federation, the government of the Republic of Karelia and the Chinese energy service provider Sinomec signed an agreement in 2016 to cooperate on an offshore wind project in the White Sea but the project has stalled (TASS, 2018).

Related Impacts

Environmental pressures associated with offshore wind farm development are in general associated with infrastructure (cables, anchors, etc.), the possibility of vessels colliding with wind turbine towers, possible barrier effects for seabirds, and noise. During the construction work and maintenance operations, vessel operations and the use of explosives produce physical disturbance and noise. During the operational phase, wind turbines present a permanent source of noise (Norwegian Ministry of the Environment, 2009).

4.7.2 Seabed mining

Arctic coastal states' interest in exploiting potential seabed resources has been increasing in recent years. In particular, Norway has been assessing seabed mineral deposits in recent years and may issue licenses for deep seabed mining as early as 2023 (Adomaitis, 2021).

Related Impacts

The environmental impacts associated with seabed mining vary depending on the type of deposit, its physical and chemical properties, the geographic location, and the extraction technologies used. Mining activities may lead to the destruction of benthic and hydrothermal vent habitats and ecological communities. In addition to the direct impacts on the sea floor, mining may also affect the midwater column because of the transportation of the mined minerals or the possible release of discharge water containing metal-rich particles from the crusts or sulphides which could be ingested by organisms. Besides, mining vessels have an environmental impact comparable to other shipping activities (Koschinsky et al., 2018).

4.7.3 Submarine fibre-optic cables

At the moment, two major submarine fibre-optic cable projects are planned in the Arctic. The "Far North Fiber Express Route", led by Finnish company Cinia, is an international project that aims to build a fibre-optic route through the Arctic Ocean from Asia to North America and Northern Europe via the Northwest Passage by the end of 2025 (Nilsen, 2021a). The Russian "Polar Express" project aims to connect the Murmansk region with Vladivostok by 2026 with a submarine cable running along Russia's Arctic coast (Nilsen, 2021b).

Related Impacts

The submarine fibre-optic cables themselves are rather small in dimension, and their installation, maintenance and repair can be undertaken with minimal impact on the marine environment. However, there is still a risk of damage to vulnerable seabed habitats caused by burying cables, for which various methods, like ploughing and jetting, are used. Activities such as surveying cable routes and repairing submarine cables may also cause pollution or harmful the marine environment (Jurdana et al, 2014).

5 Governance of the Arctic Marine Environment

Figure 12: MPAs and other area-based management tools in the Arctic. IASS visualisation based on Flanders Marine Institute (2019), GRID-Arendal (2019), Ocean Conservancy (2021), Ramsar (2017), UNEP-WCMC and IUCN (2022), UNESCO (2021b).

A range of institutions and agreements have been developed at the international, regional and national levels to regulate human activities and ensure the conservation and sustainable use of marine biodiversity. The institutions and agreements in place either holistically aim to contribute to the sustainable use and conservation of marine biodiversity, address specific sectors/pressures, or focus on specific marine species.

In this chapter, an overview of relevant international and regional agreements and frameworks with implications for the conservation and sustainable use of marine biodiversity in Arctic waters will be provided. The key international and regional organisations and legal agreements relevant to marine conservation in the Arctic are depicted in Figure 13 and Figure 20 respectively. In Annex 1, Table 1, an overview of the membership and treaty ratification status by the Arctic coastal states is presented.

The applicable national rules and regulations governing sea-based human activities as well as with regards to the establishment of conservation tools are explained in further detail in the national case studies. This study provides a broad overview of the conservation tools in place (see Figure 12) and a more detailed explanation of those which are directly related to the described international and regional agreements and frameworks. Since all the marine protected areas (MPAs) in the Arctic are established under national jurisdiction, their designation and management are not covered in this report but are discussed in detail in the national case studies (see Introduction).

Apart from these ‘official’ regulations, Indigenous management practices contribute to conservation outcomes. Arctic Indigenous Peoples have been stewarding the land and sea for thousands of years, which has resulted in sustained biodiversity conservation (Indigenous Circle of Experts, 2018). The contribution of such efforts to area-based conservation is oftentimes not considered, though, as governments may not recognise the efforts as formally designating protected areas, the areas may not meet national or international definitions; and/or those managing the area may not want it to be designated as a protected area (PAME, 2017).

5.1 Main International Intergovernmental Institutions and Agreements

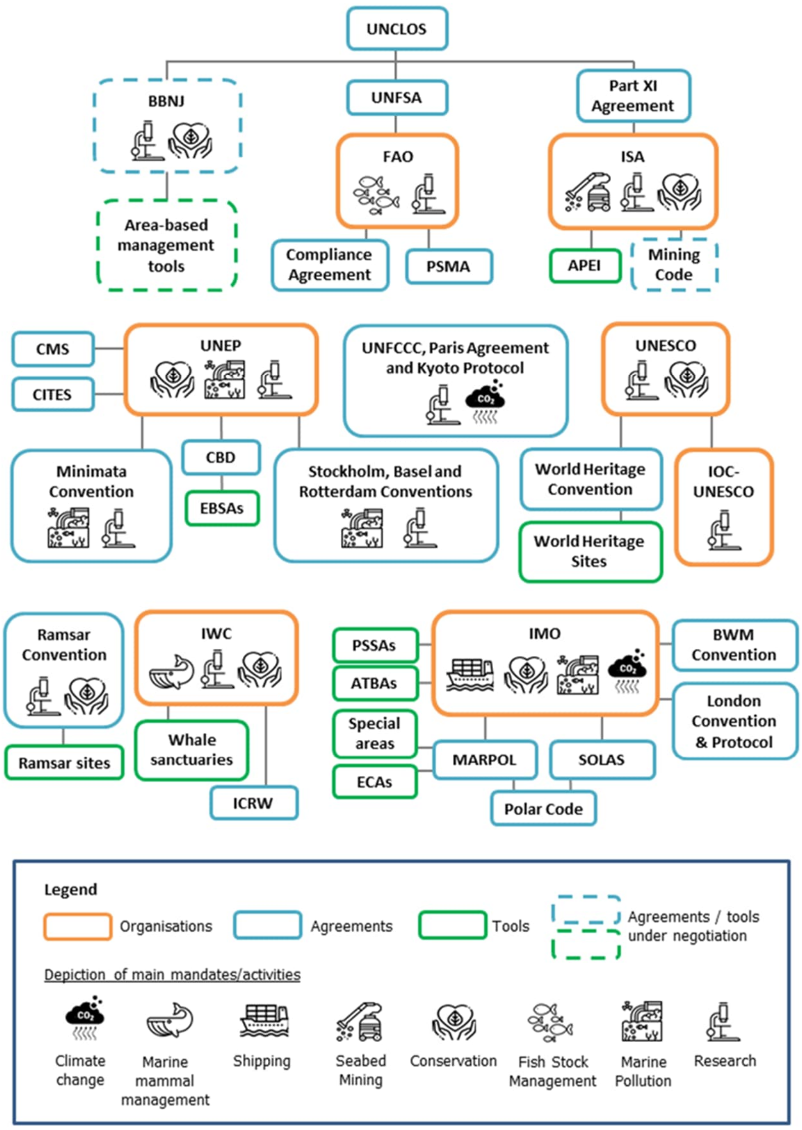

Figure 13: Key international organisations and legal agreements relevant to marine conservation in the Arctic. IASS visualisation.

The conservation and sustainable use of marine biodiversity in Arctic waters is based on the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which is complemented by other instruments, frameworks and agreements, such as those established under the Convention on Biological Diversity (CBD), the Food and Agriculture Organization of the United Nations (FAO), the International Maritime Organization (IMO), the United Nations Environment Programme (UNEP), the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), the UNESCO World Heritage Convention, and the International Whaling Commission (IWC).

UNCLOS is a framework convention that relies on implementation through relevant organisations at international, regional and/or national level. Under UNCLOS, implementation agreements have been negotiated to provide guidance on the implementation of the convention with regards to deep seabed minerals and fisheries. A third implementation agreement related to the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction is currently under negotiation (UN BBNJ process).

This chapter provides an overview of the key international organisations and legal agreements relevant to marine conservation in the Arctic as well as the rules, regulations and tools which are, or could be, employed to protect the Arctic marine biodiversity and ensure its sustainable use (Figure 13). In Annex 1, Table 1, an overview of the membership and treaty ratification status by the Arctic coastal states is presented.

5.1.1 United Nations Convention on the Law of the Sea (UNCLOS)

The 1982 United Nations Convention on the Law of the Sea (UNCLOS) provides the overall legal framework as well as some detailed regulations for the utilisation and protection of the world's oceans, including the Arctic Ocean (Sfraga et al., 2020). While the United States is not a signatory to UNCLOS, scholars generally agree that most of the UNCLOS provisions are customary international law and as such also constrain the actions of the United States (Bankes & Neves, 2020).

Under UNCLOS, foreign ships have the so-called 'right of innocent passage' through territorial seas (Spohr et al., 2021). Of special importance to the Arctic, UNCLOS Article 234 allows coastal states the adoption and enforcement of non-discriminatory pollution prevention, reduction and control laws within the waters of the EEZ that are ice-covered for most of the year. The Russian Federation and Canada have used this article to introduce special rules and regulations for shipping in the Northern Sea Route and the Canadian Arctic (Spohr et al., 2021).

In accordance with the provisions of UNCLOS, each Arctic state has established the following maritime zones: Internal Waters; a Territorial Sea (12 nautical miles); a Contiguous Zone (24 nautical miles); and an Exclusive Economic Zone (200 nautical miles). In these zones, the coastal states have full sovereign rights with regards to the exploration, exploitation, conservation, and management of the living and non-living natural resources of the water column and the seabed. The Arctic coastal states have no exclusive rights to the waters beyond national jurisdiction, the so-called 'high seas', and the seabed and subsoil beyond national jurisdiction, called 'The Area' (Figure 14).

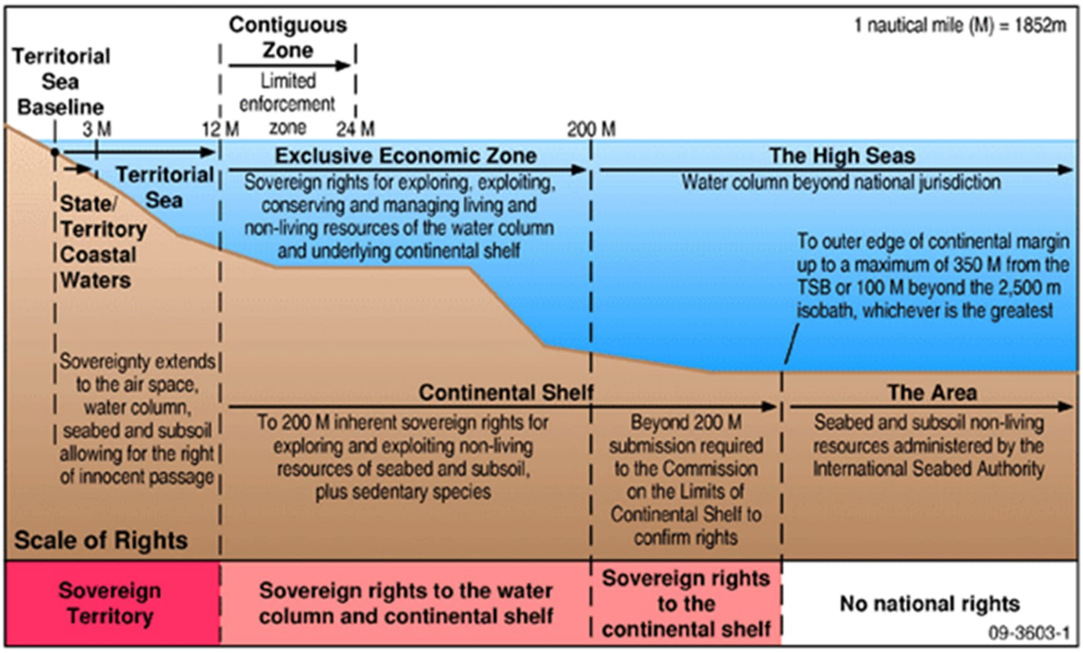

Figure 14: Maritime zones and rights under the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Source: NOAA (2020).

