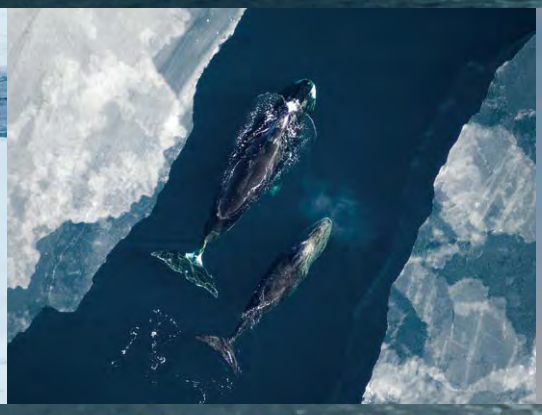
Natural Marine World Heritage in the Arctic Ocean

Report of an expert workshop and review process

April, 2017



NRDC

IUCN

UNESCO

United Nations Educational, Scientific and Cultural Organization

With the support of

World Heritage Centre

FONDATION PRINCE ALBERT II DE MONACO

WWF

PUBLISHED BY

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CITATION

Speer, L., Nelson, R., Casier, R., Gavrilo, M., von Quillfeldt, C., Cleary, J., Halpin, P. and Hooper, P. (2017). *Natural Marine World Heritage in the Arctic Ocean, Report of an expert workshop and review process*. Gland, Switzerland: IUCN. 112p.

COVER PHOTOS

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DESIGN / LAYOUT BY

Imre Sebestyén jr. / Studio Unit Graphics

REPORT DATE

April, 2017

AVAILABLE FROM

IUCN (International Union for Conservation of Nature and Natural Resources)
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Acknowledgements

IUCN and UNESCO's World Heritage Centre are grateful for the generous support for this publication provided by the Prince Albert II of Monaco Foundation, the Natural Resources Defense Council (NRDC) and the World Wide Fund For Nature (WWF). NRDC is grateful to the Prince Albert II of Monaco Foundation, Oceans 5, and an anonymous donor for their generous support of NRDC's international Arctic marine conservation work.

We gratefully acknowledge the experts who contributed their time and expertise at the workshop, and in providing or reviewing the technical content of this report. Workshop participants and reviewers are listed below; their titles and affiliations may be found in Annex 2. The authors remain solely responsible for the final content of this report. Its contents do not necessarily reflect the individual views of workshop participants or their organizations.

Workshop participants (many of whom reviewed portions of this report): Tim Badman, Alexey Butorin, Robbert Casier, Tom Christensen, Jesse Cleary, Raphaël Cuvelier, Fanny Douvere, Maria Gavrilo, Patrick Halpin, Patricia Hooper, Brendan Kelly, Carl Gustaf Lundin, Francine Mercier, Anders Mosbech, David Obura, Nilufer Oral, Madeleine Redfern, Tatiana Saksina, Lisa Speer, Evgeny Syroechkovsky, Clive Tesar, Cecilie von Quillfeldt.

Additional reviewers: Bastian Bertzky, David Boertmann, Tenna Boye, Natalia Chernova, Jacqueline Grebmeier, Anatoly Kochnev, Ksenia Kosobokova, V.O. Mokievsky, David Obura, Elena Osipova, Stephanie Pfirman, Jake Rice, Vassily Spiridonov, Clive Tesar, Bruno Tremblay.

This report builds on prior work under the UNESCO World Heritage Marine Programme and the IUCN World Heritage Programme, and parts of the text have been derived from previous reports.

Abbreviations

CBD	Convention on Biological Diversity
EBSA	Ecologically and Biologically Significant Area
EEZ	Exclusive Economic Zone
ICOMOS	International Council on Monuments and Sites
IUCN	International Union for Conservation of Nature
NRDC	Natural Resources Defense Council
OUV	Outstanding Universal Value
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHC	World Heritage Convention

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PREFACE

By Prince Albert II of Monaco

Warming twice as fast as the rest of the planet, the Arctic is ground zero for climate change. Rising temperatures, ocean acidification, and the dramatic loss of sea ice threaten to unravel the intricate ecological relationships that have evolved over millennia in this unique and vulnerable part of our planet, and the cultures who depend upon them. In addition, melting ice means the Arctic is opening to new human activity in the ocean, such as offshore oil and gas development, shipping and fishing. These activities have the potential to inflict further stress on Arctic marine ecosystems already straining under the effects of climate change.

I believe we have a historic opportunity, and a profound obligation, to do what we can to educate people around the world about the need to protect ecologically important and sensitive ocean habitats in the Arctic for future generations. The need to act is urgent. The Paris Climate Agreement of 2015 represented a crucial step toward addressing global warming and its effects on the Arctic. As we work to implement that agreement, we must also strengthen the health and resilience of the Arctic by protecting key habitats and ecosystems from damaging human activities.

This report presents the results of a scientific workshop convened to identify globally unique marine areas in the Arctic that exemplify the criteria for inscription on the UNESCO World Heritage List. It builds on a previous report, published in 2007, on Arctic World Heritage funded in part by my Foundation. The report will help call attention to the need to protect globally significant Arctic marine ecosystems, and lays the groundwork for further evaluation by governments and local communities of the cultural values of these areas, as a prelude to developing potential nomination of sites for inscription on the UNESCO World Heritage List.

The Arctic marine environment lags behind the terrestrial environment both in terms of protected areas and in the number of World Heritage sites. It is my hope this report will help rectify this imbalance and highlight the need for rapid action to conserve this remarkable part of our planet.

EXECUTIVE SUMMARY

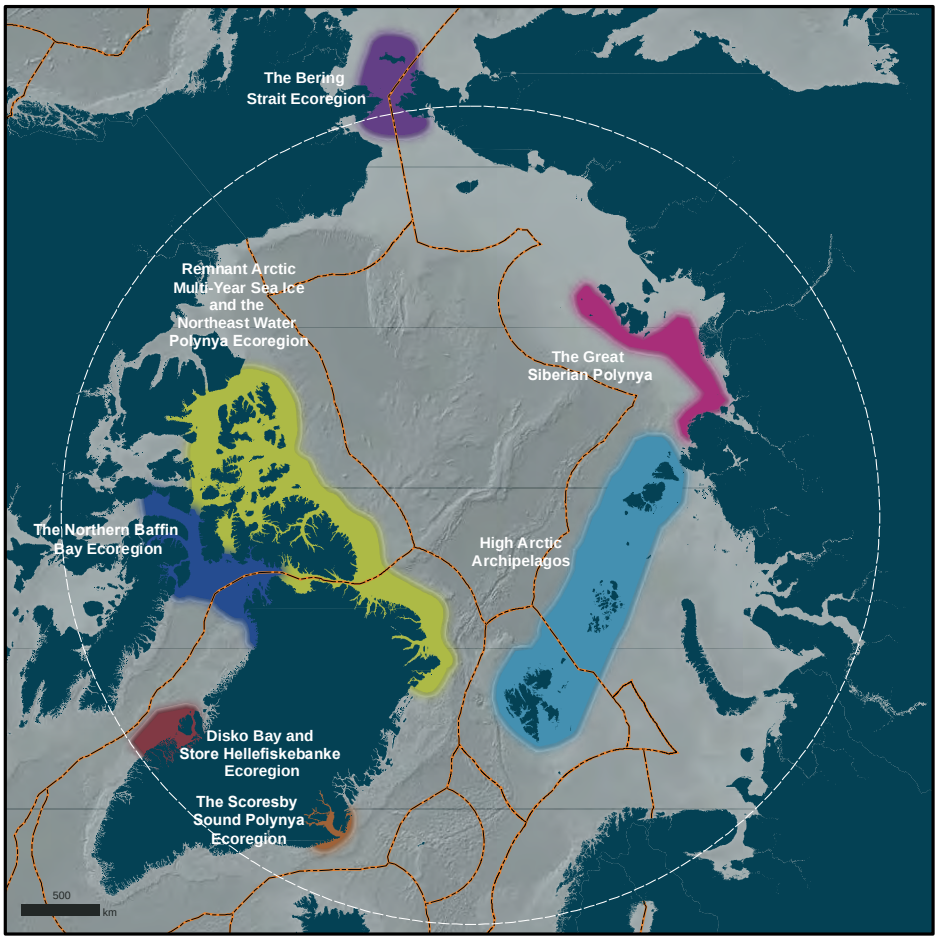
The 1972 UNESCO World Heritage Convention unites nations behind a shared commitment to preserve the world's outstanding cultural and natural heritage for the benefit of present and future generations.

This report presents the results of a scientific assessment of globally significant ecosystems in the Arctic Ocean that may be of Outstanding Universal Value (OUV) with respect to the natural criteria for World Heritage status. The report is intended to advance recognition and conservation of globally significant natural marine sites in the Arctic, a region which is currently under-represented on the World Heritage List. The report does not assess potential OUV related to cultural heritage, which was beyond the scope of the project.

This report describes seven exceptional areas in the Arctic Ocean that are of such global significance that they may be of OUV and thus be priorities for inscription on the World Heritage List.

The methodology used to identify these sites involved:

1) Preparation of a preliminary desktop scientific assessment of the key physical and biological features that distinguish the Arctic Ocean globally, along with an evaluation of illustrative sites that best exemplify these features and are of sufficient integrity and scale to be considered of OUV. The desktop study was based on existing data and information gathered from peer-reviewed scientific publications, previous assessments



Illustrations of Potential OUV in the Arctic Marine Environment

—— Marine Boundary

The marine areas of potential Outstanding Universal Value represent the priorities that emerged through the workshop and review process described in this report. These are not an exclusive selection of sites. Boundaries of sites are approximate and indicative, not absolute.

Map: Marine Geospatial Ecology Lab, Duke University (2016)

and expert knowledge, with special attention to pan-Arctic biogeographic and biodiversity analyses.

2) In February 2016 the desktop study was reviewed through a meeting of scientists and other experts with expertise in a variety of disciplines in order to validate and prioritise the analysis. This was followed by individual and group consultations with workshop participants and further peer-review. Workshop participants and additional reviewers are listed in Annex 2.

The seven areas identified through this process do not represent a comprehensive list, but are intended to be illustrative of sites that best illustrate the globally unique features of the Arctic Ocean. They are:

- **The Bering Strait Ecoregion (including St. Lawrence Island).** As the Pacific gateway to the Arctic Ocean, the Bering Strait Ecoregion is one of the world's great migration corridors. An estimated 12 million seabirds nest, forage and breed in the Bering Strait Ecoregion, and hundreds of thousands of marine mammals of several species migrate through the Strait in both spring and fall. The region also illustrates important geological history, having functioned during periods of low sea level as a land bridge between North America and Eurasia.
- **Remnant Arctic Multi-Year Sea Ice and the Northeast Water Polynya Ecoregion.** Containing much of the thickest, oldest ice in the Arctic and one of its largest polynyas,[1] this region presents a striking combination of Arctic marine phenomena. Multi-year sea ice, a globally unique habitat, and its associated species are likely to persist for the longest period of time here as the Arctic warms and sea ice melts. The adjacent Northeast Water Polynya supports many species, including the critically endangered Spitsbergen stock of bowhead whale.
- **The Northern Baffin Bay Ecoregion.** This area contains the North Water Polynya, the largest Arctic polynya and one of the most productive marine environments in the Arctic Ocean, if not the entire Northern Hemisphere. The North Water Polynya supports the largest single-species aggregation of seabirds (little auks) anywhere on earth. Lancaster Sound supports high concentrations of polar bears, and the Northern Baffin Bay Ecoregion is of critical importance to most of the global population of narwhal, the entire Eastern High Arctic/Baffin Bay beluga population, and a significant proportion of the Eastern Canada-West Greenland bowhead whale population.
- **Disko Bay and Store Hellefiskebanke Ecoregion.** Complex physical and ecological processes in the Disko Bay and Store Hellefiskebanke Ecoregion, which is linked to an existing World Heritage site in western Greenland, lead to enhanced primary production in this area, which in turn supports diverse Arctic mammals and seabirds. Store Hellefiskebanke is a critical winter habitat for the West Greenland/Baffin Island walrus population (around 1,400 animals estimated in 2012), along with hundreds of thousands of king eiders.
- **The Scoresby Sound Polynya Ecoregion.** The Scoresby Sound Polynya Ecoregion includes the world's largest fjord system. Among other functions, the associated polynya provides seabirds with important feeding opportunities in spring and early summer, when ice still blocks coasts further to the north and south. The Scoresby Sound Polynya Ecoregion is very important for several IUCN Red-Listed species, including the critically endangered Spitsbergen stock of bowhead whale, narwhal, polar bear, Atlantic walrus and ivory gull, and supports the second largest breeding population of little auks.
- **High Arctic Archipelagos.** Consisting of the waters between and around the Arctic's extreme northern archipelagos (Svalbard, Franz Josef Land and Severnaya Zemlya), the High Arctic Archipelagos separate shallow coastal seas from the deep Arctic Basin, and are a region of high productivity and important habitat for walrus, polar bear and other threatened species. The shelf topography of the region is extremely diverse and includes archipelagos and islands, insular shelves, shallow and deep-water fjords, edge and cross troughs, and sea-bottom edge glacial formations. The High Arctic Archipelagos support connected populations of birds and mammals, including 85% of the global population of ivory gulls.
- **The Great Siberian Polynya.** Located in the Russian Arctic, the Great Siberian Polynya is a spectacular example of Arctic polynya ecosystems and is of great significance to marine biological diversity. Most species of fish, and nearly all the seabirds and marine mammals in the Laptev Sea are dependent on the Great Siberian Polynya. This region is also one of the most important ice-exporting areas in the Arctic.

Through the course of this project, a number of additional areas were identified as worthy of further consideration as Arctic marine regions of potential OUV (see Annex 3).

1 A polynya is an area of persistent open water surrounded by sea ice. Polynyas often provide critical habitat for birds, mammals and other marine life.

Conclusions and recommendations

The sites identified through this process are illustrative of the exceptional nature and value of the Arctic marine environment. This report is meant to inspire their possible future protection as part of our global marine heritage.

As Arctic sea ice retreats, these superb marine features are becoming increasingly accessible to fishing, shipping and new economic demands and threats. The dramatic pace at which Arctic sea ice has declined in recent years highlights the urgency for enhanced understanding and protection of these priceless places of potential OUV. Protection through the 1972 UNESCO World Heritage Convention is one crucial way to secure these places for generations to come.

An analysis of the current Tentative Lists of States Parties to the World Heritage Convention that have jurisdiction over portions of the Arctic Ocean highlights important gaps when compared to the scientific assessment reflected in this report. Only two of the seven areas of possible OUV as identified in this report are currently partially represented on the Tentative Lists of States Parties: Svalbard Archipelago (Norway) and Quttinirpaaq (Canada). There is thus a serious mismatch between the Tentative Lists and marine areas of possible OUV in the Arctic Ocean.

In view of this, States Parties to the 1972 World Heritage Convention may wish to consider the following recommendations:

1) **To update their respective Tentative Lists in relation to the Arctic**. Before a site can be nominated for potential inscription on the UNESCO World Heritage List, it needs to be included on the relevant States Parties' Tentative List for a minimum of one year. Considering the current mismatch between the Tentative Lists and the marine conservation value of the Arctic Ocean, this is a crucial first step toward closing the Arctic gap in the UNESCO World Heritage List;

2) **To provide enhanced protection** of the areas identified in this report from potentially damaging activities. None of the areas described in this report are fully protected, and for some no site-specific enhanced protection measures exist. In order to be considered of OUV, sites need to have an adequate protection and management system in place;

3) **To evaluate OUV in the Arctic region in relation to terrestrial, freshwater, coastal and estuarine nature conservation values.** This report focuses on marine areas, with limited consideration of coastal areas. It does not address the terrestrial or freshwater nature conservation values of the region, nor did it consider estuaries and deltas. The Arctic hosts globally significant areas for nature conservation beyond its highly significant marine values that are the subject of the present report. The biodiversity, geodiversity and wider nature conservation values of the Arctic need to be assessed for their potential OUV, as a priority step to the representation of the Arctic on the World Heritage List. This will also be important for some of the marine conservation areas identified in this report, especially those with terrestrial components;

4) **To evaluate OUV in the Arctic Ocean and the broader Arctic region from a cultural and traditional knowledge perspective**. A key conclusion of the expert workshop centered on the intimate relationship between local communities, particularly indigenous peoples and traditional cultures, and the Arctic's natural marine environment. The OUV of the Arctic region should be considered from both its cultural and natural perspectives. Furthermore, the full recognition of the rights of concerned communities, as recognized in the Convention's Operational Guidelines, is fundamental in any nomination process. Cultural values and traditional use and rights will need to be considered within and beyond the relevant priority areas identified in this report;

5) **To pursue a wider evaluation of marine conservation values in the Arctic, including the High Seas.** There are more marine areas in the Arctic Ocean that could be considered to be of OUV beyond the seven priorities identified in this report, and further evaluation is needed of the areas identified in Annex 3 at a minimum. The potential application of the World Heritage Convention in the High Seas is a topic of current discussion, and thus the High Seas of the Arctic, including the North Pole, provides a further focus for the identification of potential OUV in the region.

6) **To nominate candidate areas in the Arctic Ocean as World Heritage Sites** that meet fully the criteria, integrity, protection and management requirements of OUV, and thus would merit inscription on the UNESCO World Heritage List, considering the priority areas described in this report.

CHAPTER 1:
INTRODUCTION

1.1 The 1972 UNESCO World Heritage Convention and the Arctic

The 1972 UNESCO World Heritage Convention[1] unites nations behind a shared commitment to preserve the world's outstanding cultural and natural heritage for the benefit of present and future generations. It recognizes that the protection of this heritage is the collective responsibility of the international community as a whole.

As of 1 February 2017, there are 1052 properties inscribed on the World Heritage List, including 814 cultural sites, 203 natural sites and 35 mixed sites, across 165 different States Parties.[2] About 50 sites are considered marine,[3] representing just 4.7 percent of all 1052 World Heritage sites but covering 55.5 percent of the total area of all natural and mixed World Heritage sites.[4]

Currently, five World Heritage properties are located north of the Arctic Circle, including three natural, one mixed and one cultural site: [5]

- The Rock Art of Alta, *Norway, 1985*, (cultural);
- Laponian Area, *Sweden, 1996*, (mixed);
- Ilulissat Icefjord, *Denmark, 2004*, (natural);
- Natural System of Wrangel Island Reserve, *Russian Federation, 2004*, (natural); and
- Putorana Plateau, *Russian Federation, 2010*, (natural).

Of these World Heritage sites, only one site is recognized within the World Heritage Marine Programme: the Natural System of Wrangel Island Reserve (Russian Federation). Since its designation in 2004, no new marine World Heritage sites in the Arctic Ocean have been inscribed on the World Heritage List. In that time-frame accelerating loss of sea ice and accompanying economic development have posed increasing risks to unique and globally significant Arctic marine features.