Under UNCLOS, coastal states may extend their sovereign rights to the continental shelf where it extends beyond the 200 nautical miles limit. All of the Arctic coastal states have undertaken exploration activities as well as efforts to map the extent of their continental margins beyond the 200 nautical mile EEZ limit. Norway, the Russian Federation, Canada and Denmark have submitted respective data for review to the UN Commission on the Limits of the Continental Shelf (Figure 15). Norway has already established outer limits of its continental shelf beyond 200 nautical miles based on the recommendation of the UN Commission on the Limits of the Continental Shelf (UN CLCS), while the data submitted by the Russian Federation, Canada and Denmark is still under review. Since the US has not ratified UNCLOS, it currently cannot submit data to the UN CLCS (Tarantola et al., 2019).

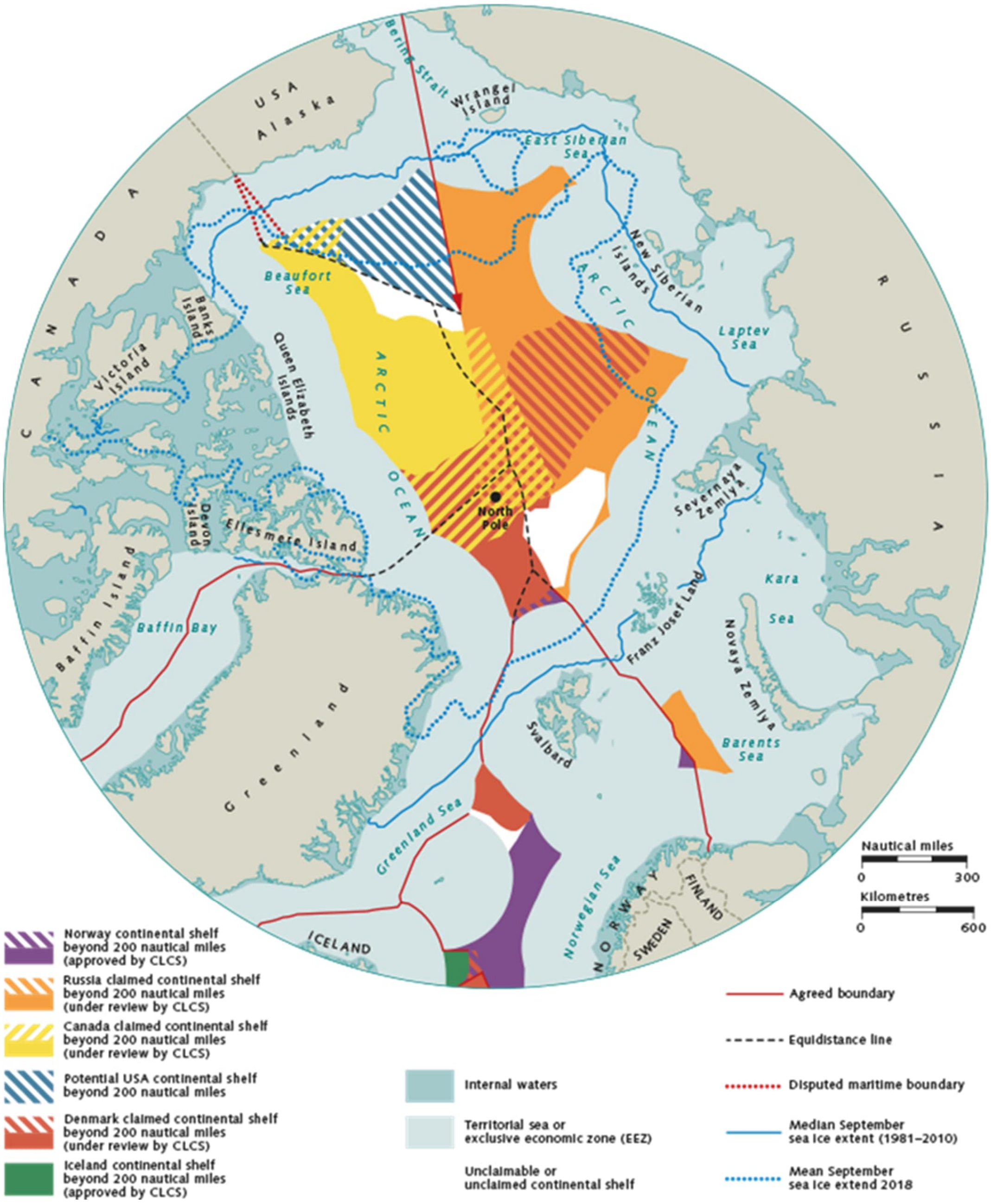

Figure 15: Continental shelf claims in the Arctic. Source: Löschke & Lehmköster (2019).

5.1.2 Part XI Agreement and the International Seabed Authority (ISA)

Part XI of UNCLOS and the 1994 Agreement relating to the Implementation of Part XI of UNCLOS established that activities relating to deep seabed mining in the Area are regulated by the International Seabed Authority (ISA). The ISA manages activities linked to the exploration and exploitation of mineral resources in the Area and is responsible for employing measures to ensure the effective protection of the marine environment.

The complete set of rules, regulations and procedures set up by the ISA to regulate prospecting, exploration and exploitation of marine minerals in the Area make up the "Mining Code". So far, the ISA has issued regulations on prospecting and exploration for polymetallic nodules, polymetallic sulphides, and cobalt-rich crusts (ISA, 2021a). Other elements of the Mining Code, including regulations pertaining to the exploitation of mineral resources, are still under development (ISA, 2021b).

Regional Environmental Management Plans (REMPs) are one vital element of the approaches the ISA implements to protect the marine environment. The first REMP was adopted in 2012 for the Clarion-Clipperton Zone of the Central Pacific and included the designation of nine "Areas of Particular Environmental Interest" (APEIs) where the exploitation of mineral resources is not permitted. The development of future REMPs for every region with exploration contracts is planned (ISA, 2021c). In the Arctic, no exploration contracts exist to date and scientific data on Arctic resources in the Area are scarce. Moreover, additional technological challenges exist with regards to extracting resources from the deep-sea seabed in the harsh climatic conditions prevalent in the Arctic (Todorov, 2019).

5.1.3 Agreements under the Food and Agriculture Organization of the United Nations (FAO)

Agreement relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN FSA)

The 1995 Agreement relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UN FSA) was negotiated under UNCLOS and obliges member states to cooperate regarding transboundary fish stocks and discrete high seas fish stocks. The fisheries management for these fish stocks is to be carried out at the regional level through regional fisheries bodies or specific arrangements or agreements. The regional fisheries bodies or specific arrangements or agreements in place in the Arctic are presented below in the chapter introducing key regional institutions and agreements.

Agreement on Port State Measures (PSMA)

The 2009 Agreement on Port State Measures (PSMA) is a binding international agreement that aims to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing by preventing vessels involved in IUU fishing from utilising ports and landing their catches. The PSMA applies to fishing vessels requesting entry to ports other than those of their flag State (FAO, 2021a).

Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement)

The Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (The Compliance Agreement) of 1993 aims to ensure that flag states strengthen the control over their vessels in order to guarantee compliance with international conservation and management measures. The Compliance Agreement furthermore aims to counteract the "re-flagging" of vessels fishing on the high seas under flags of states which are not able or willing to implement international conservation and management measures (FAO, 2021b). The Russian Federation is not party to the agreement, whereas all other Arctic coastal states are (FAO, 2021c).

Voluntary Instruments

Relevant voluntary instruments developed under the FAO include the 1995 FAO Code of Conduct for Responsible Fisheries, the 1998 International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (IPOA-Seabirds), and the 2001 International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU).

5.1.4 Agreement on Biodiversity Beyond National Jurisdiction (BBNJ)

A new implementing agreement under UNCLOS is currently being negotiated with regards to the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ agreement). The agreement will regulate aspects related to area-based management, marine genetic resources, environmental impact assessments, technology transfers and capacity building in the areas beyond national jurisdiction.

While it is yet to be decided how the new agreement will interact with existing sectoral and regional bodies such as the Arctic Council, it is expected that, once negotiated and in force, the BBNJ agreement will have a key role for conserving marine biodiversity in the High Seas of the Arctic (Spohr et al., 2021).

5.1.5 Agreements under the International Maritime Organization (IMO)

The International Maritime Organization (IMO) is an UN agency responsible for developing international standards for ship safety and security and for the protection of the marine environment and the atmosphere from harmful shipping impacts (IMO, 2021a). The IMO has adopted several international agreements (see below for an overview) and a wide range of measures to prevent and control pollution by ships and to mitigate the possible effects of maritime operations and accidents (IMO, 2021b).

In 2018, the IMO adopted new and amended ships' routeing measures in the Bering Sea and Bering Strait to reduce the risks of incidents. The proposal for these voluntary routeing measures was submitted by the United States and the Russian Federation. The measures include six two-way routes and six precautionary areas. Three Areas To Be Avoided (ATBAs) were created in the Bering Sea, following a proposal by the United States, to increase the safety of navigation and protect the marine environment. These are the first measures adopted by the IMO for the Arctic region (IMO, 2021c).

Another tool available under the IMO to protect the marine environment is the establishment of a Particularly Sensitive Sea Area (PSSA). A PSSA is an area of high ecological, socioeconomic or scientific significance which might be vulnerable to harm inflicted by international maritime activities. The criteria for the identification of a PSSAs are similar to the criteria established under the CBD for the identification of EBSAs (see below in the section on CBD for more information and Figure 16 for a comparison). A PSSA can be protected by ship routeing measures, including the establishment of ATBAs which should be avoided by all ships, or by certain classes of ships (IMO, 2021d).

No PSSAs have been designated in the Arctic to date but the 2009 and 2013 Arctic Marine Shipping Assessment's (AMSA) reports elaborated by Arctic Council Working Groups recommended that the Arctic States explore the need for PSSAs designation by the IMO and identified areas of heightened ecological and cultural significance (PAME, 2009; AMAP, CAFF & SDWG, 2013; Figure 16).