1.2 Ecological relationships linking the Arctic Ocean to existing World Heritage sites in other regions

The Arctic Ocean has a profound impact on the wellbeing of ecosystems all over the world. Many birds that breed in the Arctic during summer season, for example, migrate south during winter to feed and rest. They go as far south as the Wadden Sea (Denmark, Germany, Netherlands) and the Banc d'Arguin National Park (Mauritania), two of the most critical points for migratory birds on the East Atlantic Flyway and inscribed on the World Heritage List in 2010 and 1989 respectively (Figure 1). The ecosystems of these two World Heritage sites are thus intimately connected with the Arctic Ocean and the protection of the Arctic's key features is important to those sites.[6]

Figure 1: Interconnectivity between the Arctic and the Wadden Sea and Banc d'Arguin National Park World Heritage marine sites. (Source: Wadden Sea Flyway Initiative)[7]

Similarly, the Whale Sanctuary of El Vizcaino (Mexico) is recognized as the world's most important reproductive site for the once endangered Eastern subpopulation of the North Pacific grey whale, and was listed as World Heritage in 1993. Most of the subpopulation migrates between the lagoons of El Vizcaino and the summer feeding grounds

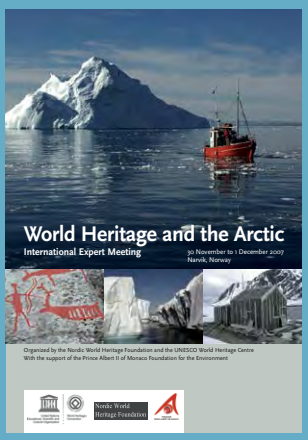
in the Chukchi, Beaufort and Northwestern Bering Seas in the Arctic. Research suggests that some whales migrate all the way from Mexico to the feeding grounds near the Natural System of Wrangel Island Reserve (Russian Federation) World Heritage site.[8]

These are just two examples of the connections between the Arctic Ocean and existing World Heritage sites in lower latitudes. These connections, along with the responsibilities of States under the World Heritage Convention to protect their own and each other's World Heritage, and the requirements for integrity, protection and management for World Heritage sites, form a strong argument for increased protection of the Arctic. The OUV of some World Heritage sites may be jeopardized if no additional protection measures are taken in the Arctic region.

Box 1: Previous analyses of World Heritage in the Arctic

The 2007 Expert Meeting on World Heritage and the Arctic

The first International Expert Meeting on World Heritage and the Arctic took place from 30 November to 1 December 2007 in Narvik, Norway, organized by the Nordic World Heritage Foundation and the UNESCO World Heritage Centre, with the support of the Prince Albert II of Monaco Foundation.[10] The meeting focused on the exchange of information on the natural and cultural heritage of the Arctic region, with identification of potential sites of Outstanding Universal Value for the World Heritage List. Participants at the meeting noted that "*the Arctic Region is one of the gaps on the World Heritage List with only two natural properties, one mixed and one cultural property, located north of the Arctic Circle*." It was also emphasized that "*the Arctic region is important for global processes and is to be considered as precious heritage for humankind. The region includes a number of unique and outstanding natural and cultural heritage places which require protection, improved management and international recognition due to their vulnerability*." Seven recommendations were made during the meeting, including a proposal put forward by IUCN to prepare a thematic study on natural heritage in the Arctic region.



Preliminary Gap Analysis

In 2012, the UNESCO World Heritage Marine Programme commissioned an initial overview of existing marine World Heritage sites to assess the extent to which major marine regions and marine ecosystems are represented on the World Heritage List.[11] The review found several key gaps – regions and ecosystem types where there are few if any marine World Heritage sites, despite the presence of exceptional marine features. The review concluded that: "*The Arctic Realm might be of special interest. Nearly no World Heritage sites exist anywhere along the vast and distinct Arctic coastlines but contain many exceptional marine features.*"

IUCN Thematic Study on Marine World Heritage

In 2013, IUCN published its thematic study on marine World Heritage,[12] which analyzed the biogeographic coverage of marine World Heritage sites and identified broad gaps in representation. It showed that only 0.1 percent of the Arctic Province[13] enjoys World Heritage status, despite the fact that this area is vast, distinct and contains many exceptional marine features. This finding confirmed an earlier analysis prepared by IUCN for the 28th session of the World Heritage Committee in 2004,[14] in which the Tundra and Polar Systems biome was identified as a major gap in World Heritage coverage.

(Source: UNESCO, IUCN)

1.3 Securing a representative and balanced World Heritage List and protection of sites of Outstanding Universal Value in the Arctic

An essential step in implementing the World Heritage Convention is the identification of sites of potential Outstanding Universal Value for inclusion on the UNESCO World Heritage List. The technical responsibility under the Convention to advise on this matter rests primarily with IUCN, which functions as official advisor to the World Heritage Committee on natural heritage. IUCN develops advice through the conduct of thematic studies and expert workshops, and the provision of upstream advice on Tentative Lists and potential nominations, with the overall aim of supporting States Parties in their implementation of the World Heritage Convention.

In 1994, the World Heritage Committee launched the Global Strategy for a Representative, Balanced and Credible World Heritage List.[9] Implementation of the Global Strategy involves encouraging countries to become States Parties to the Convention, preparing Tentative Lists and preparing nominations of properties from categories and regions currently not well-represented on the World Heritage List.

Several analyses conducted by UNESCO's World Heritage Centre and IUCN have shown that the Arctic region is underrepresented on the World Heritage List (Box 1).

1.4 Identifying candidate marine World Heritage sites in the Arctic

Following the conclusions of these analyses, UNESCO's World Heritage Marine Programme, IUCN's Global Marine and Polar Programme and the Natural Resources Defense Council (NRDC) embarked on a project to identify candidate marine World Heritage sites in the Arctic that are potentially of Outstanding Universal Value (OUV) with respect to natural criteria. The project, which received support from the Prince Albert II of Monaco Foundation, NRDC and WWF Canada, builds upon the work of NRDC and IUCN in 2010 to identify ecologically and biologically sensitive areas (EBSAs) in the Arctic marine environment that should be considered for protection. The current project also takes forward one of the seven recommendations of the 2007 International Expert Meeting on World Heritage and the Arctic. The results of this three year project are reflected in this report.

CHAPTER 2:
OBJECTIVES, SCOPE AND METHODOLOGY

2.1 Goals and objectives

The objective of this project is to assess, from a scientific standpoint, marine features of potential Outstanding Universal Value (OUV) with respect to natural criteria in the Arctic region, and to identify areas that reflect the most unique and globally exceptional features in the Arctic that may merit protection through the World Heritage Convention. The ultimate goal of this project is to secure better protection of the Arctic's most exceptional marine ecosystems.

2.2 Scope of analysis

For purposes of this report, the Arctic marine region is defined as *the Arctic Ocean and related seas above the Arctic Circle.* On the Pacific side of the Arctic, the boundary of the study area was extended south on the advice of the expert workshop held during the course of the study, described below. Thus, on the Pacific side, the report considers the entire Bering Strait region (including St. Lawrence Island), which was considered by workshop participants to be ecologically inseparable from the Arctic Ocean and globally unique.

Major river estuaries and deltas, and areas for which global significance is derived principally from terrestrial attributes, were not considered in this report, but should be included in future evaluations. That part of the Central Arctic Ocean outside the jurisdiction of States was also not considered. Features of potential OUV are very likely to be present in this area, as with other regions of the High Seas.[15]

Finally, the report focuses only on natural marine areas in the Arctic and does not address any of the possible cultural criteria of the World Heritage Convention. Cultural areas of potential OUV in the Arctic require further evaluation in consultation with local and indigenous communities as well as the advisory bodies for cultural heritage under the World Heritage Convention. This type of assessment was beyond the scope of this project.

2.3 Methodology

Recognizing that marine ecosystems almost always transcend national boundaries, an ecosystem approach was used to identify possible marine areas of OUV rather than a country-by-country approach. An ecosystem approach focuses on identifying and describing ecologically significant features without regard to jurisdictional boundaries. This approach is more suitable to the dynamics of the marine environment and reflects more meaningful scales from an ecosystem perspective.

Following this approach, the project focused on two key components:

- Identification of the key marine physical and biological features that distinguish the Arctic region from others globally ("unique features"); and
- Identification of marine areas in the Arctic that best exemplify these unique features, and that also are of sufficient integrity and scale to potentially meet the criteria and requirements of OUV.

The identification of unique features and marine areas of potential OUV was done in two steps:

- A preliminary desktop assessment developed by the NRDC-IUCN project team; and
- A scientific expert meeting to discuss, review and fine-tune the results of the desktop study.

The process is described in more detail below.

The purpose of this report is not to propose an exclusive selection of potential new marine World Heritage sites in the Arctic, but rather simply to illustrate the need for, and the urgency of, protection of the most exceptional marine places in the Arctic. The selected illustrations emerged as priorities through the workshop and review process and reflect examples of the unique variety of ecosystems, natural marine phenomena and biodiversity that exist in the Arctic that could merit World Heritage recognition.

2.3.1 Identification of globally significant marine physical and biological features in the Arctic

A preliminary desktop assessment of unique marine physical and biological features was developed by the NRDC-IUCN project team. Experts on the Arctic marine environment and natural World Heritage developed a preliminary evaluation of these features and their global uniqueness. Special attention was given to the natural criteria on which OUV is assessed (criteria vii, viii, ix and x).

During a two-day expert working meeting held at UNESCO Headquarters, Paris (France) from 25 to 26 February 2016,[16] the identified features were discussed and reviewed. Invited workshop participants included marine scientists from the five States with marine territory in the Arctic Ocean (Russian Federation, Canada, Denmark, the United States of America and Norway), who attended in their personal capacities, and experts in World Heritage processes, nominations and evaluations. Special attention was given to ensuring a balance in geography and in expertise (sea ice biota, oceanography, avifauna, marine mammals, etc.) among the expert working meeting participants. A list of participants and the agenda for the expert working meeting can be found in Annex 2.

The main features assessed consisted of:

A) The physical processes that define and drive the region's marine ecosystems:

- Geology – the geological features of the seabed;
- Oceanography – major currents, ice dynamics and productivity processes that define biological linkages across the Arctic Ocean, and its sub-regional structure; and
- Climatology – the major climatic features of the region.

B) The biological characteristics and processes present:

- Biogeography – the overall distribution of species across the Arctic and how this reflects the historical and present-day processes that have led to the suite of species and habitats present today;
- Habitats – the major and unique habitats and ecosystems in the Arctic; and
- Species – species that are unique, of special concern, or show unique patterns and behaviors on a global scale.

Participants, scientific expert working meeting (25-26 February 2016, Paris, France). © UNESCO/Andreas B. Krueger

2.3.2 Identification of marine areas of potential Outstanding Universal Value in the Arctic

An initial overview of possible marine areas of OUV that best express the above features was prepared, drawing on existing information in peer-reviewed scientific publications, previous international scientific efforts to identify ecologically or biologically significant areas (EBSAs) in the Arctic marine environment, and expert knowledge.

Spatial data from previous EBSA identification efforts were obtained and collated using ESRI ArcGIS 10.3 software, and maps of the draft areas were extracted from the original datasets.

The results of the preliminary desktop assessment, which included both site descriptions and maps, were discussed, prioritized and revised at the February 2016 scientific expert working meeting. Sites were identified that best exemplify unique features in the Arctic using the World Heritage criteria, considering requirements for integrity and management. During the expert meeting, modifications to the draft site descriptions, features and boundaries were discussed. New maps were created each day to inform the discussion. Additional GIS datasets and figures from supporting publications were provided by meeting participants and reviewed as GIS overlays during the boundary iterations.

After the expert meeting, revised site descriptions were prepared and reviewed by relevant participants and outside reviewers, and comments were incorporated into a final draft report, which was circulated a final time to workshop participants for review. Some selected sites were translated to Russian to facilitate the review done by Russian experts.

The resulting set of illustrative sites is a first step toward a more comprehensive evaluation of potential OUV involving cultural and terrestrial considerations and criteria, led by Arctic States in consultation with local communities and indigenous peoples. It is important to note that the boundaries of the selected marine areas of potential OUV in the maps in Chapter 4 are all indicative. Before moving to nominations, careful consideration of potential configuration and boundaries of potential sites will be required. For some sites proposed before and during the workshop, there was either not enough scientific information available or disagreement among participants about aspects of potential OUV. Those sites, which the expert workshop nevertheless agreed may also contain features of OUV, may be found in Annex 3, as "Sites worth further consideration."

CHAPTER 3:
UNIQUE MARINE FEATURES OF THE ARCTIC

3.1 The global significance of the Arctic Ocean

The Arctic Ocean supports a globally unique variety of habitats and species, and plays a key role in shaping Earth's climate system.[17] The Arctic marine region includes 25% of the world's continental shelves, 35% of its coastline, and receives water from 20 of the world's 100 longest rivers, which contribute 11% of global river runoff.[18] At the same time, the Arctic region encompasses only 0.05% of the global human population, making it one of the least disturbed, most pristine oceans on Earth. Rapid climate change across the Earth is amplified in the Arctic, and as a result, the region is warming at least twice as fast as the rest of the planet.[19]

Arctic marine ecosystems differ from other marine ecosystems on the planet, including those in the Antarctic. In the Arctic, the ocean is surrounded by continents, while in the Antarctic the continent is surrounded by ocean. This contributes to marked differences in climate, oceanic and atmospheric circulation patterns, species composition and seasonal and long term ice patterns between the poles. In addition, the Arctic is home to some 4 million people, while the Antarctic lacks permanent residents and the associated indigenous cultures and heritage that have developed over millennia in the Arctic.

Species in both poles display remarkable adaptations to extreme cold and highly variable climatic conditions. With approximately 7,600 marine species, the Arctic has similar species richness to the Antarctic, but with a distinct species composition.[20]

3.2 Geomorphology

With an area of about 14 million square kilometers, the Arctic Ocean is the smallest and youngest of the Earth's oceans. It is characterized by a deep central basin surrounded by extensive continental shelves.

3.2.1 Arctic Ocean Basins

The Arctic Ocean's deep central basin is bisected by the 1800-kilometer-long Lomonosov Ridge, separating the central basin into the Eurasian and Amerasian Basins.

The Eurasian Basin is subdivided into two sub-basins, Amundsen and Nansen, separated by the Gakkel Ridge. The Gakkel Ridge is the northern most extension of the global mid-ocean ridge system.[21] Volcanic activity has given rise to approximately 150 seamounts along the Ridge,[22] along with nine to twelve hydrothermal vents, a frequency higher than found in any previously surveyed area of the mid-ocean ridge.[23] Given the isolation of the Gakkel Ridge, it is likely that new species of chemosynthetic faunal communities will be discovered here.[24] The deepest known location in the Arctic (5243 m) is within a rift valley of the Gakkel Ridge.[25]

Within the Amerasian Basin, the massive Alpha-Mendeleev Ridge system separates the Canada Basin from the Makarov Basin. The Alpha-Mendeleev Ridge is morphologically complex, with numerous seamounts and summit elevations that range from more than 2000 to 740 meters below sea level.[26] The Canada Basin is characterized by the Canada Abyssal Plain and several small 'isolated' basins, as well as the Chukchi Continental Borderland consisting of tightly clustered, steep and high-standing ridges.[27]

3.2.2 Arctic Continental Shelves

The Arctic continental shelves make up approximately half of the total area of the Arctic Ocean and, together with adjacent sea shelves, represent nearly 30% of the total shelf area of the world's oceans.[28]

The continental shelves are asymmetrically distributed around the circumference of the Arctic Basin (Figure 2).[29] North of Alaska and Greenland, the shelf is 100 to 200 kilometers wide. In contrast, the Siberian and Chukchi shelves off Eurasia extend more than 1000 kilometers in

Figure 2: Map of the Arctic marine environment. (Source: CAFF 2013)[33]

width.[30] The edge of the continental margin is incised by 345 large submarine canyons, which are highly important in basin-shelf interactions such as dense water drainage and upwelling.[31] The continental shelves nearly enclose the Arctic Ocean: Fram Strait, between Greenland and Svalbard, is the basin's only deep connection to the wider oceans.[32]

From the enormous landmasses encircling the Arctic Ocean comes an abundance of fresh river water. The Arctic Ocean is the most river-influenced of all world oceans, covering only 3% of the global ocean surface area but capturing 11% of global river runoff, draining a hinterland that stretches as far south as the Great Lakes and the northern Himalayas. Riverine inputs are projected to increase with global warming.[34]

3.3 Oceanography

The Arctic Ocean is fed by both the Pacific and Atlantic oceans.[35] The North Atlantic Current transports relatively warm and saline Atlantic water into the Arctic Ocean through two main branches: the Fram Strait and the Barents Sea. Atlantic water spreads throughout the entire

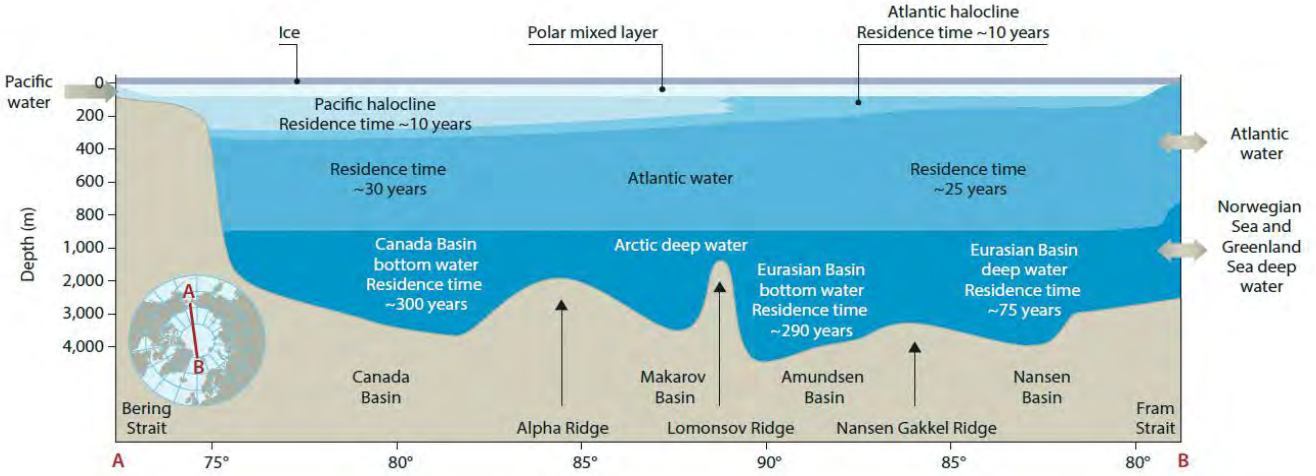


Figure 3: Arctic Ocean stratification. (Source: Arctic Monitoring and Assessment Program)

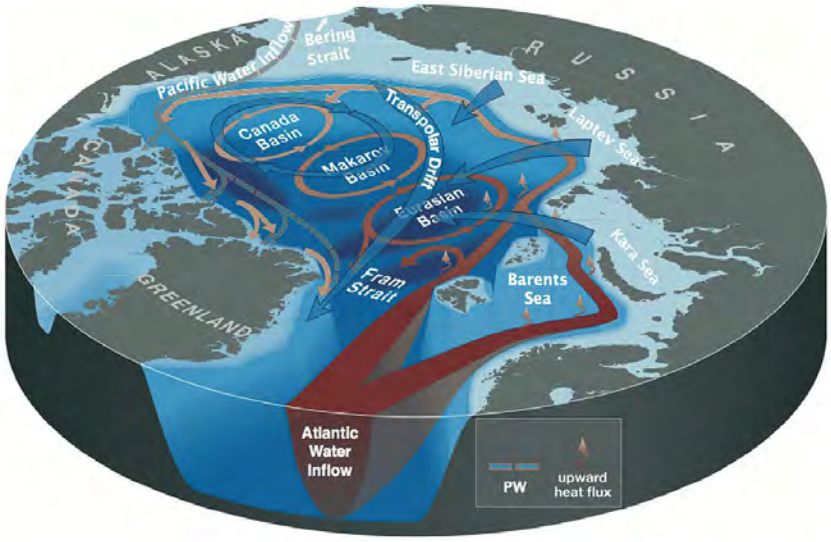


Figure 4: Arctic Ocean circulation. (Source: Polyakov et al. 2013)[42]

Arctic Ocean, and is the major contributor of heat to the Arctic climate system.[36] The flow of Atlantic waters is on average five times larger than the inflow of Pacific waters.[37] Pacific water enters the Arctic Ocean through the shallow and narrow Bering Strait and exits through the Canadian Arctic Archipelago and the western Fram Strait.

The Arctic Ocean is characterized by strong saline stratification. Less dense and less saline Pacific waters, which stay mostly confined to the Amerasian Basin, form a distinct layer on top of the Atlantic layer.[38] Stratification is further reinforced by large amounts of freshwater from rivers and ice melt from the surrounding land area, which create a low salinity surface layer atop Pacific waters in the Amerasian Basin and Atlantic waters in the Eurasian Basin[39] (Figure 3). The resulting stratification limits upwelling and keeps heat from the warm Atlantic water from reaching the surface, and thus plays a crucial role in the formation and retention of sea ice.[40]

The inflows from the Pacific and Atlantic oceans are driven by the Northern Hemisphere Thermohaline Circulation. Wind-driven circulation of ice and the upper ocean forces the Trans-Polar Drift from Siberia to the Fram Strait, and stirs the Beaufort Gyre. The Arctic Circumpolar Boundary Current, an eddy-rich interior circulation system, carries Atlantic water cyclonically around the boundaries of the basins.[41] Deep-water exchange occurs when water entering from Fram Strait spreads – extremely slowly - from the Nansen Basin to the Amundsen Basin to the Makarov Basin and finally to the Canada Basin, before flowing back to the North Atlantic (Figure 4).

3.4 Climatology

The climate of the Arctic has fluctuated dramatically through time. After a period of relative climate stability for the last 10,000 years, the Arctic climate is again experiencing dramatic change, this time driven by anthropogenic greenhouse gas emissions.[43]

3.4.1 Historical Climate

The evolution of climate in the Arctic is marked by extremes. At the start of the Cenozoic period (~66 million years ago), the planet was ice free. A general cooling took place throughout the Cenozoic, and the harsh Arctic conditions of today began approximately 3 million years ago. Since then the region has oscillated between more than 20 cycles of glacial and interglacial states, which forced species to migrate, adapt, or go extinct. This history of glaciation is a key driver of species composition and richness in the Arctic Ocean.[44] During glacial periods, the Bering Strait was closed and the volume of Atlantic water entering the Arctic Ocean was reduced. During warmer interglacials, the Bering Strait opened, allowing Pacific Ocean species to migrate into the Arctic.[45] The evolutionary origin of many species in the Arctic can be traced to the Pacific Ocean at the time of the first opening of the Bering Strait.[46]

3.4.2 Current Climate

The Arctic Ocean region is typified by seasonal extremes in solar irradiance, ice cover, temperature and riverine inflow.[47]

The Arctic Basin is one of the driest parts of the Arctic.[48] It also experiences the longest period without sunlight of any part of the Arctic and the longest period of continuous sunlight. Until recently, much of the Arctic Basin was typically covered by perennial sea ice.

The surrounding seas receive more precipitation than the Arctic Basin.[49] These seas are covered largely by seasonal

ice, which forms in the winter and melts in the summer (the southern part of the Barents Sea is ice-free year-round).

Sea ice is frozen sea water that floats on the ocean's surface. As ice forms in the ocean, salt is extruded through tiny brine channels that form in the ice. As salt is extruded, the ice becomes fresher over time. In this way, sea ice increases the salinity of the ocean's surface via brine extrusion where it forms, and decreases the salinity where it melts, both of which can affect circulation patterns.

Sea ice is important to the climate in a variety of ways. It acts as an insulator, diminishing the transfer of heat from the ocean to the atmosphere in winter. White ice reflects sunlight, thereby reducing the amount of solar energy absorbed by the ocean. Sea ice also provides a surface on which snow can accumulate, which further decreases the absorption of solar energy.

3.4.3 Projected Future Climate

WARMING AND LOSS OF SEA ICE

Although the last 10,000 years have been characterized by climatic stability, the Earth is now in a period of rapid anthropogenic climate change, which is amplified in the Arctic. Since the mid-20th century, temperatures have increased twice as fast in the Arctic as in the mid-latitudes[50] (Figure 5). This is partly due to the change in reflectivity from white ice, which reflects much of the sun's energy back into space, to dark water, which absorbs more solar radiation. More solar radiation warms the ocean, melting more ice. Sea ice also helps keep the Arctic cold by insulating the sub-zero atmosphere from the relatively warm ocean in winter. As ice diminishes, it no longer insulates the atmosphere in autumn and winter from the warmth of the ocean, resulting in warmer winter temperatures and a reduction in the amount of ice that forms in winter.

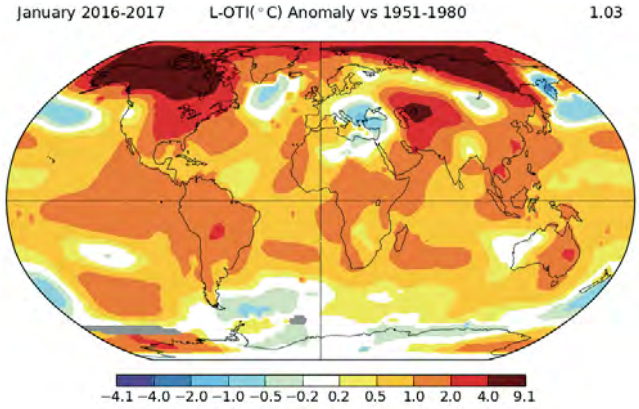


Figure 5: Global temperature anomalies for January 2016-February 2017 against mid-20th century temperatures. (Source: NASA GISS)

Warming in the Arctic will likely accelerate in the future through these and other types of positive feedback loops. Other potential contributors to warming include Arctic terrestrial ecosystems transitioning from net carbon sinks to net carbon sources, and increases in boreal and tundra fires and industrial activities that generate soot, which when deposited on ice can affect ice reflectivity and accelerate melting.[51]

Rapid climate change is already profoundly affecting Arctic marine environments. Arctic sea ice – both annual ice and multi-year ice – is decreasing in volume and extent at an accelerating rate.[52] Some projections indicate that the Arctic Ocean could be ice-free in late summer by mid-century or even before, as actual declines in extent have outpaced modeled declines.[53] Currently, sea ice extent shows decreasing trends in all months and virtually all regions (the exception being the Bering Sea during winter)[54] (Figure 6).

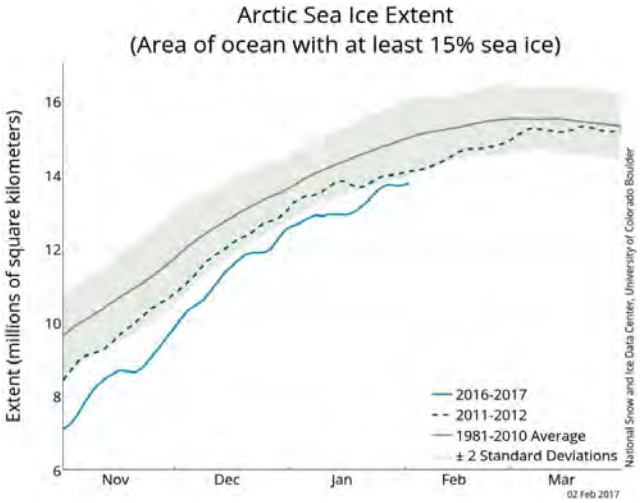


Figure 6: Arctic sea ice extent through February, 2017. (Source: National Snow and Ice Data Center)

Loss of sea ice, along with changes in the timing of ice breakup in spring and freeze-up in fall, is already affecting the timing and patterns of primary production, altering food webs and reducing the availability of different types of sea ice habitats.[55] Changes in sea ice surface conditions have and will impact ice-associated species, including ice algae, ice amphipods, ringed seals and polar bears. Changes in sea ice conditions also indirectly affect pelagic and benthic communities through changes in stratification, light attenuation and nutrient availability.[56] While ice-associated species may be adversely affected, sea ice loss facilitates migration and movement of some species that avoid the ice, such as orcas and other open water species. As a result, sea ice loss will modify species diversity and trophic interactions in Arctic marine ecosystems.[57]

CHANGES IN OCEAN CHEMISTRY

Increased concentrations of carbon dioxide in the atmosphere are taken up in part by the oceans, which leads to ocean acidification, a phenomenon that is amplified in the Arctic as colder water dissolves more carbon dioxide than warmer water. Indeed, simulation models show the Arctic Ocean may experience the greatest acidification within the global ocean, with the largest simulated pH changes worldwide occurring in Arctic surface waters.[58] Ocean acidification alters water chemistry, reducing the concentration of carbonate ions, which a large and diverse group of marine organisms require to build shells or skeletons.[59]

Increased river runoff and melting sea ice driven by rapid warming are also leading to substantial increases in freshwater input, especially pronounced in the Amerasian Basin. This freshwater flux has modified Arctic ocean circulation, and the possibility exists that the increase could affect global thermohaline circulation.[60]

Finally, levels of dissolved oxygen, essential to life in the ocean, are declining throughout the world's oceans, the result of a combination of warming-induced decline in the solubility of oxygen in seawater and reduced ventilation of the deep ocean (Figure 7).

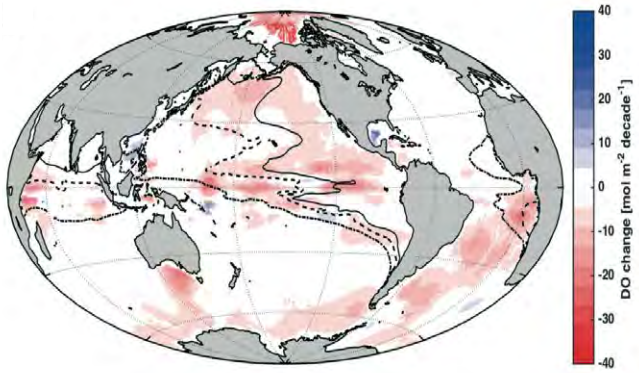


Figure 7: Change in dissolved oxygen per decade (color coded). Note Arctic region especially affected. (Schmidtko et al. 2017. Reprinted by permission from Macmillan Publishers Ltd.)[93]

3.5 Biogeography and unique habitats

As described in preceding sections, gradients in geomorphology, latitude, river inflow, oceanic currents, geological history and climate structure a wide range of environmental conditions in the Arctic marine environment.[61] These conditions support globally unique habitats and species, including most notably those associated with sea ice.[62] Differences in ice cover thickness, along with mixing between warm- and cold-water currents, or currents with different nutrient content create a mosaic of low-nutrient, less-productive areas and more enriched areas, which is reflected in differences in population density and species diversity across the Arctic Ocean. For example, the Bering and Barents Seas are nutrient-rich and harbor a diversity of invertebrates, fish and birds. In contrast, the deep seafloor of the central Arctic Ocean is oligotrophic and species poor.[63]

The biogeography of the Arctic is in flux, as climate change continues to drive sea ice decline and changes in water mass distribution, temperature and chemistry (see Features/Climatology). Range shifts and extensions have been documented in sub-Arctic waters over the last decade. Northward range extensions have been observed for phytoplankton, zooplankton, benthic invertebrates, fish, and marine birds.[64]

3.5.1 Arctic Sea Ice

Arctic sea ice is a globally significant marine feature. Sea ice is itself an ecosystem, supporting highly specialized biota that depend on sea ice for all or part of their life cycles. A high proportion of ice flora and fauna are found only in the Arctic.[65]

Sea ice can be classified according to age and origin. Young ice is newly formed sea ice, usually less than 30 centimeters thick, expanding in the autumn as temperatures fall, and also forming on leads that open in mid-winter due to shifts in the pack ice. If first-year ice survives the summer, it is then classified as multi-year ice, which can range from 1-5 metres thick. Lastly, icebergs or "ice features of land origin" are large masses of floating ice that originate from glaciers.[66]

Physical and chemical conditions in different types of sea ice vary significantly, creating a variety of habitats for micro-organisms. For example, sea ice salinity can range from nearly zero in multi-year ice to intensely salty patches in sea ice brine channels and pockets. Temperature and light conditions in, on and under sea ice vary spatially and seasonally.[67]

Sea ice supports unique and diverse biota that reside on, in and under the ice. Sea ice is porous, permeable and filled with channels containing nutrient-laden brine that provide habitat for a variety of viruses, bacteria, algae, fungi, and protozoans which are consumed by amphipods, copepods and other ice fauna. Densities of ice fauna can be as high as ~250,000 individuals in a square meter.[68] These in turn provide food for polar cod (*Boreogadus saida)*, a keystone species in the Arctic, which is preyed upon by a variety of birds and marine mammals. Sea ice also provides breeding, feeding and

resting grounds for a variety of species, some of which spend their entire life cycles on or near the ice.[69]

Changes in sea ice extent, thickness and snow cover directly affect sea-ice associated food webs. Changes in sea ice surface conditions have and will impact the reproduction and foraging success of ice-associated species, including ringed seal and polar bear. Changes in sea ice conditions also affect primary productivity as well as pelagic and benthic communities through changes in stratification, light attenuation and nutrient availability.[70] While ice-associated species may be adversely affected, sea ice loss facilitates migration and movement of some species that avoid the ice, such as orcas and other open water species. As a result, sea ice loss will modify species diversity and trophic interactions in Arctic marine ecosystems.[71]

3.5.2 Polynyas

Polynyas are areas of open water surrounded by sea ice. They can vary greatly in size and shape, from small openings only a few square kilometers, to the North Water Polynya, which covers ~50,000 square kilometers.[73] Polynyas occur throughout the Arctic and have a profound impact on atmospheric, oceanographic and biological processes.[74] Seasonally, they are among the most biologically productive ecosystems on the planet, supporting extensive phytoplankton blooms in the Arctic spring.[75] Algae and phytoplankton start blooming weeks or even months earlier in polynyas than nearby waters covered with ice, providing a nutrient burst that fuels early spring migrations of birds and marine mammals.[76]

Polynyas enable enhanced concentrations of fish, marine birds and mammals to overwinter at high latitudes.[77] In winter, large recurrent polynyas provide habitat for a diverse array of birds, and in spring they support some of the largest concentrations of seabirds anywhere in the Arctic.[78] Annually recurring polynyas are of particular ecological significance for marine mammals, supporting many species of ice-associated seals and cetaceans.[79] In regions with very high tidal activity, small coastal polynyas typically remain open throughout the winter, providing refuge for a wide variety of marine birds, as well as whales and seals, potentially attracting ice-dependent predators like polar bears.[80]

3.5.3 The Marginal Ice Zone

Primary productivity in the Arctic Ocean is determined in large measure by light availability, which increases as sea ice recedes in the spring, prompting phytoplankton to bloom along the ice edge. The location of this transition area between open water and ice – known as the "marginal ice zone" - plays a key role in determining the timing and magnitude of the spring phytoplankton bloom, which feeds copepods, amphipods and benthic invertebrates. These in turn are consumed by fish, birds and marine mammals.

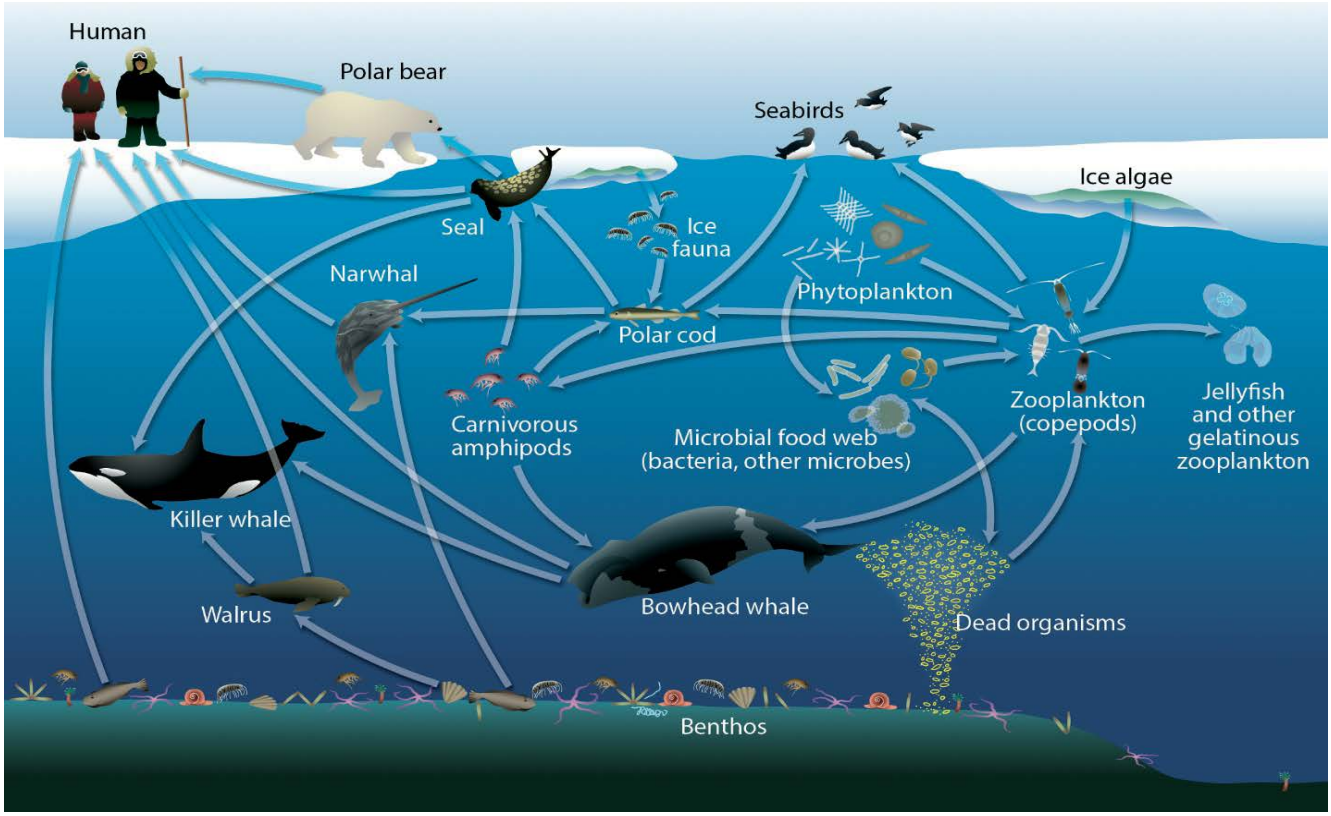


Figure 8: The Arctic marine food web. (Source: CAFF, 2013 adapted from Darnis et al. 2012)[72]

Warming in the Arctic means the timing of the spring ice melt and associated phytoplankton bloom in some areas is occurring days or weeks earlier than in the past. This results in a disconnect for species such as Arctic tern and Pacific grey whale, whose migrations are timed to arrive at the height of the spring bloom.[81]

3.5.4 Coastal Areas and Archipelagos

Coastal waters, especially over the relatively shallow continental shelf and banks, are particularly productive marine areas, where the presence, formation and melt of annual sea ice, combined with coastal erosion and riverine runoff mix to form some of the most dynamic ecosystems in the world.[82]

Water from the Pacific Ocean, the Atlantic Ocean and the Arctic's numerous rivers flow into the Arctic, and the mixing and stratification of water masses over the Arctic's shallow coastal shelves lead to unique ecosystems. Pacific water flowing through the shallow Bering Strait into the Chukchi Sea fuels a significant benthic community, which provides food for impressive concentrations of birds and marine mammals, while the Atlantic water flowing into the Barents Sea translates into high standing stocks of shrimp and small pelagic fish that support one of the principal fisheries of the world.[83]