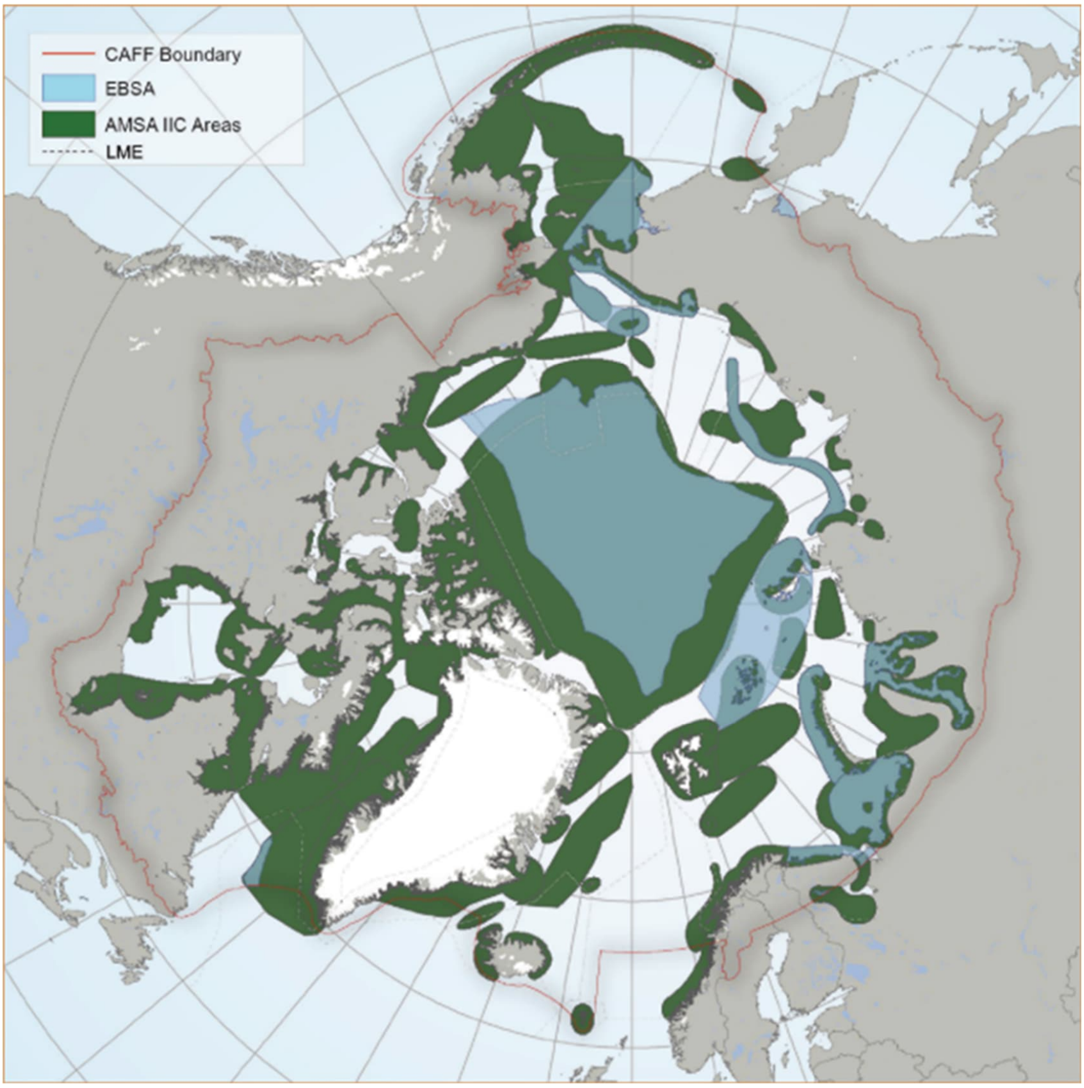

Figure 16: EBSAs and marine areas of heightened ecological and cultural significance. Source: PAME & CAFF (2017).

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) & London Protocol

The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) aims to promote the control of all sources of marine pollution. The London Protocol was adopted in 1996 to modernise the London Convention and, ultimately, replace it. The London Protocol prohibits all dumping, apart from possibly acceptable wastes listed in the reverse list (IMO, 2021e). All Arctic coastal states are parties to the London Convention, but the Russian Federation and the Unites States did not ratify the London Protocol.

International Convention for the Prevention of Pollution from Ships (MARPOL)

The 1973 International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention addressing the prevention of marine pollution from ships resulting both from accidental pollution and from routine operations. MARPOL has been updated through several amendments over the years and currently includes six technical Annexes (IMO, 2021f).

Most MARPOL Annexes include the option to establish Special Areas for technical reasons relating to oceanographical and ecological conditions and to traffic density. These Special Areas are provided with a higher level of protection through the adoption of additional mandatory methods for the prevention of sea pollution. Another tool under IMO is the establishment of Emission Control Areas (ECAs) under the Annex VI Regulations for the Prevention of Air Pollution from Ships. Within the ECAs, more stringent controls on sulphur emissions and nitrogen oxides are being carried out. No Special Areas or ECAs have been designated in the Arctic (IMO, 2021h).

At the 76th session of IMO's Marine Environment Protection Committee (MEPC 76) in 2021, amendments to MARPOL Annex I were approved, thus introducing a prohibition on the use and carriage for use as fuel of heavy fuel oil by ships in Arctic waters from 1 July 2024. Exemptions apply, inter alia, to vessels engaged in securing the safety of ships, search and rescue operations, and oil spill preparedness and response. In addition, MARPOL parties with a coastline bordering Arctic waters can exempt their vessels when operating in their waters until 1 July 2029 (IMO, 2021g). The amendment has been criticised by several environmental groups for not being strict enough as it includes several waivers and exceptions (Reuters, 2021). Stricter regulations were, however, unlikely to be adopted since the Russian Federation only conceded to approving the regulations after the introduction of the waiver for Arctic coastal states (Humpert, 2020).

International Code for Ships Operating in Polar Waters (Polar Code)

The International Code for Ships Operating in Polar Waters (Polar Code) of 2014 is mandatory under both the 1974 International Convention for the Safety of Life at Sea (SOLAS) and MARPOL and pertains to passenger and cargo ships of 500 gross tons or more operating in the waters surrounding the poles. The Polar Code includes mandatory measures regarding safety and pollution prevention as well as recommended provisions for safety and pollution, including the recommendation not to use or carry heavy fuel oil in the Arctic (IMO, 2021c).

International Convention for the Control and Management of Ships' Ballast Water and Sediments (BMW Convention)

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted in 2004 to help prevent the spread of potentially harmful aquatic organisms and pathogens through the ballast water of ships. Under the convention, ships must remove aquatic organisms and pathogens from their ballast water or render them harmless before releasing the water into a different site (IMO, 2021a).

5.1.6 Agreements under the United Nations Environment Programme (UNEP)

As the leading global environmental authority, UNEP administers or provides secretariat functions for several multilateral environmental agreements, including the Convention on Biological Diversity (CBD), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on the Conservation of Migratory Species of Wild Animals (CMS), the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention), the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention), the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention), and the Minamata Convention on Mercury (Minamata Convention) (UNEP, 2021). All these agreements will be discussed in more detail in the following paragraphs.

Every two years, UNEP hosts the world's highest-level decision-making body on the environment, the United Nations Environment Assembly (UNEA). At UNEA, priorities for global environmental policies are set and international resolutions are adopted (UNEP, 2022).

Convention on Biological Diversity (CBD)

The 1992 Convention on Biological Diversity (CBD) has as its main objectives to ensure 1) the conservation of biological diversity, 2) the sustainable use of the components of biological diversity, and 3) the fair and equitable sharing of the benefits obtained from the utilisation of genetic resources (CBD, 2021a). The CBD is a legally binding framework agreement that is further concretised through decisions of the Conference of the Parties (COP). The decision must be implemented by the parties to the CBD through national legislation, strategies, action plans or programmes. The parties need to submit regular national reports to show progress in implementing the CBD COP decisions.

In 2010, the CBD COP adopted a Strategic Plan for Biodiversity for 2011-2020, including the Aichi Biodiversity Targets. Target 6 required for example that by 2020, all fish and invertebrate stocks and aquatic plants shall be managed and harvested sustainably and, according to Target 11, 10% of marine and coastal areas shall be conserved through protected areas and other effective area-based conservation measures (CBD, 2021b). However, neither of the targets were achieved by 2020.

A tool developed under the CBD to support the identification of areas in need of protection is the identification of so-called Ecologically or Biologically Significant Marine Areas (EBSAs). The application of EBSA criteria is primarily a scientific and technical exercise that does not imply specific management measures. Rather, states and competent intergovernmental organisations are requested to identify EBSAs and to select appropriate conservation and management measures. A series of regional workshops were organised to enable the description of EBSAs (CBD, 2021c).

A joint workshop of IUCN and the Natural Resources Defense Council (NRDC) identified 13 "Super EBSAs" in the Arctic region that are of key importance as they meet many or all criteria developed under the CBD in 2010 (Speer & Laughlin, 2011; Figure 17).

In addition, a CBD regional EBSA workshop for the Arctic was convened in 2014. Russia was the only Arctic coastal state willing to describe EBSAs within their own EEZ at the workshop. In addition, the High Seas of the Arctic were considered. The workshop identified 11 areas meeting the EBSA criteria and these were then accepted by the CBD COP for inclusion in the EBSA repository (CBD, 2014; Figure 18).

Following the expiration of the Strategic Plan for Biodiversity for 2011-2020 and the Aichi Targets, a new and ambitious global framework for biodiversity conservation is currently being drafted. The adoption of the Post-2020 Global Biodiversity Framework is anticipated to take place at the second part of the 15th meeting of the Conference of the Parties to the CBD, which has been postponed to the end of 2022 due to the Covid-19 pandemic. The current draft of a new global biodiversity framework proposes 21 targets and 10 milestones to be reached by 2030, including the conservation of at least 30% of land and sea areas globally through protected areas and other effective area-based conservation measures (CBD, 2021d).

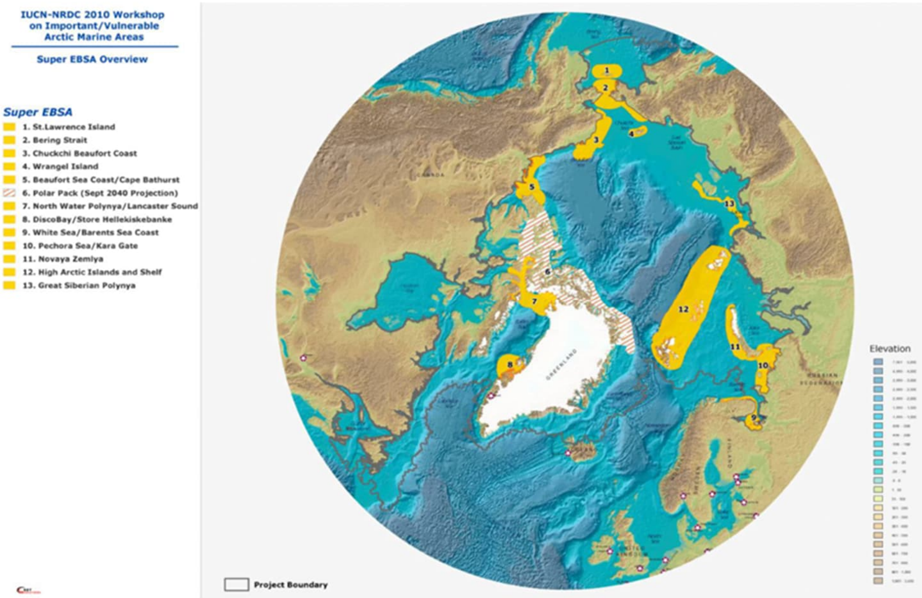

Figure 17: Super EBSAs identified in 2010 IUCN/NRDC workshop. Source: Speer & Laughlin (2011); image by VETRO, Inc.