Where large Arctic rivers drain into the Arctic Ocean, mixing of marine water with nutrient-rich fresh water enhances productivity and attracts large concentrations of marine wildlife. Deltas and offshore plumes from major rivers are heavily used feeding areas.[84]

Archipelagos of the Arctic are valuable for biodiversity in the Arctic.[85] The four main islands of Svalbard are home to large breeding bird colonies, and the waters and polynyas north of the islands are important areas for marine mammals.[86] Other archipelagos of the Arctic Ocean include Franz Josef Land, the New Siberian Islands, Novaya Zemlya, and the Canadian Arctic Archipelago, the second-largest in the world, composed of more than 36,563 islands.[87]

3.6 Species of the Arctic

3.6.1 Species Diversity

Species richness in the Arctic Ocean is comprised of a moderate number of endemics together with species that emigrated from areas outside the Arctic over time.[88] Some endemic Arctic lineages – such as the bowhead, beluga and narwhal whales and several ice-associated seal species – developed during the glaciated periods of the Miocene. The evolutionary origin of many modern Arctic marine species – particularly invertebrates - can be traced to the Pacific Ocean at the time of the opening of the Bering Strait, some 3.5 million years ago, when species-rich Pacific waters moved through the Arctic to the North Atlantic, enriching the Arctic Ocean.[89] Species then migrated, adapted or went extinct during the subsequent cycling of glacial and interglacial periods throughout the Pleistocene (see Climatology). Areas that were unglaciated during the last ice age provided refugia and thus possess higher species richness: the area around the Bering Strait and Chukotka is particularly rich in species, including shorebirds and mammals.[90]

Species richness in higher trophic levels is generally lower in the Arctic than at lower latitudes, likely due to the extreme seasonality, short growing season, widespread persistent ice cover and overall harsh climate characteristics of the region.[91] Conversely, the diversity of marine benthic invertebrates, crustaceans, phytoplankton, microalgae, and other organisms, may equal or exceed that of corresponding groups at lower latitudes.[92]

Diversity of mammals, fish and invertebrates tends to be high where North Pacific and North Atlantic waters enter the Arctic Ocean. Diversity of marine fish is particularly high in the Bering and White Seas. Marine invertebrates have highest diversity occurring in the Barents, Kara and White Seas. For both fish and invertebrates, high diversity near the Arctic gateways is largely the result of mixing of subarctic and Arctic fauna.[94] Biological diversity hotspots include contact zones between sea and land (the coastal zone), sea and freshwater (river mouths and estuaries), or sea and ice (polynyas or the marginal ice zone), as well as convergence points between different water masses (oceanographic fronts).[95]

3.6.2 Arctic Endemic Species

Arctic Ocean marine endemics occur across pelagic, benthic and sea ice realms. The inventory of endemic Arctic marine species is incomplete, and many species are likely yet to be discovered.[96] In the relatively well-explored Laptev Sea, 307 endemic species have been detected from among a total of about 1500 species.[97] Higher proportions of endemic species are found in the deep sea (i.e., an estimated 50-80% endemism rate, although this may be artificially high because of the low sampling effort) where past glaciations isolated benthic species.[98] The Arctic is highly important to global biodiversity given the high number of Arctic endemic seabird taxa.[99] On the shallow shelves, modern Arctic conditions have evolved

only recently: this short history, as well as the connectivity to the North Pacific and Atlantic oceans, contributes to the presence of relatively few endemic Arctic marine species here.[100]

MARINE MAMMALS

Of the thirty-five species of marine mammals that inhabit or seasonally use Arctic waters, seven are endemic to the Arctic: polar bear; narwhal, beluga and bowhead whales; walrus; ringed seal and bearded seal[101] (Figure 9). The reproduction, moulting, resting and feeding behavior of the Arctic's endemic marine mammals are closely linked to sea ice dynamics.[102] Assessing the status and trends of marine mammal populations in the Arctic is difficult because of the elusive nature of many species, and there are numerous gaps in basic information regarding population sizes, trends and distributions.[103]

Polar bear: Polar bears (*Ursus maritimus)* occur throughout ice-covered Arctic regions, especially in areas of annual ice over the continental shelf and the inter-island channels of archipelagos, although some occur in the permanent multi-year pack ice of the central Arctic basin.[105] There are nineteen subpopulations of polar bears, comprising a total global population of between 20,000 to 25,000 individuals.[106] Of these subpopulations, seven are declining, four are stable and one is considered to be increasing, while trends for the other seven are unknown.[107] Polar bears are currently listed as Vulnerable on the IUCN Red List of Threatened Species (hereafter IUCN Red List).[108] The species has demonstrated shifts in summer and fall distribution in recent decades. As sea ice recedes or breaks up earlier, more polar bears are arriving on land earlier, staying for longer periods and appearing in areas not used previously. Polar bear denning locations have also shifted in some regions in response to changing ice conditions, with more dens appearing on land.[109]

Narwhal: The narwhal (*Monodon monoceros)* is endemic to the Arctic, and is the most specialized of the Arctic cetaceans, being highly adapted to ice habitat. Narwhals are confined to the Atlantic Arctic in the eastern Canadian high Arctic and in waters around Greenland, Svalbard and Franz Josef Land,[110] and sporadically move into waters from the Barents Sea through to the Chukchi Sea.[111] They overwinter along the continental slope where they feed intensively from November to March, and spend the summer months in ice-free shallow bays and fjords.[112] There are ~100,000 narwhals today, although there is substantial uncertainty about numbers and trends in large parts of the range and clear evidence of decline for specific subpopulations, leading to a Near Threatened status on the IUCN Red List.[113]

Beluga whales: Beluga whales (*Delphinapterus leucas)* have a circumpolar Arctic distribution, with a global population of at least 150,000 individuals, divided into 29 discrete subpopulations by summer distribution.[114] Belugas from the Alaska coast, Canadian high Arctic and Hudson Bay undertake long migrations between summer and wintering sites, while others remain in the same region year-round.[115] Some beluga whales have shifted their distribution offshore with the receding sea ice edge.[116] Trends in abundance are unavailable for most beluga sub-populations, but of the assessed subpopulations, three are known to be declining, while

Arctic Marine Mammals (Bold indicates Arctic endemic)		
Narwhal whale	Stellar sea lion	Baird's beaked whale
Beluga whale	Grey seal	Stejneger's beaked whale
Bowhead whale	Harbor seal	Cuvier's beaked whale
Ringed seal	North Pacific right whale	Northern bottlenose whale
Bearded seal	North Atlantic right whale	Killer whale
Walrus	Grey whale	White-beaked dolphin
Polar bear	Blue whale	Long-finned pilot whale
Spotted seal	Fin whale	Atlantic white-sided dolphin
Ribbon seal	Sei whale	Dall's porpoise
Harp seal	Minke whale	Harbor porpoise
Hooded seal	Humpback whale	Sea otter
Northern fur seal	Sperm whale	

Figure 9: Marine mammals occurring in the Arctic Ocean. (Information sourced from Arctic Biodiversity Assessment 2013)

one is increasing, one is stable, and one endangered subpopulation had no sightings during the most recent survey.[117] The global population of beluga whales is classified as Near Threatened on the IUCN Red List.[118]

Bowhead whales: The bowhead (*Balaena mysticetus),* once commonly known in the North Atlantic and adjacent Arctic as the Greenland right whale, has a discontinuous circumpolar distribution. In the aggregate, bowhead whales number fewer than 20,000, with five recognized subpopulations: Bering-Chukchi-Beaufort Seas, Hudson Bay-Foxe Basin, Davis Strait-Baffin Bay, Svalbard-Barents Sea and the Okhotsk Sea.[119] The large (and growing) Bering-Chukchi-Beaufort Sea subpopulation comprises the largest segment of the population, and is largely responsible for the classification of the global bowhead whale population as of Least Concern on the IUCN Red List.[120] However, the Svalbard-Barents Sea (Spitsbergen) subpopulation, which ranges from the east coast of Greenland across the Greenland Sea to Severnaya Zemlya in the Russian Federation, is classified as Critically Endangered.[121] Bowhead whales migrate from sub-Arctic seas in winter into the high Arctic in summer. They often feed in polynyas or areas covered with loose sea ice in spring or in open water areas in late summer and fall when sea ice has retreated offshore.[122]

Ringed seal: Ringed seal (*Pusa hispida*) have a circumpolar distribution, inhabiting permanently or seasonally ice-covered areas from the North Pole to the low Arctic with their distribution extending into some lake and river systems in northern Canada.[123] The worldwide abundance of ringed seals is likely in the low millions, is comprised of five subspecies, and is a species of Least Concern on the IUCN Red List.[124]

Bearded seal: Bearded seal (*Erignathus barbatus*) have a patchy circumpolar distribution. They are strongly associated with sea ice and are benthic feeders. Bearded seal pups are normally born on pack ice or small floes of annually-formed sea ice.[125] The population has been estimated at ~500,000 individuals, and they are classified as a species of Least Concern on the IUCN Red List.[126]

Walrus: Walruses have a discontinuous circumpolar distribution with two recognized subspecies: the Atlantic walrus (*Odobenus rosmarus rosmarus*), distributed from the eastern Canadian Arctic to the Kara Sea, and the Pacific walrus (*Odobenus rosmarus divergens)* distributed in the Pacific Arctic in the Bering and Chukchi Seas.[127] The Laptev walrus, once suspected of being a third subspecies, has been proven to be the westernmost population of Pacific walrus, although the population is unique in that it does not migrate.[128] The size of the Pacific walrus population is estimated at 129,000 individuals in a portion of the range, but a range-wide estimate is not available. Atlantic walruses are estimated at 20,000 animals.[129] The trend in global population abundance for walrus is unknown, and walruses are classified as Vulnerable on the IUCN Red List.[130]

BIRDS

The Arctic hosts an incredible diversity of endemic seabirds, including all the loons, all four species of skuas and jaegers found in the northern hemisphere, and the single fulmarine petrel (*Fulmarus glacialis)* that occurs in the Arctic.[131] Additional endemics include two species of terns, eight species of auks, five species of *Larus* gulls, three gull's genera (*Pagophila, Xema, Rodosthetia*) and both species of Rissa gulls.[132] There are eight species of seaducks considered Arctic specialists, and five of them are Arctic endemics. Most marine-related geese of Branta species (*B. hrota, bernicla, nigricans, and* emperor goose *Chen canagica*) are Arctic breeding endemics. The high number of endemic seabird taxa make the Arctic Ocean highly important to global bird diversity.[133] The Arctic Ocean also supports the highest breeding densities of seabirds in the Northern Hemisphere, along with some of the largest seabird populations in the world. Many Arctic seabird species number in the millions.[134] Because of this concentration of numbers and endemic taxa, seabirds have a disproportionate influence on Arctic marine ecosystems and on Arctic biodiversity compared with lower latitudes.[135]

There are 64 seabird species (defined as birds that are strictly marine feeders) in the Arctic, and 44[136] seabird species that breed within the Arctic.[137] In addition, 59 species of shorebirds breed in the Arctic (of which 41 species breed exclusively in the Arctic) and are primarily associated with coastal areas, though seaducks, divers and some geese and swans also spend time at sea.[138] Most Arctic birds are migratory, and connect the Arctic to all other parts of the globe[139] (Figure 10). Ivory gulls (*Pagophila eburnea)* are one of the most specialized arctic seabirds, living in association with pack ice for most of their lives, and are classified as Near Threatened on the IUCN Red List.[140] Other notable species include king eider (*Somateria spectabilis*), spectacled eider (*Somateria fischeri*), Steller's eider (*Polysticta stelleri*), common eider (*Somateria mollissima)*, and long tailed duck (*Clangula hyemalis*), the latter three classified as Vulnerable, Near Threatened, and Vulnerable on the IUCN Red List, respectively.

FISH

Fifteen marine fish species – primarily sculpins, snailfishes and eelpouts - are considered rare and endemic to the Arctic Ocean.[142] Of the approximately 16,000 marine fish

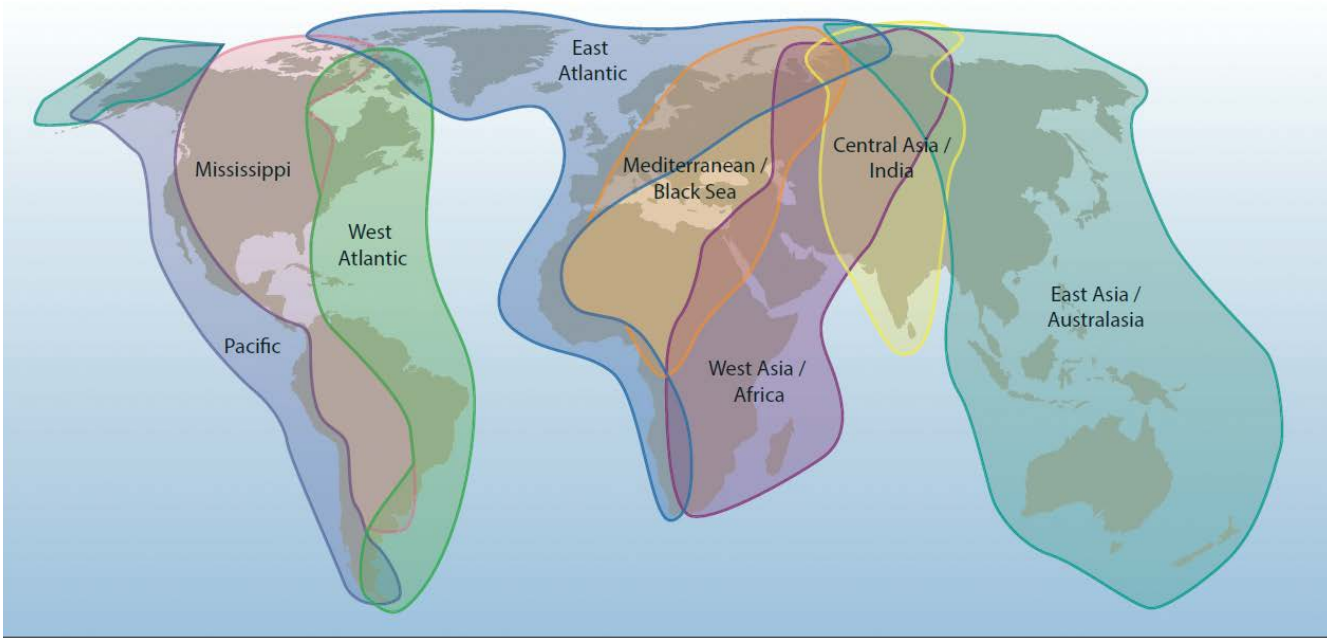


Figure 10: Major flyways of Arctic birds. (Source: Arctic Biodiversity Assessment 2013)[141]

species globally, there are 633 known fish species that occur throughout the Arctic Ocean and 63 marine fish are considered true Arctic generalists.[143] Additionally, 41 diadromous fish species (i.e., those species that migrate between fresh and saltwater) – 18% of the global total – spend some portion of their life cycle in Arctic seas.[144] Knowledge of Arctic fishes remains scant compared with other areas - even the Southern Ocean - and as many as 95% of the Arctic marine fish species have not been evaluated for threat status according to IUCN criteria.[145]

Cod: Two species of cod (family *Gadidae*) are endemic to the Arctic Ocean: Arctic cod (*Arctogadus glacialis*) and polar cod (*Boreogadus saida*). These species are the only cryopelagic fishes in the northern hemisphere, utilizing sea ice for both habitat and spawning substrate.[146] Polar cod is a keystone species in the marine Arctic, in terms of both its abundance and trophic role.[147] Additionally, it is the only marine fish species that is widespread throughout the entire Arctic Ocean, including the Central Arctic Basin.[148] Arctic cod, on the other hand, is much less abundant and is primarily associated with fjords and Arctic shelves,[149] with a circumpolar range extending across the Arctic Ocean up to the North Pole and south to Greenland and the northern Barents Sea.[150]

Salmonids: Arctic diadromous fishes are mostly anadromous salmonids (*Salmonidae),* which include ciscoes, whitefishes, trouts, chars and salmons. Salmonids inhabit inshore and nearshore waters except for a few species that range far offshore during their ocean years.[151] One prominent species is the Arctic char (*Salvelinus alpinus*), which reaches its greatest abundance north of the polar circle, and makes short but repeated journeys out to sea during summer.[152]

OTHER

Known macroalgae (seaweed) endemics include 21 species.[153] An estimated 15-20% of all Arctic zooplankton species are endemics,[154] including the calanoid copepod species (3 species in the genus *Calanus),* which are abundant and are considered key elements of polar marine ecosystems.[155] Sea ice endemics include amphipods, ice algae (*Melosira arctica* grows into meter-long curtains under multi-year ice), the first known sea-ice dwelling hydroid, and one of the few, but very abundant, sea-ice dwelling nematode species (*Cryonema tenue).*[156]

Bowhead whale in the Arctic. © Vicki Beaver (NSB), Alaska Fisheries Science Center, NOAA Fisheries Service

CHAPTER 4:
POTENTIAL SITES OF OUTSTANDING UNIVERSAL VALUE IN THE ARCTIC OCEAN

4.1 Outstanding Universal Value: the concept that underpins World Heritage[157]

Central to the 1972 UNESCO World Heritage Convention is the concept of Outstanding Universal Value (OUV). OUV defines why a place is considered sufficiently significant to justify recognition and inscription on the UNESCO World Heritage List. OUV is what underpins the World Heritage Convention and is defined in the Convention's *Operational Guidelines* as:

> "...cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole."[158]

Assessing OUV requires extensive analysis. In order to determine whether the features of the proposed site are outstanding *globally*, a global comparative analysis must be undertaken that assesses the features of the site in relation to other sites on a global basis. Existing properties on the World Heritage List must be screened to ensure that the site in question is not already addressed by a better example on the List, and includes features that are lacking from the existing portfolio of World Heritage sites. These processes require significant investment in conducting the appropriate level of data collection – in situ and from the literature – both on the site in question, and its comparison against sites around the world.

The selection of sites described in this chapter involved the following approach:[160]

Outstanding: Unique examples across the Arctic Ocean were identified that showcase the different types of ecosystems, natural phenomena and biodiversity of possible OUV that exist in the region. Thus, the illustrative sites included represent some of the very best examples of possible OUV in the Arctic, selected on the basis of existing scientific literature and expert review.

Universal: In order to capture sites of the most widespread concern for all of humanity, illustrations from across the Arctic were considered. While geographical distribution of illustrative sites was considered, the approach focused on identifying the most compelling examples of different aspects of potential natural marine OUV for the Arctic as a whole, thus fulfilling this important aspect of the Convention.

Value: Two processes were run in tandem to ensure that only a selection of the most important locations was included as illustrations. The process drew on analyses of existing information of ecosystems, biodiversity and marine phenomena in the Arctic. The information is

The components of Outstanding Universal Value can be defined as follows:[159]

Outstanding – the site should be *exceptional*. The World Heritage Convention sets out to define the geography of the superlative – the most outstanding natural and cultural places on Earth.	**Universal** - The scope of the Convention is *global* in relation to the significance of the properties to be protected as well as its importance to all people of the world. Sites cannot be considered for OUV from only a national or regional perspective.	**Value** - implies clearly defining the *significance* of a property, ranking its importance based on clear and consistent standards, including the recognition and assessment of its integrity.

largely based on a number of EBSA processes conducted under the auspices of the Arctic Council, the Convention on Biological Diversity, and others along with a review of the literature and consultation with scientists specialized in the field of Arctic marine ecosystems and biodiversity (see Chapter 2.3, Methodology). This information was then assimilated into the illustrative list of sites included here and finalized through an iterative process with workshop participants and reviewers. An important determinant was the adequacy of scientific documentation available to describe possible OUV of the illustrative sites. A central issue for further analysis of possible OUV in the Arctic is the fact that much of the area remains unexplored, and many species and phenomena are likely not yet known to science.

4.2 Aspects that determine Outstanding Universal Value

Nominating a site for inscription on the UNESCO World Heritage List requires a rigorous process of identifying the features of potential OUV at a site and making a case for inscription. The concept of OUV itself is based on three foundations:

1) A site is required to meet one or more of the World Heritage criteria;
2) A site is required to meet the conditions of integrity (and authenticity for cultural and mixed properties);
3) A site must meet the requirements for protection and management.

All three aspects must be in place for a site to be recognized as of OUV and be eligible for inscription on the UNESCO World Heritage List.[161]

Only States Parties to the World Heritage Convention can propose sites for inscription on the World Heritage List. The compilation of a complete World Heritage nomination dossier might take several years. Once nominated, potential World Heritage sites go through a rigorous evaluation of their values, integrity, and the effectiveness of protection and management necessary to maintain the values for which the site is proposed for inscription. This evaluation is undertaken through a multidisciplinary evaluation of the potential OUV, which is carried out by IUCN for all natural World Heritage. The results of this evaluation are presented to the annual UNESCO World Heritage Committee, and it is the Committee that makes the ultimate decision over whether a site is of OUV.[162]

4.2.1 World Heritage inscription criteria

Under the World Heritage Convention's Operational Guidelines, four criteria relate to natural heritage (vii–x) (and which implement Article 2 of the actual Convention).[163] Possible new World Heritage marine sites identified in this report therefore need to reflect at least one of the natural criteria (Table 1).

Since the primary documents for World Heritage listing do not make specific reference to physical marine or ocean processes, IUCN has developed additional guidance for marine systems.[164] Criterion viii refers to earth history, geological processes, landforms, geomorphic and physiographic features, clearly targeting physical and geological features, in contrast to the biological features of criteria ix and x. Physical oceanographic features may be most directly related to these terms, so criterion viii can be considered as the most appropriate one for physical ocean processes, including water masses, currents, waves, coastal and land-sea interaction processes, and polar ice. Application of criteria vii, ix and x in marine systems is consistent with their application on land. Criterion vii is generally considered only where sites already meet at least one of criteria viii, ix or x. Criterion ix explicitly mentions 'coastal' and 'marine' and biological oceanographic processes, and habitat and ecosystem dynamics can be treated equivalently in the sea as on land. Criterion x, focusing on species and critical habitats for their conservation, can similarly be applied in the same way both in the sea and on land.

4.2.2 Integrity

In addition to meeting at least one of the above World Heritage criteria, a natural site must also meet the conditions of integrity, which is defined in the Convention's *Operational Guidelines* as:

> "... a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes. Examining the conditions of integrity, therefore requires assessing the extent to which the site: a) includes all elements necessary to express its Outstanding Universal Value; b) is of adequate size to ensure the complete representation of the features and processes which convey the site's significance; c) suffers from adverse effects of development and/or neglect." [165]

Table 1: The four World Heritage criteria for natural heritage (bold emphasis added)

(vii) superlative natural phenomena – contains superlative **natural phenomena** or areas of **exceptional natural beauty** and aesthetic importance	**(viii) geology and earth history (including oceanography)** – outstanding examples of **major stages of Earth's history**, including the record of life, significant ongoing **geological processes**, significant **geomorphic or physiographic features**	**(ix) ecosystems, communities and biological processes** – outstanding examples of significant ongoing **ecological and biological processes** in the **evolution and development** of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	**(x) diversity and threatened species** – the most important and significant **natural habitats** for in situ **conservation of biological diversity**, including threatened species of OUV from the point of view of science or conservation

A key consideration is not necessarily the absolute physical size of the site, but whether the site is of the appropriate size to protect the values for which it is to be inscribed on the World Heritage List. The illustrations in this report were assessed with respect to several aspects related to size, including the size and dynamics/characteristics of the feature, its integrity, and design of the management system to maintain the site.

4.2.3 Protection and management

Finally, to be assessed as being of OUV, each nominated site must have an adequate protection and management system to ensure its safeguarding.

Two of the most challenging issues for World Heritage marine sites are climate change and how to assure protection and conservation of a site's irreplaceable values in the context of shifting demands for socio-economic development and use. These uses include both long standing cultural and traditional uses that can be inseparable from nature conservation values, to new and challenging industrial activities including resource extraction. Apart from a few remote sites that are off limits for exploitation due to their geographic location, virtually all World Heritage marine sites around the world are confronted with both these challenges.

Undoubtedly, climate change is the most pressing challenge facing our global marine World Heritage now and into the future. While some sites serve as refugia for

© Maksim Antipin / Beringia National Park (Берингия)

TYPES OF WORLD HERITAGE SITES

Natural, cultural and **mixed** – Six cultural and four natural criteria are used in assessing OUV of sites. Sites may be inscribed for any one of these criteria, to be 'natural' or 'cultural' World Heritage sites, or a combination of natural and cultural criteria, as 'mixed' World Heritage sites. Sites that are globally significant examples of the interactions between people and the natural environment are recognized as 'cultural landscapes'. As indicated above, this project focused only on identifying marine sites of potential natural OUV.

Serial sites consist of two or more component parts that do not share a direct boundary, but which are related for example because they belong to the same geological or geomorphological formation, biogeographic province, ecosystem type, or are biophysically linked. The whole series of sites should be of OUV, not only its individual components. Serial nominations are inscribed as a single site on the World Heritage List.

Transboundary sites may occur where the features of a single or serial site span international boundaries. Transboundary nominations are inscribed as a single site on the World Heritage List, and require joint nomination by the States Parties involved.

For more information: http://whc.unesco.org/en/guidelines/

species due to oceanographic and climate conditions that have so far spared them from devastating impacts, most others are already experiencing noticeable degradation. More frequent coral bleaching events, changes in ocean chemistry including acidification and deoxygenation, varying rates of sea level rise and changes to food webs are already being observed in several World Heritage sites.

4.3 Reporting and monitoring[166]

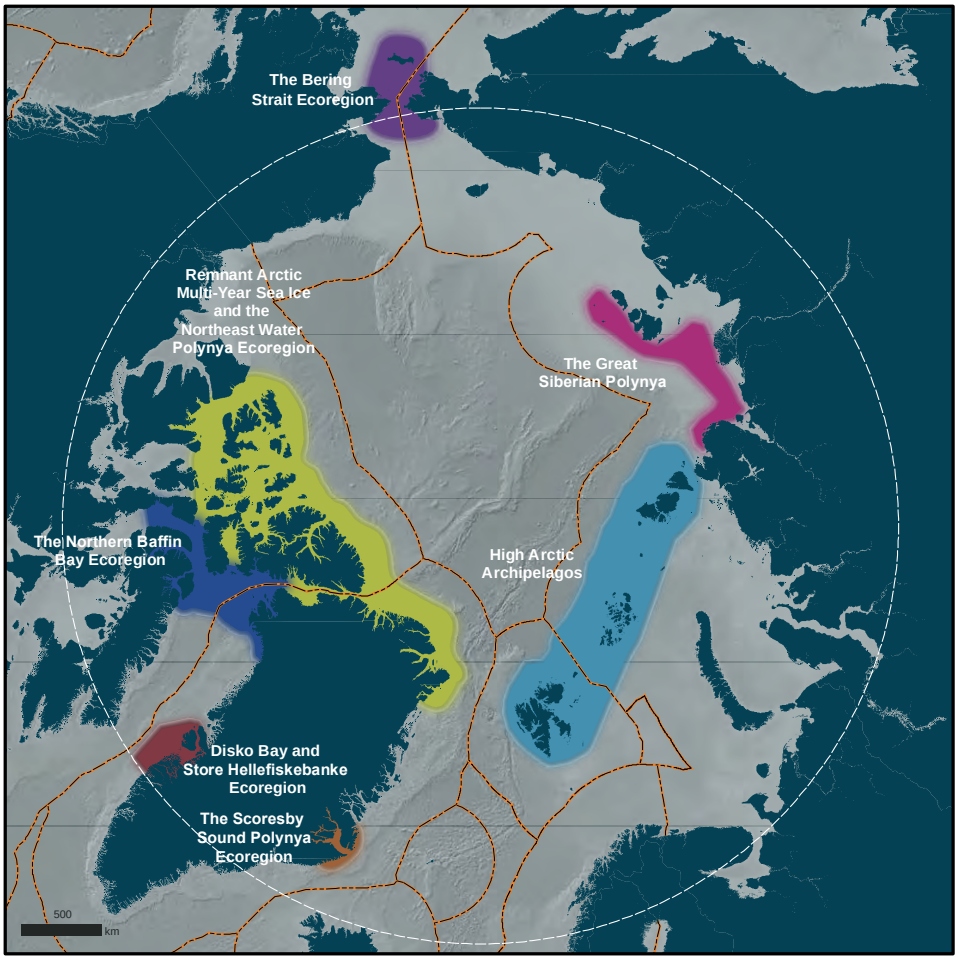
Inscribing a site on the World Heritage List is the beginning of a permanent relationship with the World Heritage Convention.[167] The primary objective of the Convention is to ensure that the values of sites under its protection will be maintained for future generations. States Parties have the obligation to properly protect sites' OUV and may be required to report on the state of conservation and protection measures put in place. These reports allow the World Heritage Committee to assess the conditions at sites and determine whether there is a need for specific measures to resolve recurrent problems. A regular periodic report is also made for all inscribed sites, every 6-7 years.

One crucial measure available to the World Heritage Committee is the inscription of a site on the List of World Heritage in Danger,[168] which recognizes sites under threat of losing their OUV and where particularly urgent national or international attention is required. In situations where the site deteriorates to a point where the OUV is lost, the World Heritage Committee may also decide to remove it from the World Heritage List.

4.4 Illustrations of Potential Outstanding Universal Value in the Arctic Marine Environment

Based on the considerations detailed in the previous sections, this section presents seven marine areas that are illustrative of potential Outstanding Universal Value (OUV) in the Arctic. These seven areas each contain one or more characteristics highlighting the unique features of the Arctic, as presented in Chapter 3. As indicated above, these sites are intended to be illustrative, and are not a comprehensive list.

- **The Bering Strait Ecoregion (including St. Lawrence Island).** As the Pacific gateway to the Arctic Ocean, the Bering Strait Ecoregion is one of the world's great migration corridors. An estimated 12 million seabirds nest, forage and breed in the Bering Strait Ecoregion, and hundreds of thousands of marine mammals of several species migrate through the Strait in both spring and fall. The region also illustrates important geological history, having functioned during periods of low sea level as a land bridge between North America and Eurasia.
- **Remnant Arctic Multi-Year Sea Ice and the Northeast Water Polynya Ecoregion.** Containing much of the thickest, oldest ice in the Arctic and one of its largest polynyas, this region presents a striking combination of Arctic marine phenomena. Multi-year sea ice, a globally unique habitat, and its associated species are likely to persist for the longest period of time here as the Arctic warms and sea ice melts. The adjacent Northeast Water Polynya supports many species, including the critically endangered Spitsbergen stock of bowhead whale.



Illustrations of Potential OUV in the Arctic Marine Environment

—— Marine Boundary

The marine areas of potential Outstanding Universal Value represent the priorities that emerged through the workshop and review process described in this report. These are not an exclusive selection of sites. Boundaries of sites are approximate and indicative, not absolute.

Map: Marine Geospatial Ecology Lab, Duke University (2016)

- **The Northern Baffin Bay Ecoregion.** This area contains the North Water Polynya, the largest Arctic polynya and one of the most productive marine environments in the Arctic Ocean, if not the entire Northern Hemisphere. The North Water Polynya supports the largest single-species aggregation of marine birds (little auks) anywhere on earth. Lancaster Sound supports high concentrations of polar bears, and the Northern Baffin Bay Ecoregion is of critical importance to most of the global population of narwhal, the entire Eastern High Arctic/Baffin Bay beluga population, and a significant proportion of the Eastern Canada-West Greenland bowhead whale population.
- **Disko Bay and Store Hellefiskebanke Ecoregion.** Complex physical and ecological processes in the Disko Bay and Store Hellefiskebanke Ecoregion, which is linked to an existing World Heritage site in western Greenland, lead to enhanced primary production in this area, which in turn supports diverse Arctic mammals and seabirds. Store Hellefiskebanke is a critical winter habitat for the West Greenland/Baffin Island walrus population (around 1,400 animals estimated in 2012), along with hundreds of thousands of king eiders.
- **The Scoresby Sound Polynya Ecoregion.** The Scoresby Sound Polynya Ecoregion includes the world's largest fjord system. Among other functions, the associated polynya provides seabirds with important feeding opportunities in spring and early summer, when ice still blocks coasts further to the north and south. The Scoresby Sound Polynya Ecoregion is very important for several IUCN Red-Listed species, including the critically endangered Spitsbergen stock of bowhead whale, narwhal, polar bear, Atlantic walrus, and ivory gull, and supports the second largest breeding population of little auks.
- **High Arctic Archipelagos.** Consisting of the waters between and around the Arctic's extreme northern archipelagos (Svalbard, Franz Josef Land and Severnaya Zemlya), the High Arctic Archipelagos

separate shallow coastal seas from the deep Arctic Basin, and are a region of high productivity and important habitat for walrus, polar bear and other threatened species. The shelf topography of the region is extremely diverse and includes archipelagos and islands, insular shelves, shallow and deep-water fjords, edge and cross troughs, and sea-bottom edge glacial formations. The High Arctic Archipelagos support connected populations of birds and mammals, including 85% of the global population of ivory gulls.

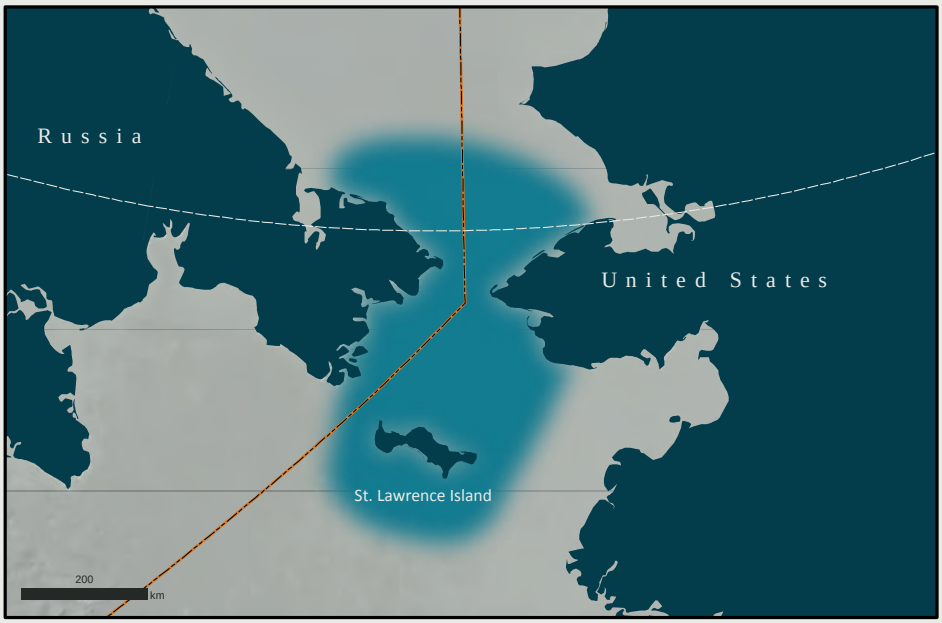
- **The Great Siberian Polynya.** Located in the Russian Arctic, the Great Siberian Polynya is a spectacular example of Arctic polynya ecosystems and is of great significance to marine biological diversity. Most species of fish, and nearly all the seabirds and marine mammals in the Laptev Sea are dependent on the Great Siberian Polynya. This region is also one of the most important ice-exporting areas in the Arctic.

Through the course of the area review and evaluation, a number of additional areas were identified as areas worth further consideration as Arctic marine regions of potential OUV (see Annex 3). The sites identified in this chapter are thus but a sample of the truly iconic treasures in the Arctic marine environment, and are meant to inspire their possible future protection as part of our global marine heritage.

The seven illustrations presented here focus on marine areas, although some of the sites include a terrestrial component where that component is tied to the marine ecosystem (e.g., the islands of the High Arctic Archipelago). Each proposed area is also accompanied by a map generated specifically for this report. These maps are intended to provide indications of the approximate location of the marine area of potential OUV. The description of previous site recognition and of protection and management status are illustrative and are not comprehensive.

The following sections provide a brief synopsis of the potential justification of World Heritage criteria for each of the respective sites. More detailed descriptions are available in the appendices of this publication (available online at www.iucn.org/resources/publications).

BERING STRAIT ECOREGION
(INCLUDING ST. LAWRENCE ISLAND)

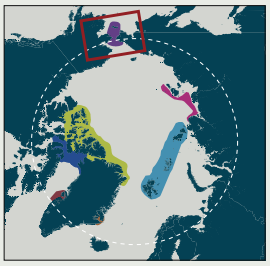


The Bering Strait Ecoregion

Area of Potential Outstanding Universal Value

Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

As the Pacific gateway to the Arctic Ocean, the Bering Strait Ecoregion constitutes one of the world's great ocean migration corridors, with millions of seabirds, whales, seals, walrus and other animals seasonally using its waters. Linking Arctic ecosystems to the north and subarctic ecosystems to the south, the Bering Strait Ecoregion exhibits extraordinary biological productivity, which in turn sustains an exceptional abundance and diversity of Arctic marine species. An estimated 12 million seabirds nest, forage and breed in the Bering Strait Ecoregion, and hundreds of thousands of marine mammals of several species migrate through the Strait in both spring and fall. Ice-dependent or ice-associated mammals that use or migrate through the Strait include bowhead, beluga, and grey whales; Pacific walrus; ringed, ribbon, spotted, and bearded seals; and polar bears. During the last ice age, the shallow sea bed of the Bering Strait region was above sea level, forming a part of the Bering land bridge across which many species of plants and animals moved between Eurasia and North America. The Bering land bridge was also important in the colonization of the Americas by human beings. St. Lawrence Island is one of the last exposed portions of the Bering land bridge.

© Maksim Antipin / Beringia National Park (Берингия)

Ribbon seal on ice. © Michael Cameron (NOAA)

2. THREATS

Like marine animals, ships transiting between the Arctic Ocean and the Pacific must travel through the narrow, 50 mile (85 kilometer) wide Strait. Shipping through the Strait has increased over time and is likely to continue to do so as sea ice retreats and development in the Arctic advances. Shipping impacts on marine wildlife include collisions, noise disturbance and the potential for accidents and spills.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

Beluga whale pod, Chukchi Sea. © Laura Morse (NOAA)

3.1 Potential justification of World Heritage Criteria

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

The Bering and Chukchi sea continental shelves are broad and shallow, and emergent during periods of low sea level, blocking circulation between the Pacific and Arctic ocean basins. As sea levels rose at the end of the last ice age, the Bering Strait formed as an essential link in the global hydrologic cycle, forming the Pacific gateway to the Arctic Ocean. The alternating presence and absence of the land barrier through the Bering Strait region had profound effects on the biogeography of the North Pacific and Arctic Oceans.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The Bering Strait Ecoregion represents one of the most productive biological regimes in the world. The Anadyr Current, which originates in the basin of the Bering Sea, transports nutrient rich waters and great numbers of oceanic zooplankton into the Bering Strait region. This in turn sustains a very high biomass of benthic invertebrates, marine mammals and seabirds. The physical constraints of the Bering Strait seasonally concentrate many different species, as the region is the only migration corridor for species of fish, birds and marine mammals transiting from the Pacific to the Arctic in the spring and back in the fall and winter.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The Bering Strait Ecoregion supports some of the largest seabird colonies in the world. Additionally, millions of seabirds and marine mammals migrate through the region in spring and fall. The entire global population of spectacled eiders migrates through the Bering Strait and winters in polynyas off St. Lawrence island. IUCN Red-Listed species in the region include Steller sea lion, polar bear, Pacific walrus, beluga, fin and North Pacific right whales, short-tailed albatross, emperor goose, Steller's eider, long-tailed duck, spoonbill sandpiper and ivory gull.