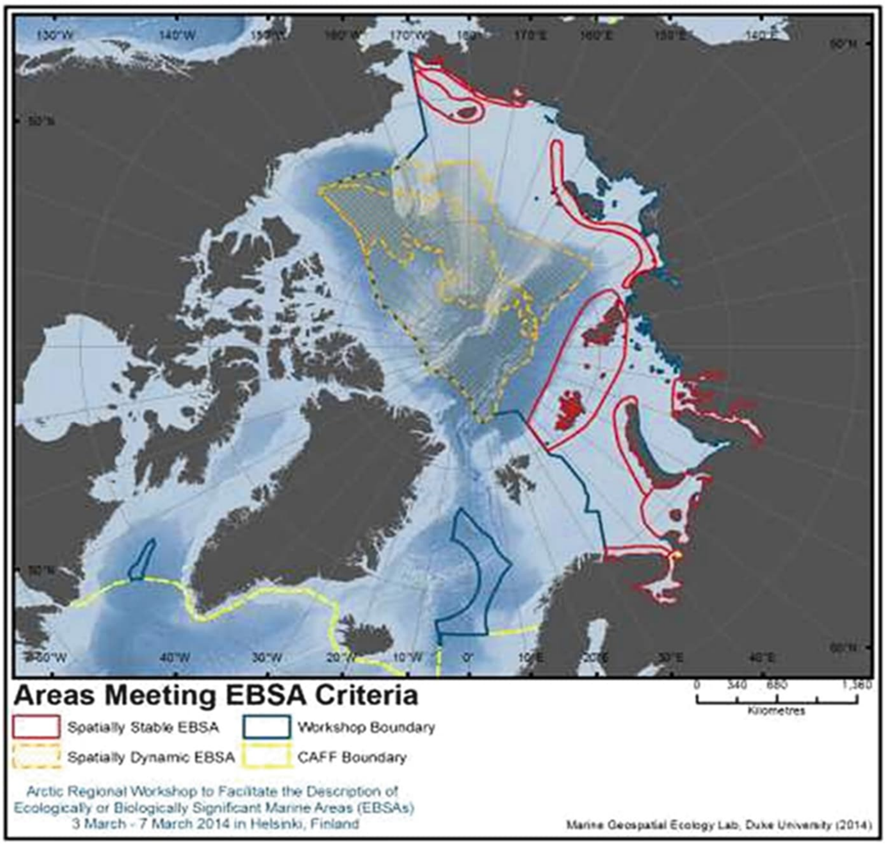

Figure 18: Areas identified as meeting EBSA criteria at the 2014 CBD regional EBSA workshop for the Arctic. Source: CBD (2014); image from UNEP/CBD/EBSA/WS/2014/1/5; map by Marine Geospatial Ecology Lab, Duke University (2014).

Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS) of 1975, also known as the Bonn Convention, aims to protect migratory species throughout their ranges. The legal instruments available under the CMS include legally binding Agreements as well as less formal Memoranda of Understanding (CMS, 2021a). Among the Agreements under CMS, the 1995 Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) also concerns Arctic marine biodiversity as it aims to conserve migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago (CMS, 2021b).

The CMS parties through which migratory species pass are referred to as Range States. The Range States strive to protect the migratory species threatened with extinction as listed in Appendix I of the Convention by undertaking habitat conservation and restoration measures, preventing and minimising adverse impacts on species' migration, and addressing other issues that might endanger them. Apart from determining responsibilities for each Party to the Convention, CMS encourages the Range States to conclude global or regional agreements for the migratory species listed in Appendix II of the Convention (CMS, 2021a).

The Arctic is frequented by several migratory marine mammals of interest to CMS. Migratory marine mammals present in the Arctic and listed in Appendix I of CMS include the bowhead whale, blue whale, sei whale (also Appendix II), fin whale (also Appendix II), and sperm whale (also Appendix II). Migratory whale species present in the Arctic listed in Appendix II include northern bottlenose whale, narwhal, and killer whale. In addition, several major flyways for migratory birds start in the Arctic and many species of migratory birds that are of interest to CMS spend part of the year in the Arctic, including Steller's eider, the Eskimo curlew, white-tailed eagle, spoon-billed sandpiper, and red knot, all of which are listed in Appendices I and II (CMS 2021c). Of the five Arctic coastal states, only Norway and Denmark are parties to the CMS (CMS, 2021a). Greenland is, however, not covered by the convention (CMS, 2021d). In 2013, CMS and the Arctic Council Working Group on Conservation of Arctic Flora and Fauna (CAFF) signed a resolution of cooperation with a view to better integrate the efforts of both instruments to protect and conserve Arctic migratory species (CMS, 2021b).

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The aim of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is to ensure that the international trade in specimens of wild animals and plants does not threaten the survival of the species. The species addressed by CITES are listed in Appendices according to their respective need for protection. Appendix I contains species threatened with extinction which can only be traded in exceptional circumstances (CITES, 2021a). Of importance to Arctic marine conservation, Appendix I includes many whales which occur in the Arctic (CITES, 2021b). Appendix II contains species which are not threatened with extinction, but for which trade must be regulated to prevent utilisation which may endanger their survival (CITES, 2021a).

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention), the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention), and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention)

The Basel, Rotterdam and Stockholm conventions all aim to protect human health and the environment from hazardous chemicals and wastes. The 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) addressed hazardous waste materials throughout their lifecycles, from production to transport to final use and disposal, aiming to protect people and the environment from the negative effects of the inappropriate management of hazardous wastes. The 2001 Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) aims to protect human health and the environment from highly dangerous pollutants by restricting and, eventually, eliminating their production, usage, trade, release and storage. The 1998 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention) encourages global efforts to protect human health and the environment and enables its parties to choose if they are willing to import the hazardous chemicals and pesticides listed in the Convention (UNITAR, 2021). The United States is the only Arctic Coastal State which has not ratified any of these conventions.

Minamata Convention on Mercury (Minamata Convention)

The 2013 Minamata Convention on Mercury (Minamata Convention) aims to protect human health and the environment from the harmful effects of mercury. Under the Convention, a ban on new mercury mines as well as the phase-out of existing ones was agreed upon. In addition, the Convention stipulates the elimination or reduction of mercury in several products and processes, establishes control measures on mercury emissions to air and releases to land and water, passed regulation of artisanal and small-scale gold mining, and addresses the storage and disposal of mercury (Mercury Convention, 2021a). The Russian Federation is the only Arctic Coastal State which has not ratified the Convention (Mercury Convention, 2021b).

5.1.7 Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)

The 1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) aims to conserve wetlands and ensure their sustainable use. Over time, the focus of the Convention has been broadened from waterfowl habitats to the protection of wetlands as an ecosystem and the recognition of the ecosystem services provided by wetlands. The Ramsar Convention requires that its parties designate at least one precisely mapped wetland area of "international importance" based on selected ecosystem characteristics. These areas are to be "used wisely" in line with Ramsar`s principles (CAFF, 2021). According to the 2017 Arctic Protected Areas Indicator report, 80 Ramsar sites existed within the CAFF boundary in 2016 (PAME & CAFF, 2017; Figure 12). In its 2018 Resolution XIII.23 on Wetlands in the Arctic and sub-Arctic, Ramsar notes that the Arctic is underrepresented among Ramsar sites and urges the parties to the Convention to designate more sites (Ramsar Convention, 2018).

5.1.8 UNESCO World Heritage Convention

The 1972 UNESCO World Heritage Convention aims to preserve cultural and natural heritage with outstanding value for all humankind. All sites which are of outstanding universal value and meet at least one out of ten selection criteria are eligible for inscription in the World Heritage List (UNESCO, 2021a). According to the 2017 Arctic Protected Areas Indicator report, 12 World Heritage sites existed within the CAFF boundary in 2016 (PAME & CAFF, 2017; Figure 12). Of these, one site is recognised within the World Heritage Marine Programme: the Natural System of Wrangel Island Reserve (UNESCO, 2021b). When compared to other regions, the Arctic is currently underrepresented on the World Heritage List (Speer et al., 2017).

A crucial step for implementing the World Heritage Convention is the identification of sites that may meet the requirements of Outstanding Universal Value and may thus be eligible for inscription in the World Heritage List. The IUCN functions as an official adviser to the World Heritage Committee with regards to natural heritage and conducts studies and expert workshops in order to support the parties to the convention in identifying potential sites (Speer et al., 2017). In 2017, IUCN identified ecosystems in the Arctic Ocean that may be of Outstanding Universal Value with regard to the natural criteria for World Heritage sites. The aim of the report was to advance the identification and conservation of globally significant natural marine sites in the Arctic (Speer et al., 2017; Figure 19).

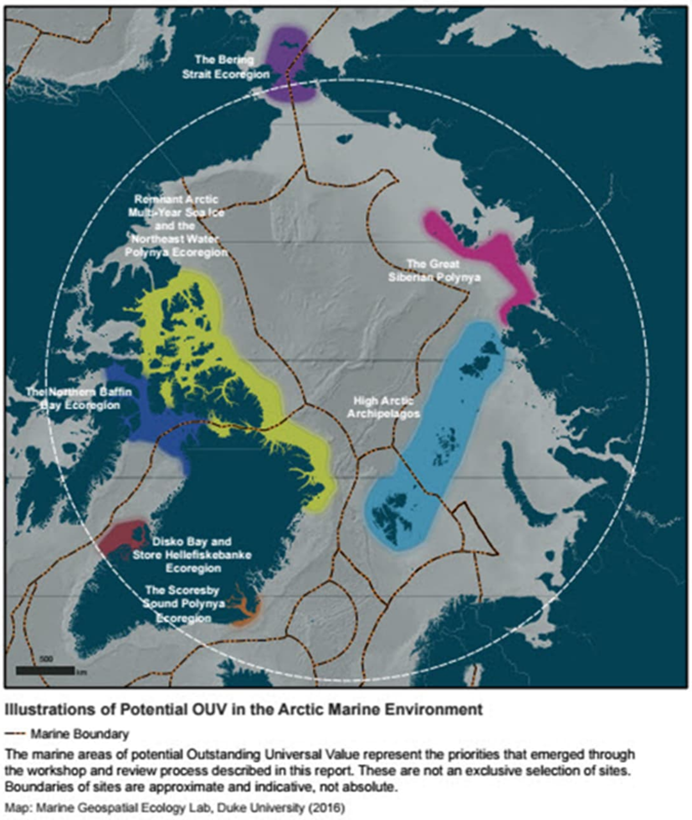

Figure 19: Illustration of potential sites of Outstanding Universal Value in the Arctic Marine Environment. Source: Speer et al. (2017)

5.1.9 Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO)

The Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) is responsible for supporting global ocean science and services. IOC-UNESCO supports its Member States to build their scientific and institutional capacity and coordinates regional and global programmes in areas such as ocean observations, tsunami warnings and marine spatial planning (IOC UNESCO, 2021a). Regional bodies were created to support the implementation of IOC-UNESCO's programmes through targeted, decentralised activities. No regional bodies have been established in the Arctic to date (IOC UNESCO, 2021b). IOC-UNESCO is currently coordinating and implementing the UN Decade of Ocean Science for Sustainable Development (2021-2030), which aims to deliver the scientific knowledge needed to support the sustainable management of the ocean and the accomplishment of the 2030 Agenda for Sustainable Development (IOC UNESCO, 2021c). As part of a global consultation process in preparation for the UN Decade, a Regional Arctic Ocean Decade Workshop was held in 2020 to discuss, select and formulate proposals for Arctic initiatives as part of the Decade (IOC UNESCO, 2021d).