3.2 Previous recognition of site value

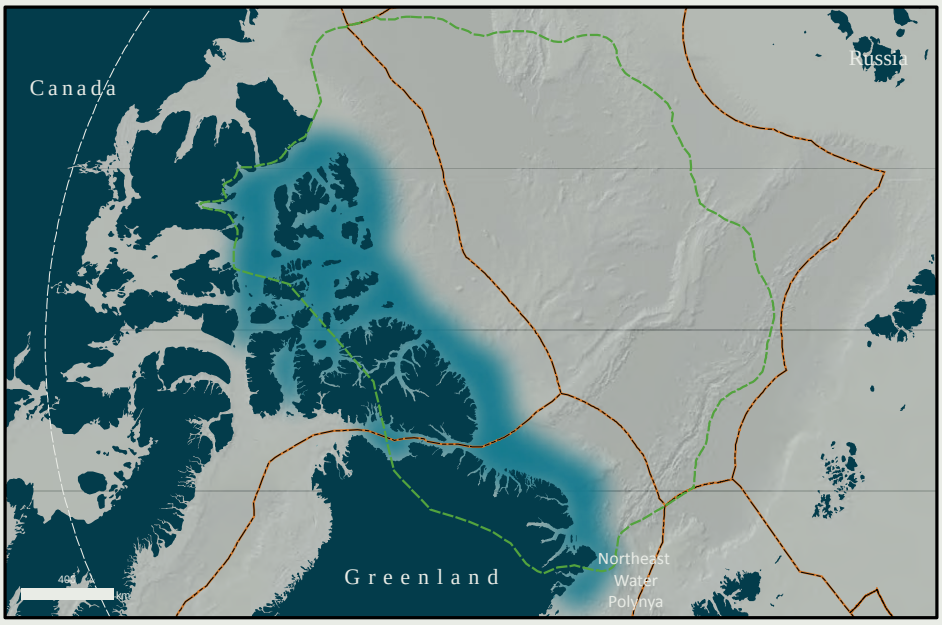
The region has been identified as an Arctic marine area of heightened ecological significance by a number of international and domestic scientific assessments.

3.3 Protection and management

A variety of protections exist throughout the region to conserve seabird colonies, bottom habitats, fisheries, marine mammals and other features, including the Beringia National Park (Russian Federation).

Crested Auklet. © F. Deines, USFWS

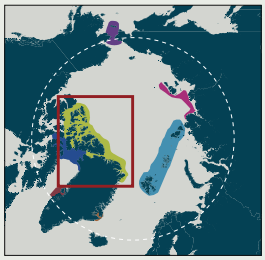
REMNANT ARCTIC MULTI-YEAR SEA ICE AND THE NORTHEAST WATER POLYNYA ECOREGION



Remnant Arctic Multi-Year Sea Ice and the Northeast Water Polynya Ecoregion

- Area of Potential Outstanding Universal Value
- Recent Extent of Multi-Year Sea Ice
- Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

This region contains much of the thickest, oldest ice in the Arctic and one of its biggest polynyas, creating a spectacular combination of Arctic ice phenomena. Multi-year sea ice is a unique habitat globally, and is rapidly disappearing in the Arctic. The region is likely to serve as a refugia for multi-year sea ice, and its associated endemic species, for the longest period of time. Adjacent to the thick ice is the Northeast Water Polynya, a stable, recurring polynya that may be one of the most important summering grounds for the critically endangered Spitsbergen stock of bowhead whale.

Polynya in North Greenland. © Euphro

Ivory gull, adult plumage. © jomilo75

2. THREATS

The primary threat to this region is loss of Arctic sea ice as a result of global warming. While the region is anticipated to retain multi-year sea ice longer than elsewhere in the Arctic, long-term reductions in age and thickness of sea ice is likely.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

3.1 Potential justification of World Heritage Criteria

CRITERION VII – SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

The unique concentration of multi-year ice present in this region and the stunning contrast of the Northeast Water (NEW) Polynya, are driven by unique natural phenomena. Ice that forms or is trapped in the Beaufort Gyre off Canada can circulate for several years or more, where it accumulates in thickness both from ice growth and from collisions between wind-driven ice floes. The Transpolar Drift current propels the ice against Canada and northern Greenland, where it stacks up and compresses, forming the thickest ice in the Arctic. The NEW Polynya is the result of ice barriers both to the north and south of the polynya that limit heavy ice intrusion, coupled with strong and persistent northerly winds advecting sea ice away from the coast.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

Multi-year ice has unique, perennial communities of algae, bacteria, other single-celled organisms and ice fauna, along with some specialized types of algae that do not normally occur in younger sea ice. As the Remnant Multi-Year Sea Ice site is projected to maintain the last multi-year ice in the Arctic, it represents a globally important and unique habitat for Arctic biodiversity, particularly Arctic species endemic to multi-year ice, under changing environmental conditions.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The Remnant Multi-Year Sea Ice site is thought to have the greatest likelihood of sustaining polar bears through the 21st century, along with its main prey, ice dependent seals, especially ringed seals. Recent observations have noted the largest abundance of the critically endangered Spitsbergen stock of bowhead whales reported from the Greenland Sea in centuries in the NEW polynya. The polynya is also the most important calving area for the northeast Greenland stock of walrus, and supports the largest known breeding colony of ivory gulls in Greenland.

3.2 Previous recognition of site value

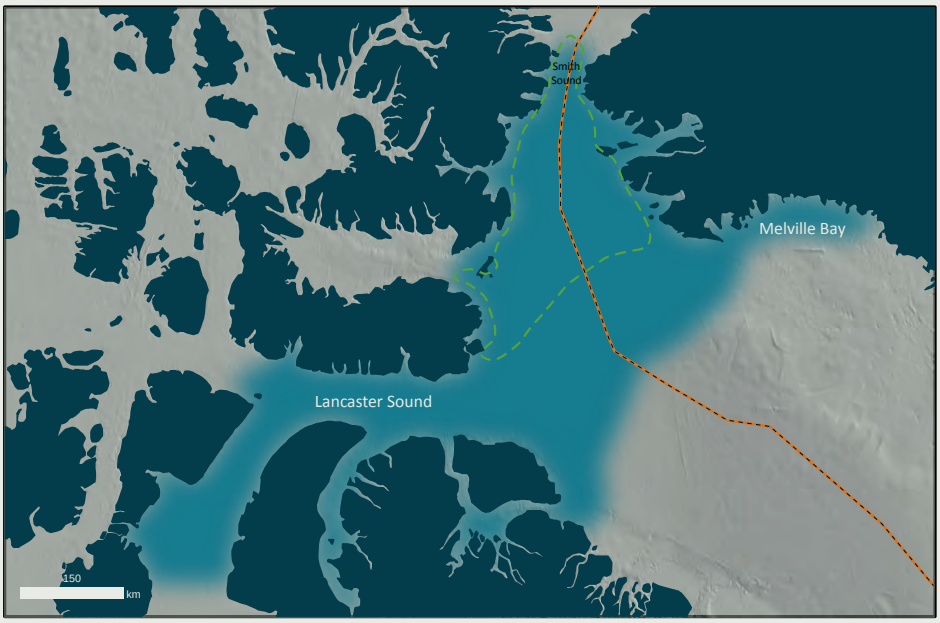
The Remnant Multi-Year Sea Ice site and the NEW Polynya have been recognized as Arctic marine areas of heightened ecological and cultural significance by a number of scientific reviews. Portions of the Remnant Multi-Year Sea Ice site are covered by the property Quttinirpaaq, submitted by Canada on its World Heritage Tentative List in 2004. (A Tentative List is an inventory of those properties which each State Party intends to consider for nomination.)

3.3 Protection and management

Small portions of the Remnant Arctic Multi-Year Sea Ice site are protected through Canadian National Park designations. The area within the three nautical miles zone off the coast in the Northeast Water Polynya and north of Greenland is part of the National Park of North East Greenland and are protected. At this time, there is no regular shipping in this site.

Polar bear family, Canadian Arctic.
© Ralph Lee Hopkins/National Geographic Creative

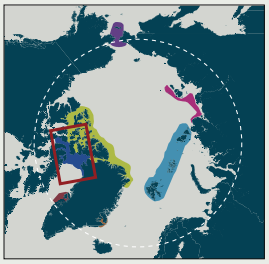
THE NORTHERN BAFFIN BAY ECOREGION



The Northern Baffin Bay Ecoregion

- Area of Potential Outstanding Universal Value
- Marine Boundary
- North Water Polynya - Spring extent

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

The Northern Baffin Bay Ecoregion is anchored by the North Water Polynya, the Arctic's largest polynya, and one of the most biologically productive ecosystems in the Northern Hemisphere. The polynya's open waters feature an unusually early spring plankton bloom, which supports exceptionally large concentrations of seabirds and marine mammals. The North Water Polynya supports a returning colony of little auks, representing 80% of the global population, the largest single-species aggregation of marine birds anywhere on earth. Lancaster Sound contains a large population and high density of polar bears, and is a migration corridor and summer aggregation area for huge numbers of seabirds and marine mammals. Endemic polar cod in all life stages can be found year-round in Lancaster Sound. More broadly, the Northern Baffin Bay Ecoregion is of critical importance to most of the global population of narwhal, the entire Eastern High Arctic/Baffin Bay beluga population, and a significant proportion of the Eastern Canada-West Greenland bowhead whale population.

Beluga whale. © Brian J. Skerry/National Geographic Creative

Pod of male narwhals, Lancaster Sound, Nunavut, Canada. © Paul Nicklen/National Geographic Creative

2. THREATS

Lancaster Sound is vulnerable to new and increased shipping and shipping infrastructure, as it forms a part of the Northwest Passage, which is newly ice-free in some years. Some petroleum exploration activities, mainly seismic surveys, occur in Greenland waters, and the Government of Greenland has identified Baffin Bay as a continued area of interest for oil exploration activities.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

3.1 Potential justification of World Heritage Criteria

CRITERION VII – SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

Named the "North Water" by 19th century whalers, the North Water Polynya occurs seasonally at the same time and place each year, providing predictable and highly productive waters that sustain long lived marine mammals and seabirds and the trophic chain upon which they subsist. Existence of the North Water Polynya depends on the formation of a seasonally recurrent ice bridge that develops between Greenland and Ellesmere Island, as well as prevailing strong northerly winds that clear the area to the south of newly formed sea ice. Similar conditions are evident in the northern Baffin Bay complex of leads and small polynyas which are linked to the North Water Polynya.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The Northern Baffin Bay Ecoregion is one of the most productive marine environments in the Northern Hemisphere. Upwelling during polynya events plays an important role in phytoplankton blooms in the early spring. This exceptionally high level of primary production sustains a variety of endemic copepods (*Calanus spp.*), which in turn support predators, including many endemic Arctic species, further up the trophic web.

CRITERION X – SIGNFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

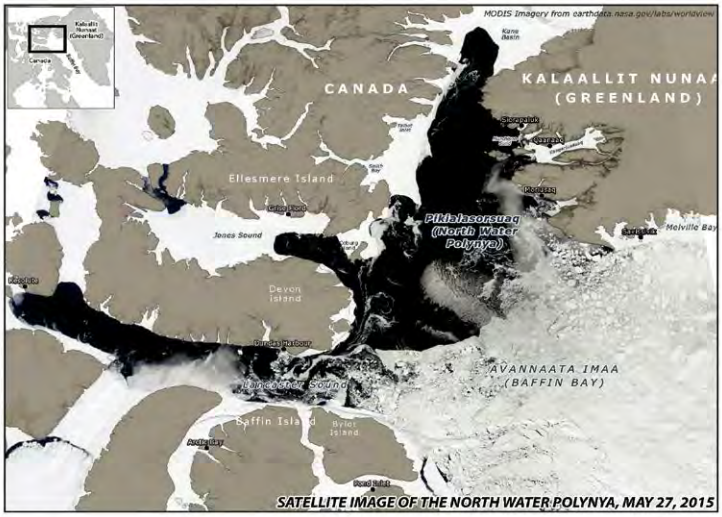
The North Water Polynya supports an exceptional abundance and diversity of seabirds, including threatened species such as the ivory gull, Sabine's gull, Arctic tern and Atlantic puffin. The North Water Polynya also supports the largest single-species aggregation (little auks) of marine birds on earth. Endemic polar cod are numerous in the region, and support the region's populations of seals, narwhal and beluga whales. In winter, the unfrozen North Water Polynya serves as a refuge for marine mammals, and Lancaster Sound is a major migration corridor for marine mammals. The region hosts a suite of threatened top Arctic predators, including polar bears, Atlantic walrus, orca whales, and bowhead whales.

3.2 Previous recognition of site value

The Northern Baffin Bay Ecoregion, consisting of the North Water Polynya (in Smith Sound), Lancaster Sound and Melville Bay, has been recognized as an Arctic marine area of heightened ecological and cultural significance through both national and international assessment processes.

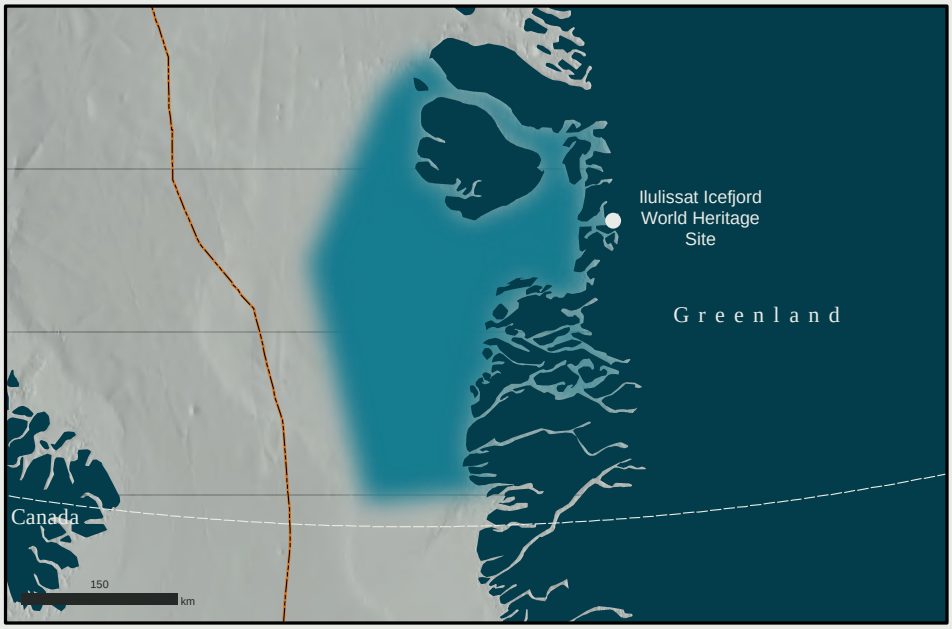
3.3 Protection and management

Portions of Northern Baffin Bay have been protected, including the coastal area of Melville Bay, and the mouth of and adjacent marine waters of Lancaster Sound. Existing agreements between Greenland and Canada promote preparedness measures against pollution, and provide transboundary science advice on the conservation and management of beluga and narwhal whale populations.



Satellite image of extent of North Water Polynya in May 2015. © David Fuglestad

DISKO BAY AND STORE HELLEFISKEBANKE ECOREGION

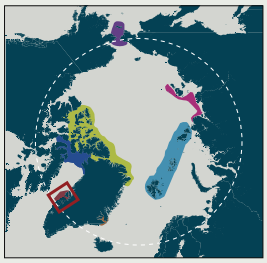


Disko Bay and Store Hellefiskebanke Ecoregion

Area of Potential Outstanding Universal Value

Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

Located off Greenland's west coast, the Disko Bay and Store Hellefiskebanke Ecoregion exhibits unusually complex oceanographic and bathymetric conditions that result in very high spring productivity, high benthic species diversity and prime foraging and breeding habitat for a variety of birds and mammals. The region receives massive amounts of freshwater from the Jakobshavn Glacier (*Sermeq Kujalleq*) through the Ilulissat Icefjord (a UNESCO World Heritage Site due to the presence of massive ice calving from Jakobshavn Glacier, the world's most productive), contributing to its unique oceanographic regime.

Bowhead whale. © Paul Nicklen/National Geographic Creative

Jakobshavn Glacier, Greenland. © Spencer Weart

2. THREATS

Climate change is already resulting in marked changes in sea ice, temperature, salinity and nutrients in Disko Bay. Bottom trawl fishing, which can cause severe damage to seafloor structure and benthic communities, is likely to increase as sea ice cover diminishes, as is shipping. Environmental impacts from increased shipping include disturbance of marine life, introduction of invasive species and discharge of oil, chemicals and waste. A large oil spill in this region would represent a serious hazard to the environment, with the potential to cause population level impacts for some seabird species. Hunting and fishing are impacting populations of seabirds and marine mammals and seabed habitats, respectively.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

3.1 Potential justification of World Heritage Criteria

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

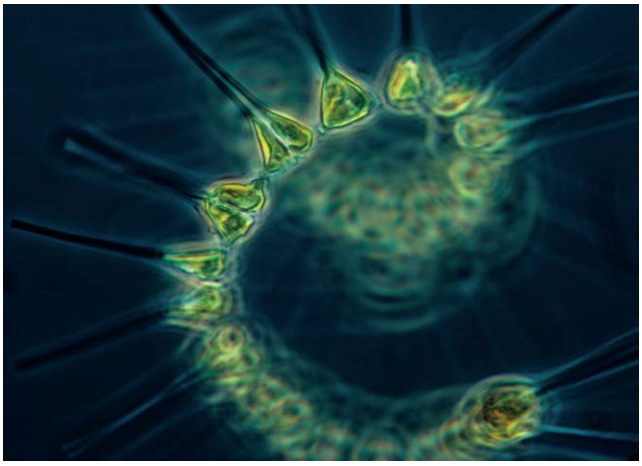
The complex oceanographic conditions of the Disko Bay and Store Hellefiskebanke Ecoregion result from Atlantic and Arctic currents combined with massive influx of freshwater from the Jakobshavn Glacier and the connected icefjord. The banks of Store Hellefiskebanke and the related upwellings support large numbers of wintering and migrating seabirds and marine mammals.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The fauna on the seabed (benthos) of Store Hellefiskebanke is very rich, with high densities (average 3300 indvs m^{-2} at 500-100 m depths) and number of species (> 600), and has been characterized as a biodiversity hotspot. In addition, tide-driven upwelling creates very high biological productivity in the spring, creating favorable breeding conditions for many marine mammals and seabirds. At sites where upwelling or fronts continuously bring nutrients to the uppermost water layers, primary production remains high throughout the summer.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The Disko Bay and Store Hellefiskebanke Ecoregion has a high diversity of breeding seabirds. In winter, Store Hellefiskebanke is a critical staging and winter habitat for nearly 500,000 king eiders mainly from breeding areas in Arctic Canada. Disko Bay serves as a foraging, staging, and probably mating area for bowhead whales in spring. The area is used by around 1,500 bowhead whales from the Baffin Bay population. Narwhals are abundant during winter in the deeper drift ice covered basins of the area. Store Hellefiskebanke is a critical winter habitat for the West Greenland/Baffin Island walrus population (around 1,400 animals estimated in 2012) and for hundreds of thousands of king eiders which breed in Canada. IUCN Red-Listed species include narwhal and beluga whales, Atlantic walrus, polar bear, ivory gull and Atlantic puffin.