5.1.10 International Whaling Commission (IWC)

The International Whaling Commission (IWC) regulates whaling and aims to ensure the conservation of whales by coordinating and funding conservation work on several whale species. The conservation work includes research, the creation of international entanglement response capacity, work aimed at avoiding ship strikes, the creation of Conservation Management Plans for key species and populations, and the adoption of a Strategic Plan for Whalewatching. An essential element of the Convention is its legally binding Schedule. The Schedule sets out the measures necessary to regulate whaling and conserve whale stocks, including, inter alia, catch limits, the designating of specified areas as whale sanctuaries, and limitations on hunting methods (IWC, 2021a). Two Whale Sanctuaries are currently designated. One covers the Indian Ocean south to 55°S and the second covers the Southern Ocean. Another proposal for a Sanctuary in the South Atlantic Ocean has been submitted to the IWC but has not attained the needed three-quarters majority of IWC members (IWC, 2021b).

Under the Schedule, the IWC set catch limits for commercial whaling to zero, thereby effectively establishing a moratorium on commercial whaling of all whale species and populations starting from the 1985/1986 season. This moratorium is still in place today. Apart from non-IWC member countries, commercial whaling is currently conducted by a few IWC members in objection or reservation to the moratorium. In recent years, the IWC members Norway, Iceland and Japan have caught whales commercially. These countries establish their own catch limits but must share catch numbers and related data with the Commission. Norway catches North Atlantic common minke whales within its EEZ (IWC, 2021c).

Besides commercial whaling, the IWC introduced regulations for aboriginal subsistence whaling and special permit (or scientific) whaling. In the case of special permit (or scientific) whaling, countries are asked to submit a special permit research proposal to the IWC. The permits are issued by individual countries with the IWC having only an advisory role (IWC, 2021f). The aim for the management of aboriginal subsistence whaling is to guarantee that the hunted populations are kept at (or brought back to) healthy levels, and to allow Indigenous people to hunt at levels suitable to their cultural and nutritional requirements. The catch limits for aboriginal subsistence whaling are set every six years, most recently at the Commission meeting in September 2018 (IWC, 2021d). In the Arctic, aboriginal subsistence hunting is carried out in Greenland, Chukotka (Russia) and Alaska. Indigenous Peoples in Canada also engage in whaling, but Canada left the IWC in 1982 (IWC, 2021e).

5.1.11 United Nations Framework Convention on Climate Change (UNFCCC), Paris Agreement & Kyoto Protocol

The 1992 United Nations Framework Convention on Climate Change (UNFCCC) is the parent treaty of the 1997 Kyoto Protocol and the 2015 Paris Agreement. The aim of all three agreements is to stabilise the greenhouse gas concentrations in the atmosphere so that dangerous human interference with the climate system is avoided (UNFCCC, 2021a).

The 2015 Paris Agreement is a legally binding international treaty, which aims to "limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels" (UNFCCC, 2021b). The Paris Agreement works on a 5-year cycle and calls on Parties to develop and pursue progressively more ambitious plans for climate action, called nationally determined contributions (NDCs) (UNFCCC, 2021b). All Arctic coastal states are Parties to the Paris Agreement (United Nations Treaty Collection, 2021a) and have submitted NDCs (UNFCCC, 2021c). In the case of Denmark, a territorial exclusion in respect of Greenland applies and Greenland itself has not yet ratified the Agreement (United Nations Treaty Collection, 2021a).

The 1997 Kyoto Protocol commits industrialised countries and economies in transition to reduce their greenhouse gas emissions in line with agreed individual targets. The Convention asks those countries to adopt policies and measures on mitigation and to report periodically (UNFCCC, 2021d). Of the Arctic coastal states, Norway, the Russian Federation and Denmark are parties to the Kyoto Protocol. The United States is not Party to the Kyoto Protocol and Canada withdrew from the Kyoto Protocol with effect from 2012 (United Nations Treaty Collection, 2021b). In its Annex B, the Kyoto Protocol set binding emission reduction targets for 37 industrialised countries and economies in transition and the European Union during the first commitment period. The Doha Amendment to the Kyoto Protocol was adopted for the second commitment period from 2013 until 2020 (UNFCCC, 2021d). It entered into force only on 31 December 2020 when the required instruments of acceptance were achieved (UNFCCC, 2021e). Of the Arctic coastal states, only Denmark has accepted the Doha Amendment. However, the acceptance excludes Greenland (United Nations Treaty Collection, 2021c).

5.2 Main Regional Intergovernmental Institutions and Agreements

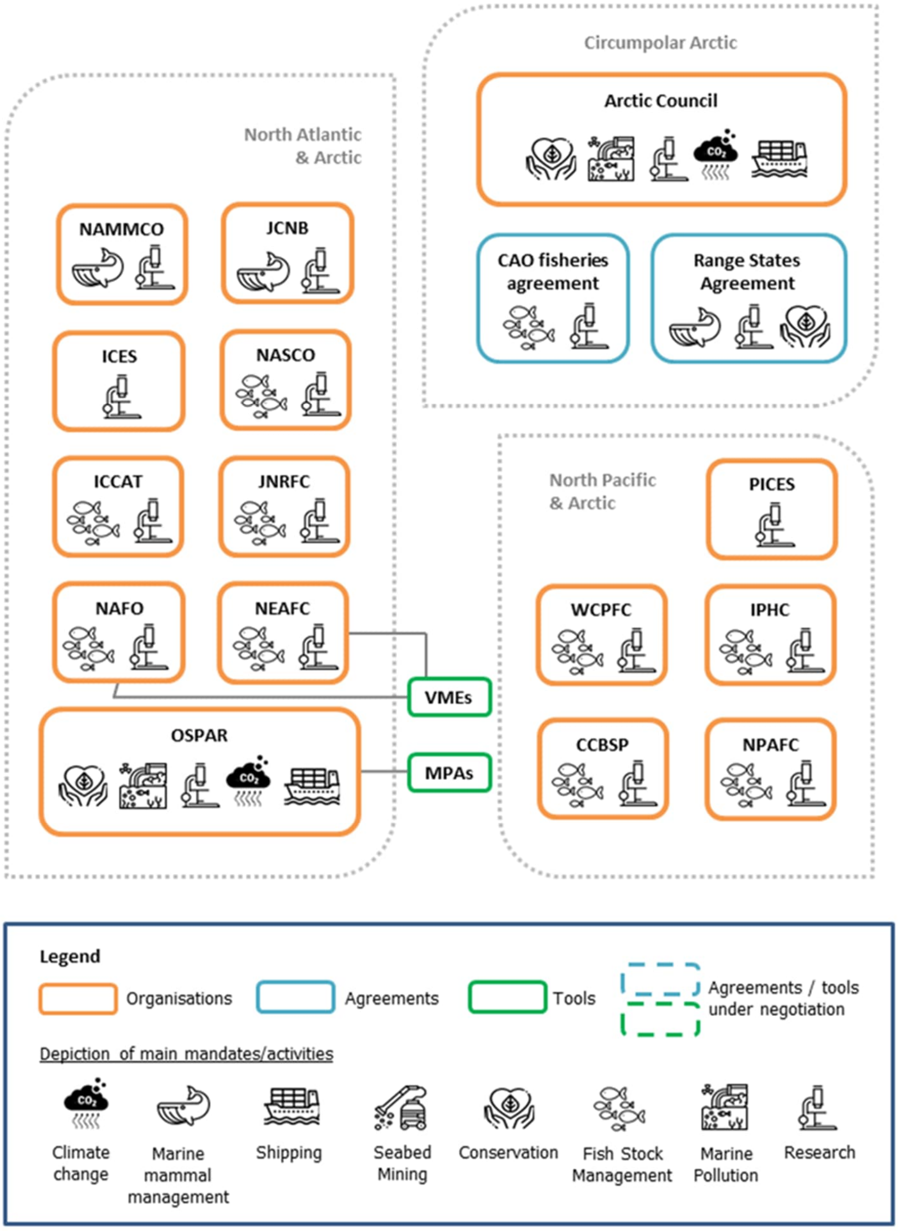

Figure 20: Key regional organisations and legal agreements relevant to marine conservation in the Arctic. IASS visualisation.

Regional organisations, mechanisms and instruments play a crucial role in the conservation and sustainable use of the oceans and their biodiversity by enabling cooperation and coordination across territorial and sectoral boundaries. The regional level can first and foremost advance the conservation and sustainable use of marine biodiversity in Arctic waters by creating context-specific platforms through which States, stakeholders and competent regional and global management organisations can communicate, coordinate and collaborate their efforts.

The Arctic Council is the leading body for the cooperation and coordination among the eight Arctic States (Canada, Denmark (by virtue of Greenland), Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States), Arctic Indigenous Peoples, and other relevant actors on issues related to sustainable development and environmental protection in the Arctic. The Arctic Council promotes sustainable development and environmental protection in the Arctic by providing assessments and recommendations. At the time of writing this report, work within the Arctic Council was suspended indefinitely by the Arctic countries due to the Russian invasion of Ukraine, leading to uncertainties about the future of circumpolar cooperation (Dickie & Gardner, 2022).

Other key regional mechanisms and agreements include the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), agreements aimed at managing certain species, regional science organisation, and several regional fisheries bodies.

This chapter provides an overview of the key regional organisations and legal agreements relevant to marine conservation in the Arctic as well as the rules, regulations and tools which are, or could be, employed to protect the Arctic marine biodiversity and ensure its sustainable use (Figure 20). In Annex 2, Table 2, an overview of the membership and treaty ratification status by the Arctic coastal states is presented.

5.2.1 Arctic Council

The Arctic Council is the main regional forum addressing issues related to environmental protection in the Arctic, including marine biodiversity. It was founded in 1996 through the signing of the Ottawa Declaration by representatives of the eight Arctic States. Other than these eight member States, six Indigenous Peoples organisations have a status as Permanent Participants in the Arctic Council. In addition to the Permanent Participants, several non-Arctic states (including Germany, France, Italy, Japan, Korea, and China) and non-governmental organisations are observers to the Arctic Council and engage with the Arctic Council in knowledge creation and coordination. While the Arctic Council cannot regulate human activities or issue legally binding decisions, it does serve as a basis for the Arctic States to conclude the following legally binding regional agreements: Search and Rescue Agreement (2011), Marine Oil Preparedness and Response Agreement (2013) and Scientific Cooperation Agreement (2017) (Spohr et al., 2021).

Work within the Arctic Council is principally carried out within the six working groups and several task forces. The working groups and task forces conduct research and analyses at the circumpolar scale on topics including climate change, biodiversity and pollution and strive to create a joint knowledge base for policymaking and coordinated action by the Arctic States (O'Rourke et al., 2021). Work on marine governance and marine conservation is mostly carried out by the working groups on Conservation of Arctic Flora and Fauna (CAFF), Protection of the Arctic Marine Environment (PAME), Arctic Monitoring and Assessment Programme (AMAP), and Emergency Preparedness, Prevention and Response (EPPR).

Major assessments and guidelines of the working groups regarding marine protection and sustainable use include the 2013 Arctic Marine Shipping Assessment Report, the Arctic Marine Strategic Plan 2015-2025 and related implementing reports, the 2015 Framework for a Pan-Arctic Network of Marine Protected Areas, and the 2017 State of the Arctic Marine Biodiversity Report. Other important initiatives include the 2013 report on ecosystem-based management in the Arctic elaborated by Arctic Council Expert Group on Ecosystem-Based Management. This report laid the foundation for the approach to ecosystem-based management which is now guiding the work of the Arctic Council and the CAFF Circumpolar Biodiversity Monitoring Programme (CBMP) which coordinates circumpolar efforts to monitor and report on the state of Arctic biodiversity. The assessments produced under the Arctic Council provide evidence that action is needed to address the threats to marine biodiversity in the Arctic and make clear recommendations regarding the actions which should be carried out by the Arctic States (Prip, 2019a). A recommendation made by PAME and others is, for example, to develop a Pan-Arctic network of MPAs to strengthen the resilience of marine ecosystems and contribute to human wellbeing in the region (PAME, 2015). Due to the non-binding nature of the Arctic Council, it is ultimately up to the individual Arctic States how and if they implement the recommendations provided by the Arctic Council Working Groups.

Ways to strengthen ocean governance in the Arctic have been discussed in recent years and led to the establishment of the Task Force on Arctic Marine Cooperation (TFAMC) in 2015. The TFAMC was tasked to assess options for improving institutional arrangements, including the creation of a new subsidiary body or a regional seas programme. The TFAMC identified several shortcomings and provided recommendations, but its mandate was restricted in 2018 due to a lack of political support. In 2020, a Marine Mechanism was launched by the Senior Arctic Officials of the Arctic States to foster regional cooperation on marine issues and address some of the needs identified by the TFAMC (Balton and Zagorski, 2020).

On March 3, 2022, following Russia's invasion of Ukraine, the other seven Arctic Council member states – Canada, Finland, Iceland, the Kingdom of Denmark, Norway, Sweden, and the United States – announced that they would suspend their participation in the organisation. In June 2022, the seven Council member states stated that they would seek to resume the Council's work on a limited scale, in projects that do not involve the participation of the Russian Federation (Jonassen, 2022). By the time this report was finalised, there had been no further updates regarding resumed activities of the Arctic Council.

5.2.2 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)

The OPSAR Commission is tasked to implement the 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention), which covers areas beyond national jurisdiction (ABNJ), as well as parts of the Arctic Ocean within its ‘Region I’.

The OSPAR Commission carries out and publishes assessments regarding the state of the marine environment, and issues legally binding decisions as well as recommendations regarding actions and measures aimed at protecting the marine environment of the North-East Atlantic, including with regard to marine biodiversity or the environmental impacts of human activities such as oil and gas exploration and exploitation. The OSPAR Commission addresses marine pollution from the offshore industry and land-based sources of pollution, as well as non-polluting human activities that can adversely affect the sea (OSPAR, 2021a). The effectiveness of the measures planned and taken by the parties to the OSPAR Convention is assessed through Intermediate Assessments (2017) and Quality Status Assessments (2010, 2023) (OSPAR, 2021b). Of the Arctic coastal states, Denmark and Norway are parties to OSPAR (OSPAR, 2021c).

Under the Convention’s Annex V, the OSPAR Commission is mandated to create a coherent and well-managed network of MPAs. For a site to become part of the envisaged network, it has to satisfy the criteria set out in the selection guidelines, and, has to be formally nominated by the respective Contracting Party in areas within national jurisdiction or by OPSAR contracting parties or observer organisations in case of ABNJ (International WWF-Centre for Marine Conservation, 2021).

OSPAR became an observer to the Arctic Council in 2017 and actively engages with the Arctic Council Working Groups on work related to ocean acidification, transport of chemicals, pollution from maritime disasters, pollution from ships and offshore installations, and marine litter (OSAPR, 2021c).

5.2.3 Regional Fisheries Bodies

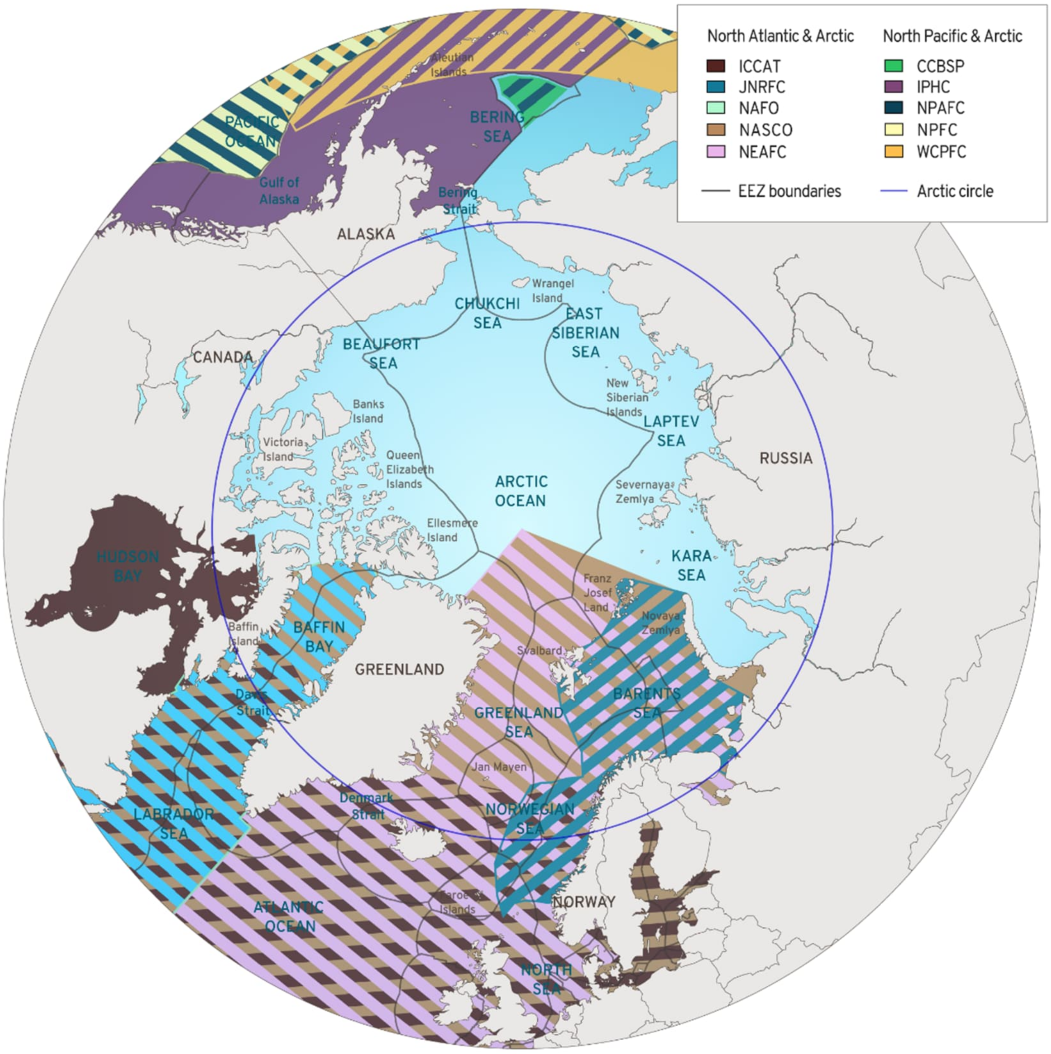

Figure 21: Regulatory areas of the regional fisheries bodies. IASS visualisation based on Flanders Marine Institute (2019), GRID-Arendal (2019), and FAO (2022).

In addition to national and bilaterally agreed rules and regulations, fisheries in the Arctic are managed by several regional fisheries bodies. These organisations vary with regards to their geographical and species coverage (Figure 21) as well as their mandate and their member states / contracting parties. Some organisations only have an advisory mandate, whereas others have a management mandate and can adopt fisheries conservation and management measures that are legally binding upon member states.

Northwest Atlantic Fisheries Organization (NAFO)

The Northwest Atlantic Fisheries Organization (NAFO) covers a large part of the Atlantic Ocean, including parts of the EEZs of Canada, Greenland, St. Pierre et Miquelon, and the United States (NAFO, 2021a). NAFO's Regulatory Area, however, lies beyond the EEZs of the Coastal States. The main fisheries regulated by NAFO are shrimp, pelagic redfish and groundfish. A moratorium is currently in place for shrimp and pelagic redfish fisheries. The groundfish fishery is mainly conducted by bottom trawls. The fisheries regulations applicable in the Regulatory Area are outlined in NAFOs Conservation and Enforcement Measures (CEMs) and include catch limitations, vessel and gear requirements, measures related to bycatch or conservation and management of sharks, and the protection of vulnerable marine ecosystems (VMEs), which are areas identified as being vulnerable to bottom contact gears (NAFO, 2021b). NAFO has so far identified 27 VMEs such as seamounts, sponges, corals, and seapens and closed these areas to bottom fishing. None of these areas is within the CAFF boundary (NAFO, 2022). All Arctic coastal states are parties to NAFO Convention on Cooperation in the Northwest Atlantic Fisheries (NAFO, 2021c).

North East Atlantic Fisheries Commission (NEAFC)

The North East Atlantic Fisheries Commission (NEAFC) is the Regional Fisheries Management Organisation for the North East Atlantic. The NAEFC regulatory area includes the areas beyond the Costal States EEZs and, within the Arctic, covers the so-called Banana hole in the Norwegian Sea, the Loophole in the Barents Sea, as well as the southern tip of the Central Arctic Ocean (NEAFC, 2021a). Within the NEAFC regulatory area, fishing is regulated through the current management measures and by the NEAFC Scheme of Control and Enforcement (NEAFC, 2021a). These measures defined by NEAFC may be related to fishing of certain stocks or individual species and/or a specific area or time period and are decided on the basis of scientific advice from The International Council for the Exploration of the Sea (ICES) (NEAFC, 2021b). Among the possible measures are the establishment of closures to protect VMEs. VMEs have been established by NEAFC in the southern part of the regulatory area but none have been established in Arctic waters (NEAFC, 2021c). Denmark, Norway and the Russian Federation are parties to the Convention on Multilateral Cooperation in North East Atlantic Fisheries. Canada is a Cooperating Non-Contracting Party (NEAFC, 2021a).