Phytoplankton - the foundation of the oceanic food chain.
© NOAA MESA Project

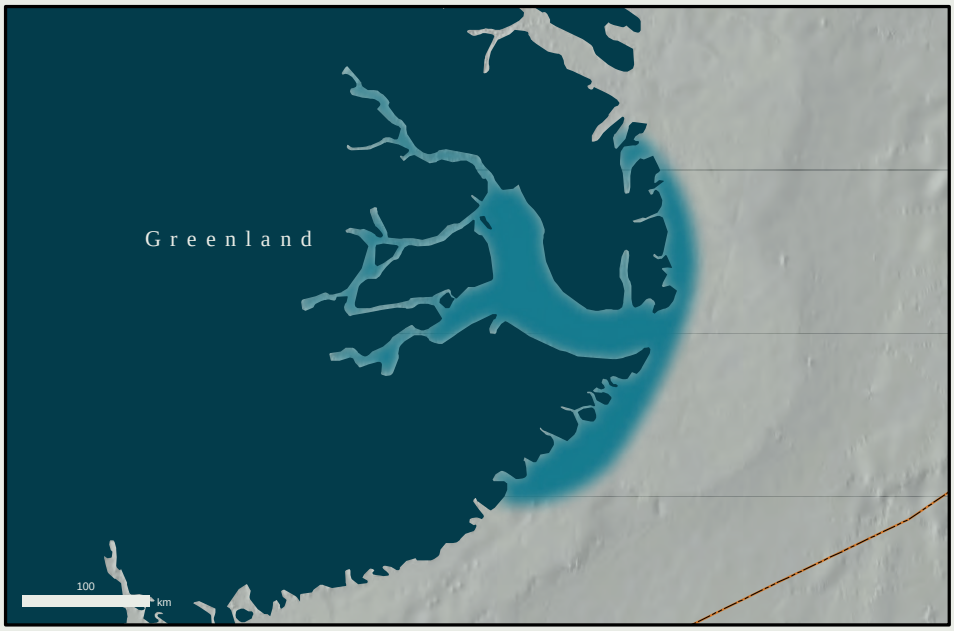
3.2 Previous recognition of site value

Disko Bay and Store Hellefiskebanke have been identified as Arctic marine areas of heightened ecological and cultural significance through international and national processes.

3.3 Protection and management

Within the Disko Bay and Store Hellesfiskebanke Ecoregion, the archipelago Kitsissunnguit (also a Ramsar site), and the Ilulissat Icefjord (also a UNESCO World Heritage site) have been protected through Greenland's Nature Protection Act. Three more areas are designated as seabird breeding sanctuaries, which regulate disturbing activities near and at seabird breeding colonies in the breeding season.

THE SCORESBY SOUND POLYNYA ECOREGION

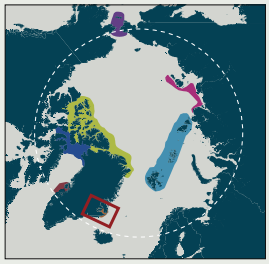


The Scoresby Sound Polynya Ecoregion

Area of Potential Outstanding Universal Value

Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

The Scoresby Sound Polynya Ecoregion is located on the east coast of Greenland and includes the Scoresby Sound Polynya, the stunning fjord system of Scoresby Sound (the world's largest fjord system) and associated offshore waters. The Scoresby Sound Polynya is situated at the mouth of Scoresby Sound. The Scoresby Sound Polynya Ecoregion is very important for several threatened species, including the critically endangered Spitsbergen stock of bowhead whale, narwhal and polar bear, and supports high concentrations of seabirds in spring and summer.

Cape Brewster, Greenland. © Peter Lyngs

Little auks passing over the mouth of Scoresby Sound, Greenland. © Peter Lyngs

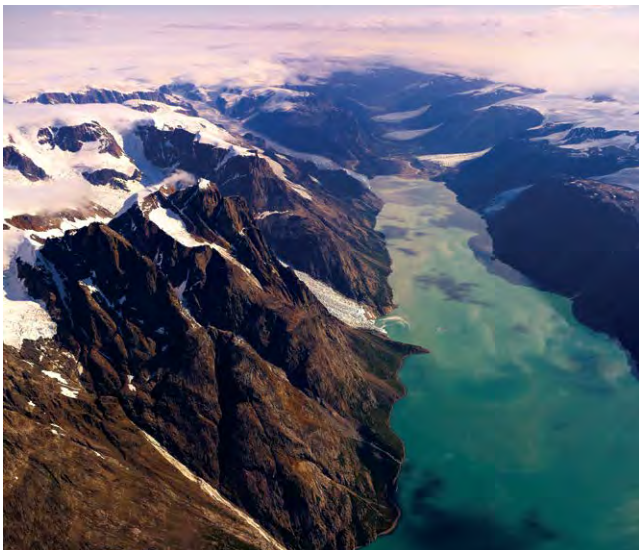
2. THREATS

Very little human activity takes place in the region, which makes it unusually pristine. The main threat is from climate change and resulting shifts in ice cover, seawater temperature and chemistry, and resulting effects on the biota of the region. Hunting impacts seabirds and marine mammals.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

3.1 Potential justification of World Heritage Criteria

CRITERION VII – SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE



© Hans Henrik Tholstrup / The Natural Museum of Denmark

Scoresby Sound is the world's largest fjord system, a vast and spectacular region comprised of steep and striking cliffs that plummet into deep water. In the summer, large icebergs float through the system, while in winter the Scoresby Sound polynya provides an area of open water, contrasting with the ice that fills the fjord. Limited human development and high marine productivity attract a large diversity of seabirds and marine mammals.

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

The Scoresby Sound fjord covers an area of 13,700 square kilometers. Several large, fast-flowing outlet glaciers drain the east side of the Greenland Ice Sheet into inner Scoresby Sound, calving large icebergs that scour the seabed and drift toward the mouth of the fjord. Water depths in the fjord can reach 1500 meters (>4,000 feet). Scoresby Sound polynya is most likely formed by strong tidal currents in combination with the presence of a gyre in the fjord mouth.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The Scoresby Sound polynya provides seabirds with feeding opportunities in spring and early summer, much earlier than along the ice blocked coasts further north and south. The polynya is the foundation for huge breeding colonies of little auks, and an estimated 3.5 million pairs breed here. The polynya is also an important spring staging area for waterbirds migrating along the east Greenland coast, including common eiders, long-tailed ducks, and red-throated divers. IUCN Red-listed species include the Spitsbergen stock of bowhead whale, narwhal, polar bear, Atlantic walrus, common eider and ivory gull.

3.2 Previous recognition of site value

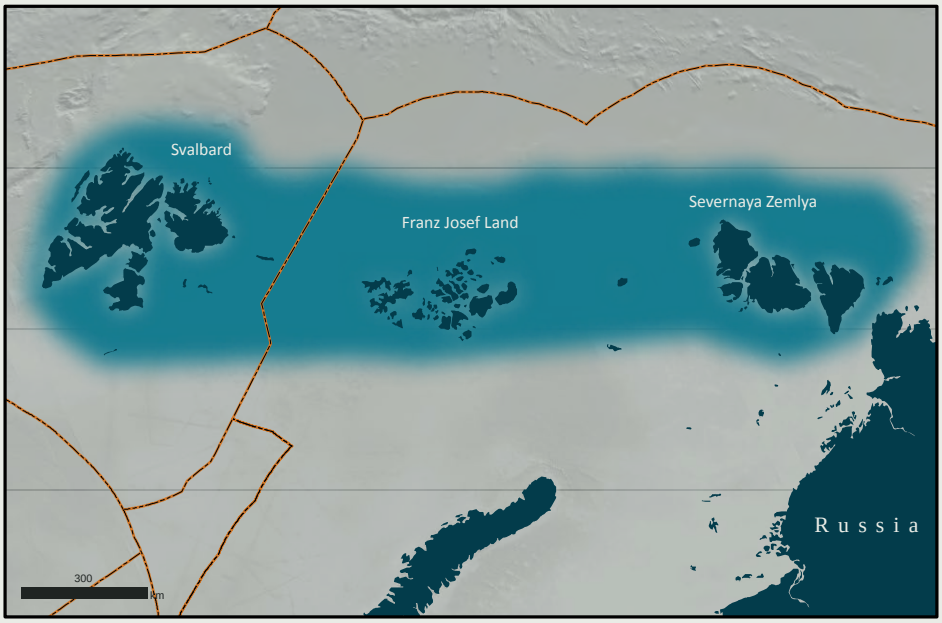
The Scoresby Sound polynya has been identified as an Arctic marine area of heightened ecological and cultural significance through both national and international processes.

3.3 Protection and management

While there are no site-specific enhanced marine protections in place, the area is lightly populated and remote from industrial development.

© Hans Henrik Tholstrup / The Natural Museum of Denmark

HIGH ARCTIC ARCHIPELAGOS

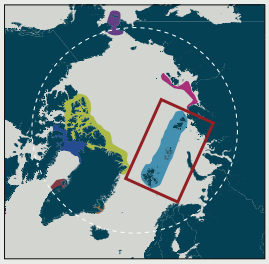


High Arctic Archipelagos

Area of Potential Outstanding Universal Value

Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

The High Arctic Archipelagos and islands are connected by the migratory routes of shared populations of walrus, polar bears and seals along with migrations of seabirds that nest in the north-eastern Atlantic and forage in the waters from northern Svalbard, Franz Josef Land and further in the northeast of the Kara Sea. The archipelagos together with the surrounding waters play a key role in maintaining populations of endemic, threatened and endangered Arctic species. An estimated 85% of the global ivory gull population (an IUCN Red List species), nest on the Svalbard, Franz Josef Land and Severnaya Zemlya archipelagos and associated islands.

Mabel Island, Franz Josef Land, Russian Federation. © Vladimir Melnik / Open Ocean: Arctic Archipelagos Project

Svalbard. © Paul Nicklen/National Geographic Creative

2. THREATS

Rapid warming of the Arctic will likely result in significant changes to the entire High Arctic region, including new patterns of species distribution. Already, boreal fish species have moved into the northern parts of the Barents Sea in large numbers, which has pushed local Arctic communities out of the shelf area. Additionally, threats from petroleum development, commercial fishing and cruise ships are all increasing in the region.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

3.1 Potential justification of World Heritage Criteria

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

The chain of three ecologically linked archipelagos in the high Arctic separates the shallow Kara and Barents Sea shelf from the deep-water Arctic Nansen Basin. The shelf topography of the region is extremely diverse and includes archipelagos and islands, insular shelves, shallow and deep-water fjords, edge and cross troughs, and sea-bottom edge glacial formations. Recent plate tectonic interpretations of Severnaya Zemlya geology suggest that the archipelago, when considered with northern Tajmyr, forms an independent microcontinent.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The North Atlantic Current that flows along the slope and shelf imports biomass and species from the Atlantic Ocean. As a result, zooplankton biomass is elevated over the entire continental slope from Svalbard to Severnaya Zemlya. In the second half of the summer the whole region becomes a dynamic Marginal Ice Zone (MIZ), which supports enhanced biological productivity. A system of stationary polynyas that form beyond the shore-fast ice of the archipelagos and islands is a distinctive feature of the region's ice regime.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The large range in primary productivity throughout the region supports rich and varied benthic communities and important feeding grounds for fish, sea birds and marine mammals. Up to 85% of the global ivory gull population nest in the High Arctic Archipelagos, and Franz Josef Land and Severnaya Zemlya support a distinct race of little auk *Alle alle polaris.* Threatened and endangered species include the critically endangered Spitsbergen stock of bowhead whales, polar bear, Atlantic walrus, narwhal, beluga, ivory gull, Atlantic puffin and the Greenland shark. Dozens more species inhabiting the High Arctic Archipelagos are also separately listed as threatened by Norway and the Russian Federation.

3.2 Previous recognition of site value

The High Arctic Archipelagos have been identified as Arctic marine areas of heightened ecological and cultural significance through domestic and international processes. Svalbard Archipelago was submitted by Norway on its World Heritage Tentative List in 2007. A Tentative List is an inventory of those properties which each State Party intends to consider for nomination.

Little auks. © A. Weith

3.3 Protection and Management

Franz Josef Land and its surrounding territorial waters are a part of the Russian Arctic National Park, the largest land and marine nature reserve in the Russian Federation. There is an ongoing effort to further expand the park to include Victoria Island with surrounding territorial waters. In Svalbard, 86.5% of the archipelago's territorial waters are protected. The marine portions of seven national parks and four nature reserves in Svalbard are designated as OSPAR Marine Protected Areas. Severnaya Zemlya is mostly uninhabited and represents a vast pristine area largely undisturbed by human development. Four small land areas of the archipelago with adjacent coastal waters have been designated as the Severnaya Zemlya State Wildlife Sanctuary *(Severozemelsky zakaznik).*

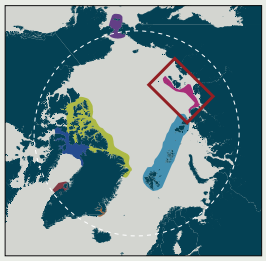
THE GREAT SIBERIAN POLYNYA

The Great Siberian Polynya

Area of Potential Outstanding Universal Value

Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



1. INTRODUCTION

The Great Siberian Polynya is a historical name for a very large, stable system of polynyas that occurs each winter over the shelves of the Laptev and East Siberian seas. Most species of fish and almost all the seabirds and marine mammals in the Laptev Sea are dependent on the Great Siberian Polynya to some extent. The ice that forms in the polynya is continually transported away by currents. Together with the rest of the Laptev Sea, the Great Siberian Polynya is one of the most important ice-exporting areas in the Arctic.

Pacific walrus. © Maksim Antipin / Beringia National Park (Беринги́я)

New Siberian Islands, Russian Federation. © Peter Sobolev

2. THREATS

Changes in ice and in oceanographic regimes related to climate change may alter the area and duration of the polynya system, which could significantly affect the functioning of the whole local marine ecosystem. Currently, almost the entire area of the Great Siberian Polynya is covered with oil licenses. Major threats include accidental oil spills, and the use of seismic surveys, which may have significant adverse impacts on cetaceans and other marine life in the shallow waters of the polynyas.

3. POTENTIAL OUTSTANDING UNIVERSAL VALUE

3.1 Potential justification of World Heritage Criteria

Criterion VII - SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

Recurring flaw polynyas are of a great significance for Arctic marine biological diversity and ecosystem function. Though polynyas are usually very dynamic, the Great Siberian Polynya is notable for its regular recurrence, and is considered a stable polynya that opens approximately in the same place each year.

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

The Great Siberian Polynya plays a key role in the oceanographic conditions of the Laptev Sea, by exerting influence on the formation and melting of sea ice. Intense ice formation in the flaw polynyas increases the salinity of the surface water layer, exerting further influence on large-scale processes in the Arctic Ocean, since the increased salinity causes convection in the underlying water layers and the water masses mix. The Great Siberian Polynya may be not only a significant exporter of ice, but also of saline shelf waters in the Arctic Ocean.

Although not marine, the New Siberian Islands archipelago is home to gigantic ice cliffs dating from the Pleistocene that contain a large quantity of paleofauna bones. The New Siberian Islands represent the largest area in the world containing such diverse and abundant mammoth fauna remaining in the permafrost.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The Great Siberian Polynya supports high primary productivity, significant growth of zooplankton and stability in high trophic level populations. By virtue of the strong vertical circulation of the water and inflow of organic material to the near-bottom water layers and bottom sediments, benthic communities are also characterized by a high productivity and wealth of species in the polynya waters.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The Great Siberian Polynya waters provide key winter habitat for the endemic Laptev walrus population, once considered a distinct subspecies, but recently identified as a population of Pacific walrus. The persistence of the Great Siberian Polynya allows walruses to stay in the Laptev Sea all year round, and Laptev walruses do not perform long-distance seasonal migrations as do other Pacific walrus populations. The Great Siberian Polynya is also important habitat for ringed seal populations and their main predator, the polar bear, and serves as a major spring migration stopover site for seabirds. IUCN Red-Listed species include Steller's eider, long-tailed duck, spectacled eider, ivory gull, polar bear, the Laptev population of Pacific walrus, beluga and grey whales.

3.2 Previous recognition of site value

The Great Siberian Polynya has been identified as an Arctic marine area of heightened ecological and cultural significance by domestic and international processes.

3.3 Protection and management

The Great Siberian Polynya has no special protected status, but a portion of Taimyrsky State Nature Biosphere Reserve near Maria Pronchishcheva Bay protects 37,018 hectares of sea waters adjacent to the Great Siberian Polynya. An effort is currently underway to establish a protected area on the New Siberian Islands which will include a portion of the Great Siberian Polynya north of the archipelago.

CHAPTER 5:
THE WORLD HERITAGE TENTATIVE LISTS

The World Heritage Tentative Lists are inventories of those properties situated within the territory of a State Party which the country considers suitable for nomination to the World Heritage List. States Parties are requested to include in their Tentative Lists details of those properties which they consider to be of potential Outstanding Universal Value and which they intend to nominate.[169] Nominations to the World Heritage List are not considered unless the nominated site has already been included on the State Party's Tentative List[170] for a minimum of one year.

Table 2 shows seven sites on the Tentative Lists as of 1 February 2017, that are located in or near the Arctic Ocean and that might include marine features, or cultural connections with marine features, according to the descriptions provided by the respective States Parties. It is important to note that sites on Tentative Lists have not yet been evaluated by the Advisory Bodies to the World Heritage Convention, nor by the World Heritage Committee, and therefore do not necessarily represent OUV.

Table 2: Sites located in or near the Arctic Ocean on the Tentative List as of 1 February 2017

SITE NAME	REF.	SITE TYPE	CRITERIA	DATE SUBMITTED
Islands of Jan Mayen and Bouvet as parts of a serial transnational nomination of the Mid-Atlantic Ridge system (Norway)	5162	Natural	(viii)(ix)(x) http://whc.unesco.org/en/tentativelists/5162/	21/06/2007
Svalbard Archipelago (Norway)	5161	Mixed natural and cultural	(v)(vi)(vii)(viii)(ix)(x) http://whc.unesco.org/en/tentativelists/5161/	21/06/2007
The Laponian Area - Tysfjord, the fjord of Hellemobotn and Rago (extension) (Norway)	1750	Mixed natural and cultural	(iii)(v)(vii)(viii)(ix) http://whc.unesco.org/en/tentativelists/1750/	07/10/2002
The Lofoten islands (Norway)	1751	Mixed natural and cultural	(iii)(viii)(ix)(x) http://whc.unesco.org/en/tentativelists/1751/	07/10/2002
Ivvavik / Vuntut / Herschel Island (Qikiqtaruk) (Canada)	1939	Mixed natural and cultural	(iv)(v)(vii)(viii)(x) http://whc.unesco.org/en/tentativelists/1939/	01/10/2004
Quttinirpaaq (Canada)	1943	Mixed natural and cultural	(iii)(vii)(viii)(x) http://whc.unesco.org/en/tentativelists/1943/	01/10/2004
Aasivissuit - Nipisat, Inuit Hunting Ground between Ice and Sea (Denmark)	1782	Cultural	(iii)(v)(vi) http://whc.unesco.org/en/tentativelists/1782/	29/01/2003

Only two of the seven illustrations of possible OUV as identified in Chapter 4 are currently reflected in sites on Tentative Lists (Svalbard Archipelago, Norway and Quttinirpaaq, Canada).[171] There is thus a considerable mismatch between the Tentative Lists submitted by Arctic States and marine areas of possible OUV as identified through scientific knowledge and expertise and described in this report. Since a site is required to be on the Tentative List for a minimum of one year before it can be nominated for inscription on the World Heritage List, updating the Tentative Lists of the respective States Parties is of crucial importance in view of closing the Arctic gap and move toward a more balanced, representative and credible World Heritage List.