Joint Norwegian-Russian Fisheries Commission (JNRFC)

The Joint Norwegian-Russian Fisheries Commission (JNRFC) was established under the supervision of NEAFC in 1975. It provides regulations for the joint management of the most important fish stocks in the Barents Sea and the Norwegian Sea, including cod, haddock, capelin, Greenland halibut, and king crab by defining fishing quota and taking joint decisions on recovery plans and measures to reduce IUU (Rudloff, 2010).

North Atlantic Salmon Conservation Organization (NASCO)

The North Atlantic Salmon Conservation Organization (NASCO) was established by the Convention for the Conservation of Salmon in the North Atlantic Ocean. NASCOs objective is to conserve, restore, and manage Atlantic salmon throughout its migratory range in the Atlantic Ocean north of 36°N, considering the best available science (NASCO, 2021a; NASCO, 2021b). Under the Convention for the Conservation of Salmon in the North Atlantic Ocean of 1984, targeted fisheries for Atlantic salmon are prohibited in most areas of the North Atlantic beyond 12 nautical miles from the coast, thus creating a large area which is free of directed salmon fisheries (NASCO, 2021c). Over the years, NASCO broadened its activities and is now addressing many issues related to salmon conservation, including the management of salmon fisheries in the states of origin, habitat protection and restoration, and aquaculture activities. All Arctic coastal states are a Party to the Convention (NASCO,2011a).

International Commission for the Conservation of Atlantic Tunas (ICCAT)

The International Commission for the Conservation of Atlantic Tunas (ICCAT) was established by the International Convention for the Conservation of Atlantic Tunas in 1966. ICCAT is responsible for the conservation of tunas and tuna-like species in the Atlantic Ocean and adjacent seas and aims at maintaining their populations at levels, which allow the maximum sustainable catch. To this end, ICAAT collects and analyses data relating to the current conditions and trends of the tuna fishery in the Convention area, assesses information concerning measures aimed at ensuring maintenance of the populations and provides contracting parties with a mechanism to agree on management measures. All Arctic coastal states are a Party to the Convention (Denmark through the EU) (FAO, 2021d).

North Pacific Anadromous Fish Commission (NPAFC)

The North Pacific Anadromous Fish Commission (NPAFC) was established under the 1992 Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean. The Commission aims to promote the conservation of anadromous stocks (Pacific salmon and steelhead trout) in the international waters of the North Pacific Ocean and its adjacent seas beyond the EEZs of the coastal States. This area also includes the so-called Donut Hole in the Central Bering Sea. Current members include the Arctic coastal states Canada, the Russian Federation and the United States (NPAFC, 2021a). Within the Convention Area, the directed fishing for anadromous fish is prohibited with the exception of approved research fishing. In addition, the conservation measures established by NPAFC aim to reduce the incidental taking of anadromous fish and prohibit retaining incidentally caught anadromous fish on board of fishing vessels (NPAFC, 2021b).

Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP)

The 1994 Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP) aims to establish an international regime for the conservation, management, and optimum utilisation of pollock resources in the Bering Sea. CCBSP gathers and examines factual information regarding pollock and other living marine resources in the Bering Sea and aims to provide a forum for establishing needed conservation and management measures for pollock as well as other living marine resources in the Convention Area as necessary in the future. The area of competence of the CCBSP is the high seas area of the Bering Sea, the so-called Donut Hole. Of the Arctic coastal states, the Russian Federation and the United States are parties to the Convention (FAO, 2021e).

International Pacific Halibut Commission (IPHC)

The International Pacific Halibut Commission (IPHC) was established by the Convention between Canada and the United States of America for the Preservation of the Pacific Halibut Fishery of the Northern Pacific Ocean and Bering Sea in 1923. The Convention applies to the EEZ of Canada and the United States in the North Pacific. IPHC manages the Pacific halibut fishery and frequently assesses the status of the stock. Under the Convention, the Convention waters were divided into areas and one or more open or closed seasons are established for each of the areas. Areas or portions of an area populated by immature Pacific halibut are designated as nursery grounds and closed to all taking of Pacific halibut. In addition, IPHC limits the size and quantity of the catch to be taken from each area and establishes rules for the fishing appliances allowed in any area (FAO, 2021f).

Western and Central Pacific Fisheries Commission (WCPFC)

The Western and Central Pacific Fisheries Commission (WCPFC) was established under the 2000 Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean (WCPF Convention). WCPFC is responsible for ensuring the conservation and sustainable use of highly migratory fish stocks in the western and central Pacific Ocean. To this end, WCPFC determines the total allowable catch or total level of fishing effort for the respective fish stocks and adopts conservation and management measures applicable to these stocks throughout their range, or in specific areas within the Convention Area. In addition, WCPFC adopted several binding measures for the prevention of bycatch and the conservation of non-target species, including sharks, seabirds, sea turtles, and cetaceans. The Area of competence includes a small area of the North Pacific which falls into the CAFF boundary. Of the Arctic coastal states, Canada and the United States are WCPFC members (FAO, 2021g).

5.2.4 Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (CAO Fisheries Agreement)

In late 2018, the Arctic coastal states as well as the main fishing nations China, Japan, South Korea, Iceland and the European Union signed the CAO Fisheries Agreement. The agreement was ratified in 2021 and provides a de-facto moratorium on commercial fishing within the High Seas of the Central Arctic Ocean until an international management regime is established. The moratorium applies for the coming 16 years and can afterwards be extended for 5-year periods unless any party to the agreement presents a formal objection. The CAO Fisheries Agreement established a joint scientific programme to conduct research and monitor the marine ecosystem and allows for exploratory fisheries to assess the sustainability and feasibility of future commercial fisheries (Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, 2022). If the scientific work under the agreement concludes that commercial fisheries in the Central Arctic Oceans are reasonable, the agreement may serve as a basis for establishing one or more regional fisheries management organisations for the Arctic Ocean (Hoel, 2020). However, it remains to be seen if sustainable commercial fisheries can be established in the Central Arctic Ocean (O'Rourke et al., 2021).

5.2.5 Agreement on the Conservation of Polar Bears (Range States Agreement)

In 1973, Canada, Denmark, Norway, the United States and the Union of Soviet Socialist Republics signed the Agreement on the Conservation of Polar Bears (Range States Agreement). Under the Agreement, the Range States acknowledged the significance of the polar bear for the Arctic region and agreed to undertake joint efforts to manage polar bears throughout the region (Range States Agreement, 2021a). The International Union for the Conservation of Nature's Polar Bear Specialist Group functions as the scientific advisory body to the Polar Bear Range States (Range States Agreement, 2021b). The collaboration of the Range States has been mostly successful in eliminating over-harvesting and has assisted in the signing of bilateral cooperative arrangements for the management of most of the shared populations (Range States Agreement, 2021c).

The bilateral agreements in place are the Inuvialuit-Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea Subpopulation between Canada and the United States, the Memorandum of Understanding between Environment Canada and the United States Department of the Interior for the Conservation and Management of Shared Polar Bear Populations, the Memorandum of Understanding between the Government of Canada, the Government of Nunavut and the Government of Greenland for the Conservation and Management of Polar Bear Populations, the Agreement between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population, and the Bilateral Environmental Agreement between the Government of the Russian Federation and the Government of Norway, including Provisions on Polar Bear Conservation (Range States Agreement, 2021d).

5.2.6 Joint Canada-Greenland Commission on the Conservation and Management of Narwhal and Beluga (JCNB)

The Canada-Greenland Joint Commission on Beluga and Narwhal (JCNB) was established in 1991 through a Memorandum of Understanding (MOU) with the aim of ensuring the responsible management of the shared stocks of narwhal and beluga that migrate between Canadian and Greenlandic waters. JCNB provides advice on research and monitoring needs and gives recommendations regarding the conservation and management of narwhal and beluga based on reviews of scientific reports from meetings of the JCNB as well as NAMMCO (NWMB, 2021).

5.2.7 North Atlantic Marine Mammal Commission (NAMMCO)

The North Atlantic Marine Mammal Commission (NAMMCO) aims to strengthen cooperation on the conservation, management and study of marine mammals in the North Atlantic. NAMMCO covers all species of cetaceans (whales, dolphins and porpoises) and pinnipeds (seals and walruses) in the region. The Commission undertakes research regarding marine mammal stocks and makes proposals for conservation and management measures to member countries, taking into account the complexity and vulnerability of the marine ecosystem as well as the rights and needs of coastal communities. NAMMCO members include the Arctic coastal states Greenland and Norway (NAMMCO, 2021b).

5.2.8 International Council for the Exploration of the Sea (ICES)

The International Council for the Exploration of the Sea (ICES) is an intergovernmental marine science organisation aiming to advance the understanding of marine ecosystems and the services they provide. ICES work is mainly accomplished through its Expert Groups and workshops and focuses on topics such as Aquaculture, Fisheries, Human Activities, Pressures and Impacts, Integrated Ecosystem Assessments and Ecosystem Observation (ICES, 2021a). ICES utilises this knowledge to generate scientific advice for organisations including NASCO, NEAFC, OSPAR and Governments of ICES member countries on a variety of issues relating to marine policies and management, including fisheries policies (ICES, 2021b). ICES area of competence is the Atlantic Ocean, including the ecoregions of the Arctic Ocean, the Greenland Sea, the Norwegian Sea and the Barents Sea (ICES, 2021c). In 2017, ICES was awarded observer status to the Arctic Council and currently engages in conducting integrated ecosystem assessments for the Central Arctic Ocean as part of the ICES/PICES/PAME Working Group on Integrated Ecosystem Assessment (IEA) for the Central Arctic Ocean (ICES, 2021d; ICES, 2021e). In addition, ICES and PICES established a Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME) to coordinate efforts to understand, estimate and predict impacts of climate change on marine ecosystems (ICES, 2021f). All Arctic coastal states are members of ICES (ICES, 2021g).

5.2.9 North Pacific Marine Science Organization (PICES)

The North Pacific Marine Science Organization (PICES) was established in 1992 to foster and coordinate marine research in the North Pacific and its adjacent seas. Work of PICES focusing on collecting and exchanging scientific knowledge about the marine environment, global weather and climate change, marine living resources and their ecosystems, and the impacts of human activities. The Arctic coastal states Canada, the Russian Federation, and the United States are members of PICES (PICES, 2021).

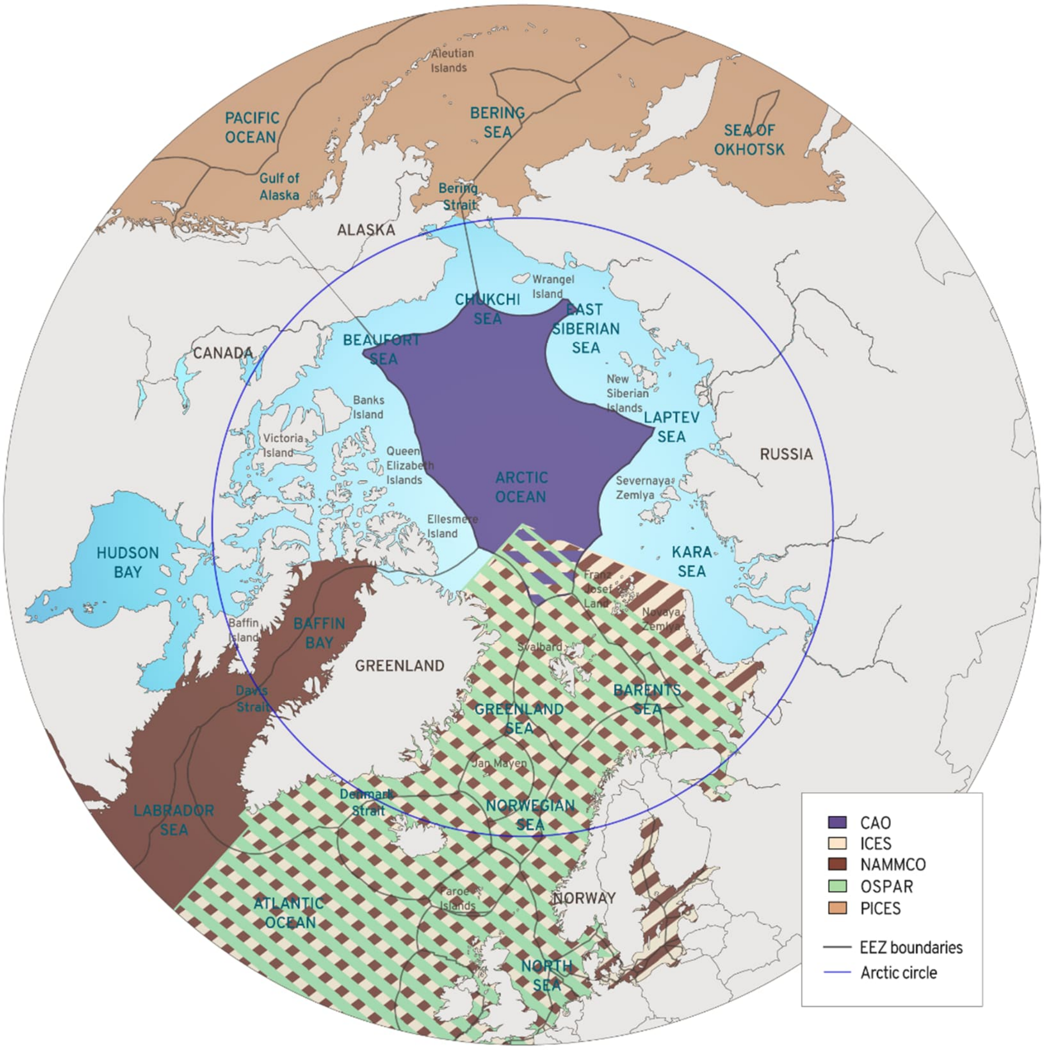

Figure 22: Regulatory areas of selected regional institutions. IASS visualisation based on Flanders Marine Institute (2019), GRID-Arendal (2019), and FAO (2022).

6 Annex

6.1 Annex 1

Table 1. Marine mammal species present in the circumpolar Arctic and their IUCN Red List categories. Source: IUCN, 2022.

Common Name	Scientific Name	Red List Category	Assessment Date
Balaenoptera musculus	Northern Blue Whale	Endangered	2018-03-16
Balaenoptera physalus	Northern Fin Whale	Vulnerable	2018-02-04
Odobenus rosmarus	Walrus	Vulnerable	2016-02-05
Ursus maritimus	Polar Bear	Vulnerable	2015-08-27
Balaena mysticetus	Bowhead Whale	Least Concern	2018-01-01
Balaenoptera acutorostrata	Minke Whale	Least Concern	2018-03-16
Delphinapterus leucas	Beluga Whale	Least Concern	2017-06-22
Erignathus barbatus	Bearded Seal	Least Concern	2016-02-17
Eschrichtius robustus	Gray Whale	Least Concern	2017-12-30
Histriophoca fasciata	Ribbon Seal	Least Concern	2015-06-09
Megaptera novaeangliae	Humpback Whale	Least Concern	2018-03-24
Monodon monoceros	Narwhal	Least Concern	2017-07-03
Pagophilus groenlandicus	Harp Seal	Least Concern	2015-06-06
Phoca largha	Spotted Seal	Least Concern	2015-06-03
Phocoena phocoena	Harbor Porpoise	Least Concern	2020-05-19
Pusa hispida	Ringed Seal	Least Concern	2016-01-16
Orcinus orca	Killer Whale	Data Deficient	2017-06-20

Retrieved from IUCN using the following search query:

- Type: Species
- Taxonomy: Animalia -> Chordata -> Mammalia
- Marine Regions: Arctic Sea

Source: IUCN. (2022). IUCN red list of threatened species. www.iucnredlist.org (Accessed: 13.07.2022)

6.2 Annex 2

Table 2. Membership and Treaty Ratification of Arctic coastal states. Green – party; red – not party.

	Dates	Canada	Greenland (Denmark)	Norway	Russian Federation	United States	Issues addressed	Geo-graphic coverage
Main international organisations and agreements								
Basel Convention	1989 (adoption) 1992 (entry into force)	[green]	[green]	[green]	[green]	[red]	Hazardous wastes	Global
BBNJ	Under negotiation						Marine biodiversity	High Seas
BWM Convention (IMO)	2004 (adoption) 2017 (entry into force	[green]	[green]	[green]	[green]	[red]	Invasive species	Global
CBD	1992 (adoption) 1993 (entry into force)	[green] Not in Cartagena & Nagoya Protocols	[green]	[green]	[green] Not in Cartagena & Nagoya Protocols	[red]	Biodiversity	Global
CITES	1973 (adoption) 1975 (entry into force)	[green]	[green]	[green]	[green]	[green]	Biodiversity (endangered species)	Global
CMS	1975 (signed) 1983 (entry into force)	[red]	[red] Denmark is a party but Greenland is not covered	[green]	[red]	[red]	Biodiversity (migratory species)	Global
Compliance Agreement (FAO)	1993 (approved) 2003 (entry into force)	[green]	[red]	[green]	[red]	[green]	Fisheries on the High Seas	High Seas
IMO	1948	[green]	[green]	[green]	[green]	[green]	Shipping safety and marine pollution prevention	Global
IOC-UNESCO	1961	[green]	[green]	[green]	[green]	[green]	Ocean science and services	Global
ISA	1994	[green]	[red] Denmark is a party but Greenland is not covered	[green]	[green]	[red]	Seabed beyond national jurisdiction	High Seas
IWC	1946	[red] Left in 1982	[green]	[green]	[green]	[green]	Whales	Global
Kyoto Protocol	1997 (adoption) 2005 (entry into force)	[red]	[green]	[green]	[green]	[red]	Climate change	Global
London Convention (IMO)	1972 (adoption) 1975 (entry into force)	[green]	[green]	[green]	[green]	[green]	Marine pollution	Global
London Protocol (IMO)	1996 (adoption) 2006 (entry into force)	[green]	[green]	[green]	[red]	[red]	Marine pollution	Global
MARPOL (IMO)	1973 (adoption) 1983 (entry into force)	[green]	[green]	[green]	[green]	[green]	Pollution from ships	Global
Minamata Convention	2013 (adoption) 2017 (entry into force)	[green]	[green]	[green]	[red]	[green]	Mercury pollution	Global
Paris Agreement	2015 (adoption) 2016 (entry into force)	[green]	[red] Denmark is a party with the exclusion of Greenland	[green]	[green]	[green]	Climate change	Global
Polar Code (IMO)	2014 (adoption) 2017 (entry into force)	[green]	[green]	[green]	[green]	[green]	Environmental protection and safety of shipping in polar regions	Polar regions

	Dates	Canada	Greenland (Denmark)	Norway	Russian Federation	United States	Issues addressed	Geo-graphic coverage
PSMA (FAO)	2009 (adoption) 2016 (entry into force)						IUU fishing	Global
Ramsar Convention	1971 (established) 1975 (entry into force)						Conservation and wise use of all wetlands	Global
Rotterdam Convention	1998 (adoption) 2004 (entry into force)						Hazardous chemicals	Global
SOLAS (IMO)	1974 (adoption) 1980 (entry into force)						Shipping safety	Global
Stockholm Convention	2001 (adoption) 2004 (entry into force)						Persistent organic pollutants	Global
UNCLOS	1982 (adoption) 1994 (entry into force)						Universal	Global
UNESCO	1945						Universal	Global
UNFCCC	1992 (adoption) 1994 (entry into force)						Climate change	Global
UNFSA	1995 (adoption) 2001 (entry into force)						Conservation and sustainable use of straddling and highly migratory fish stocks	Global
World Heritage Convention (UNESCO)	1972 (adoption) 1975 (entry into force)						Nature conservation and preservation of cultural properties	Global
Main regional organisations and agreements								
Arctic Council	1996						Universal	Circumpolar Arctic
CAO Fisheries Agreement	2018 (signed) 2021 (entry into force)						Fishing in the high seas of the central Arctic Ocean	Arctic High Seas
CCBSP	1994 (signed) 1995 (entry into force)						Pollock fisheries	Central Bering Sea (High Seas)
ICCAT	1966						Tunas and tuna-like species	Atlantic Ocean
ICES	1902						Marine science	Atlantic and Arctic, the Mediterranean Sea, the Black Sea, and the North Pacific

	Dates	Canada	Greenland (Denmark)	Norway	Russian Federation	United States	Issues addressed	Geo-graphic coverage
IPHC	1923 (conclusion and entry into force)						Pacific Halibut Fishery	EEZ of Canada and the United States in the North Pacific
JCNB	1991						Narwhal and beluga	Baffin Bay
JNRFC	1974						Fisheries	Barents and Norwegian Sea
NAFO	1979						Fisheries	Northwest Atlantic
NAMMCO	1992						Cetaceans (whales, dolphins and porpoises) and pinnipeds (seals and walruses)	North Atlantic
NASCO	1984						Salmon	North Atlantic
NEAFC	established in 1959, working since 1980	Cooperating Non-Contracting Party					Fisheries	North East Atlantic
NPAFC	1992 (signed) 1993 (entry into force)						Anadromous Fish Stocks	North Pacific
NPFC	2015						Fisheries	North Pacific
OSPAR	1992 (previously 1972 Oslo and 1974 Paris Conventions)						Protection of the Marine Environment	North-East Atlantic and Arctic
PICES	1990 (signed) 1992 (entry into force)						Marine research	North Pacific
Range States Agreement	1973 (signed) 1976 (entry into force)						Polar Bear	Circumpolar Arctic
WCPFC	2000 (adopted) 2004 (entry into force)						Highly Migratory Fish Stocks	Western and Central Pacific

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