CHAPTER 6:
CONCLUSIONS AND MOVING FORWARD

The sites identified through this process are illustrative of the exceptional nature and value of the Arctic marine environment. This report is meant to inspire their possible future protection as part of our global marine heritage.

As Arctic sea ice retreats, these superb marine features are becoming increasingly accessible to fishing, shipping and new economic demands and threats. The dramatic pace at which Arctic sea ice has declined in recent years highlights the urgency for enhanced understanding and protection of these priceless places of potential OUV. Protection through the 1972 UNESCO World Heritage Convention is one crucial way to secure these places can endure for generations to come.

An analysis of the current Tentative Lists of States Parties to the World Heritage Convention who have jurisdiction over the Arctic Ocean illustrates important gaps when compared to the scientific assessment reflected in this report. Only two of the illustrations of possible OUV as identified in this report are currently included on the Tentative Lists of States Parties: Svalbard Archipelago (Norway) and Quttinirpaaq (Canada). There is thus a serious mismatch between the Tentative Lists and marine areas of possible OUV in the Arctic Ocean.

States Parties to the 1972 UNESCO World Heritage Convention may wish to consider the following recommendations:

1) **To update their respective Tentative Lists**. Before a site can be nominated for potential inscription on the UNESCO World Heritage List, it needs to be included on the States Parties' Tentative List for a minimum of one year. Considering the current mismatch between the Tentative Lists and the marine conservation value of the Arctic Ocean, this is a crucial first step toward closing the Arctic gap on the UNESCO World Heritage List;

2) **To provide enhanced protection** of the areas identified in this report from potentially damaging activities. None of the areas described in this report are currently fully protected, and for some no site-specific enhanced protection measures are currently in place. In order to be considered of OUV, sites need to have an adequate protection and management system in place;

3) **To evaluate OUV in the Arctic region in relation to terrestrial, freshwater, coastal and estuarine nature conservation values.** This report focuses on marine areas, with limited consideration of coastal areas. It does not address the terrestrial or freshwater nature conservation values of the region, nor did it consider estuaries and deltas. The Arctic hosts globally significant areas for nature conservation beyond its highly significant marine values that are the subject of the present report. The biodiversity, geodiversity and wider nature conservation values of the Arctic need to be assessed for their potential OUV, as a priority step to the representation of the Arctic on the World Heritage List. This will also be important for some of the priority marine conservation areas identified in this report, especially those with terrestrial components.

4) **To evaluate OUV in the Arctic Ocean and the broader Arctic region from a cultural and traditional knowledge perspective**. A key conclusion of the expert workshop centered on the intimate relationship and interaction between local communities and indigenous peoples, traditional cultures and the Arctic's natural environment, and the recognition of the suite of diverse cultural heritage sites in the region. The OUV of the Arctic region should therefore be considered from both its cultural and natural perspectives to fully reflect the extent to which the Arctic region is currently underrepresented on the World Heritage List. Furthermore, the full recognition of the rights of concerned communities, as recognized in the Convention's Operational Guidelines, is fundamental in any nomination process. Cultural values and traditional use and rights will need to be considered within and beyond the relevant priority areas identified in this report;

5) **To pursue a wider evaluation of marine conservation values in the Arctic, including the High Seas.** There are more marine areas in the Arctic Ocean that could be considered to be of OUV beyond the seven priorities identified in this report, and further evaluation is needed of the areas identified in Annex 3. The potential application of the World Heritage Convention in the High Seas is a topic of current discussion, and thus the High Seas of the Arctic, including the North Pole, provides a further focus for the identification of potential OUV in the region.

6) **To nominate candidate areas in the Arctic Ocean as World Heritage Sites**, considering the priority areas described in this report that meet fully the criteria, integrity, protection and management requirements of OUV, and thus would merit inscription on the UNESCO World Heritage List.

ANNEX 1:
THE WORLD HERITAGE CONVENTION AND ITS OPERATIONS[172]

ROLES AND RESPONSIBILITIES

The **Convention concerning the Protection of the World's Cultural and Natural Heritage,** adopted in 1972 and commonly known as the World Heritage Convention was founded on the premise that certain places on Earth are of Outstanding Universal Value (OUV) and as such should form part of the common heritage of humanity. As of February 2017, the convention has been ratified by 193 countries, the States Parties to the Convention. Operationally, the following groups play a role in managing and conserving World Heritage Sites:

The States Parties - In ratifying the Convention, countries take on obligations to identify and protect sites nominated to the World Heritage List, and to protect their national heritage, both natural and cultural. The States Parties are also encouraged to integrate the sites into the day-to-day life of the public, and support scientific and technical conservation research. Countries must also report regularly to the World Heritage Committee on the state of conservation of their World Heritage properties. These reports are crucial in assessing the condition of the sites, provide support to the site managers and resolve recurrent problems. Each country has a formal World Heritage representative, the **National Focal Point**, mandated with implementing Convention activities within the country, and being the channel for information between the Secretariat, countries and other stakeholders.

The **World Heritage Committee** meets once a year, and consists of representatives from 21 of the States Parties to the Convention elected by their General Assembly. At its first session, the Committee adopted its Rules of Procedure of the World Heritage Committee. The Committee is responsible for the implementation of the World Heritage Convention, defines the use of the World Heritage Fund and allocates financial assistance upon requests from States Parties. It has the final say on whether a property is inscribed on the World Heritage List. It examines reports on the state of conservation of inscribed properties and asks States Parties to take action when properties are not being properly managed. It also decides on the inscription or deletion of properties on the List of World Heritage in Danger.

The **General Assembly** of States Parties to the World Heritage Convention meets during the sessions of the General Conference of UNESCO. During its session, the General Assembly determines the uniform percentage of contributions to the World Heritage Fund applicable to all States Parties, and elects new members to the World Heritage Committee to replace the outgoing members.

The **World Heritage Centre**, established in 1992, is the focal point and coordinator within UNESCO for all matters related to World Heritage. Ensuring the day-to-day management of the Convention, the Centre organizes the annual sessions of the World Heritage Committee and its Bureau, provides advice to States Parties in the preparation of site nominations, organizes international assistance from the World Heritage Fund upon request, and coordinates both the reporting on the condition of sites and the emergency action undertaken when a site is threatened. The Centre also organizes technical seminars and workshops, updates the World Heritage List and database, develops teaching materials to raise awareness among young people of the need for heritage preservation, and keeps the public informed of World Heritage issues. The **World Heritage Marine Programme** is located within the World Heritage Centre and is one of the Centre's six thematic programmes.

Advisory Bodies: Three international non-governmental or intergovernmental organizations are named in the Convention to provide independent advice to the World Heritage Committee in their respective areas of expertise. Their roles include evaluation of properties nominated for inscription on the World Heritage List, monitoring the state of conservation of World Heritage

natural properties, reviewing requests for international assistance, and providing input and support for capacity-building activities. These Advisory Bodies are:

The **International Union for Conservation of Nature (IUCN)** - is an international, non-governmental organization that provides the World Heritage Committee with technical evaluations of natural heritage properties and, through its worldwide network of specialists, reports on the state of conservation of listed properties. With more than 1000 members, IUCN was established in 1948 and is located in Gland, Switzerland.

The **International Council on Monuments and Sites (ICOMOS)** - provides the World Heritage Committee with evaluations of cultural and mixed properties proposed for inscription on the World Heritage List. It is an international, non-governmental organization founded in 1965, with an international secretariat in Paris.

The **International Centre for the Study of the Preservation and Restoration of Cultural Property** (ICCROM) - is an intergovernmental body which provides expert advice on how to conserve listed properties, as well as training in restoration techniques. ICCROM was set up in 1956 and is located in Rome.

The Fund for the Protection of the World Cultural and Natural Heritage of Outstanding Universal Value, called "**the World Heritage Fund**", was established under Art. 15 of the World Heritage Convention. Its resources consist primarily of assessed contributions by the States Parties of the Convention and may be used only for such purposes as the World Heritage Committee shall define.

The **World Heritage emblem** represents the interdependence of the world's natural and cultural diversity. It is used to identify properties protected by the World Heritage Convention and inscribed on the official World Heritage List, and represents the universal values for which the Convention stands. Designed by Belgian artist Michel Olyff, it was adopted as the official emblem of the World Heritage Convention in 1978. While the central square symbolizes the results of human skill and inspiration, the circle celebrates the gifts of nature. The emblem is round, like the world, a symbol of global protection for the heritage of all humankind.

BECOMING A WORLD HERITAGE SITE

Only countries that have signed the World Heritage Convention, pledging to protect their natural and cultural heritage, can submit nomination proposals for properties on their territory to be considered for inclusion in UNESCO's World Heritage List.

World Heritage sites are identified through a rigorous, multi-year nomination, evaluation and inscription process that is based on a set of specific criteria.

The first step a country must take is to make an 'inventory' of its important natural and cultural heritage sites located within its boundaries. This 'inventory' is known as the **Tentative List**, and provides a forecast of the properties that a State Party may decide to submit for inscription in the next five to ten years and which may be updated at any time. It is an important step since the World Heritage Committee cannot consider a nomination for inscription on the World Heritage List unless the property has already been included on the State Party's Tentative List.

By preparing a Tentative List and selecting sites from it, a State Party can plan when to present a **nomination file**. The World Heritage Centre offers advice and assistance to the State Party in preparing this file, which needs to be as exhaustive as possible, making sure the necessary documentation and maps are included. The nomination is submitted to the World Heritage Centre for review and to check it is complete. Once a nomination file is complete the World Heritage Centre sends it to the appropriate Advisory Bodies for evaluation.

A nominated property is independently **evaluated by the two Advisory Bodies** mandated by the World Heritage Convention: the International Council on Monuments and Sites (ICOMOS) and the International Union for Conservation of Nature (IUCN), which respectively provide the World Heritage Committee with evaluations of the cultural and natural sites nominated. The third Advisory Body is the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), an intergovernmental organization which provides the Committee with expert advice on conservation of cultural sites, as well as on training activities.

Once a site has been nominated and evaluated, it is up to the intergovernmental **World Heritage Committee** to make the final decision on its inscription. Once a year, the Committee meets to decide which sites will be inscribed on the World Heritage List. It can also defer its decision and request further information on sites from the States Parties.

Inscribing a site on the World Heritage List is the beginning, and not the end of the story. Site managers and local authorities continuously need to work towards managing, monitoring and preserving the World Heritage properties.

States Parties have an obligation to regularly prepare **reports about the state of conservation** and the various protection measures put in place at their sites. These reports allow the World Heritage Committee to assess the conditions at the sites and, eventually, to decide on the necessity of adopting specific measures to resolve recurrent problems. One of such measures could be the inscription of a property on the **List of World Heritage in Danger**.

The **Periodic Reporting** process provides an assessment of the application of the World Heritage Convention by the States Parties. It also provides updated information about the sites to record possible changes in the state of conservation of sites. The Periodic Reports – submitted by the States Parties themselves – are prepared on a regional basis and are examined by the World Heritage Committee on a pre-established schedule based on a six-year cycle. The results are included in the report of the World Heritage Committee to the General Conference of UNESCO.

Thirty-eighth Session of the World Heritage Committee (Doha, 2014). © UNESCO/Eric Esquivel

ANNEX 2:
WORKSHOP AGENDA, PARTICIPANTS & ADDITIONAL REVIEWERS

WORKSHOP AGENDA

Potential marine World Heritage sites in the Arctic Region Expert Meeting
UNESCO Headquarters
7 Place Fontenoy, Paris, Room VI (main building)
25-26 February, 2016

Thursday, 25 February 2016: Day 1	
9:00-9:45	Welcome: *Dr. Mechtild Rössler, Director, UNESCO World Heritage Centre* Introduction: *Dr. Carl Gustaf Lundin, Director, Global Marine and Polar Programme, IUCN* Overview: *Ms. Lisa Speer, Director, International Oceans, Natural Resources Defense Council*
9:45-10:00	Message from the Partner: *Mr. Raphaël Cuvelier, General Secretary, Prince Albert II of Monaco Foundation*
10:00-10:45	Understanding Outstanding Universal Value: Nomination, inscription and evaluation of sites on the UNESCO World Heritage List: *Mr. Tim Badman, Director, UNESCO World Heritage Programme* Applying OUV criteria to World Heritage marine sites: *Dr. David Obura, Director, CORDIO East Africa* Structure of the assessment: *Ms. Lisa Speer, Director, International Oceans, NRDC*
10:45-11:00	General introduction to the Arctic region: *Dr. Tatiana Saksina, IUCN, Manager Polar Programme*
11:15-11:45	Discussion: Globally significant Arctic marine features that are the basis for initial site selection
11:45-12:30	Possible World Heritage sites in the Arctic Ocean: *Ms. Lisa Speer and Ms. Patricia Hooper, NRDC*
14.00-15.30	Discussion of Possible World Heritage sites in the Arctic Ocean: assessing, strengthening or rejecting claims to OUV: *Dr. Carl Gustav Lundin, IUCN*
16:00-17:45	Discussion of Possible World Heritage sites in the Arctic Ocean: *Breakout groups*
17:45-18:00	Wrap up Day 1 and Introduction to Day 2: *Dr. Fanny Douvere and Mr. Tim Badman*
Friday, 26 February 2016: Day 2	
9:00-9:15	Summary of key goals to be achieved during this Expert Workshop: *Dr. Fanny Douvere, UNESCO*
9:15-12:45	Where we are now: Discussion of remaining issues around possible marine World Heritage Sites in the Arctic Ocean: *Dr. Tatiana Saksina, IUCN*
13:00-15:30	Selection of core group of possible World Heritage sites in the Arctic (concluding session): *Mr. Tim Badman, IUCN*
16:00-16:30	Distribution of outcomes of the workshop to governments, management bodies, and relevant international organizations: *Mr. Tim Badman, IUCN*
16:30-17:00	Consolidation of action needed on draft materials and next steps: *Ms. Lisa Speer, NRDC*
17:00-17:30	Concluding remarks and closing of the meeting: *Mr. Tim Badman, IUCN*

WORKSHOP PARTICIPANTS

NAME	ORGANIZATION	TITLE
Tim Badman	IUCN	Director, IUCN World Heritage Programme
Alexey Butorin	Natural Heritage Protection Fund / Institute of Geography, Russian Academy of Sciencies	Director, Natural Heritage Protection Fund / Scientist, Institute of Geography, Russian Academy of Sciences
Robbert Casier	UNESCO	Associate Programme Specialist, World Heritage Centre, Marine Programme
Tom Christensen	Aarhus University	Co-Chair of Circumpolar Biodiversity Monitoring Program (CBMP)
Jesse Cleary	Duke University	Director, Marine Geospatial Ecology Lab
Raphaël Cuvelier	Prince Albert II of Monaco Foundation	Coordinator of Projects
Fanny Douvere	UNESCO	Coordinator, World Heritage Marine Programme
Mario Gavrilo	Russian Arctic National Parc	Research Director
Patrick Halpin	Duke University	Director, Marine Geospatial Ecology Lab
Patricia Hooper	NRDC / Duke University	Advisor
Brendan Kelly	International Arctic Research Center, University of Alaska Fairbanks	Executive Director
Carl Gustaf Lundin	IUCN	Director, IUCN Global Marine & Polar Programme
Francine Mercier	Protected Area Establishment Branch, Parks Canada	Manager, NMCA Establishment
Anders Mosbech	Aarhus University	Head of Research and Advisory, Senior Researcher
David Obura	CORDIO	Coordinator for CORDIO East Africa
Nilufer Oral	Istanbul Bilgi University Law Faculty	IUCN Council Global Oceans Focal Person and Co-Chair of the Oceans Specialist Group of the IUCN Commission of Environmental Law
Madeleine Redfern	Iqaluit, Nunavut	Mayor
Tatiana Saksina	IUCN	Head of IUCN Polar Programme
Lisa Speer	Natural Resources Defense Council	Director, International Oceans Program
Eygeny Syroechkovskiy	All-Russian Institute for Nature Conservation (ARRINC)	Deputy Director
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Cecilie von Quillfeldt	Norwegian Polar Institute	Senior advisor

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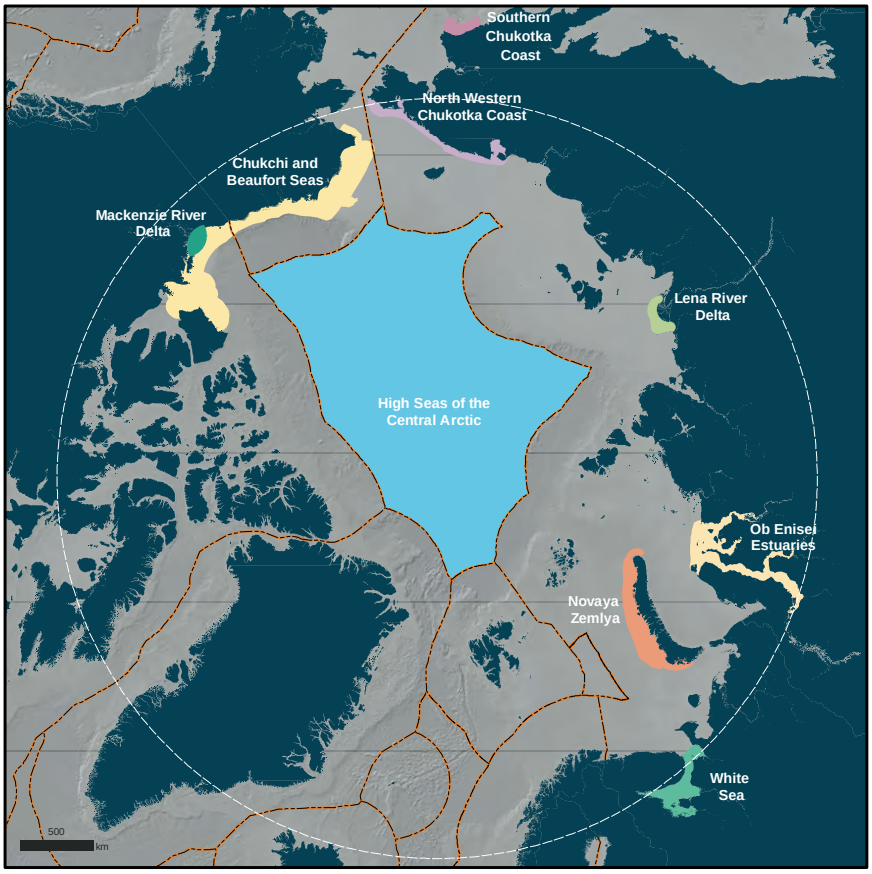
McGill University
Canada

ANNEX 3:
SITES WORTH FURTHER CONSIDERATION

The following additional sites were identified before or during the workshop as worthy of additional data collection, analysis and consideration as having potential OUV.

White Sea

The White Sea is a semi-enclosed shelf sea in the northwest Russian Arctic, connected to the Barents Sea by a long, narrow strait. Its highly productive coastal waters support the Baltic/White Sea Flyway, used by an estimated 10 million birds. The area provides staging, molting and wintering grounds for three eider species, including the endemic White Sea eider. Beluga whales are common in the White Sea, breeding in shallow bays and overwintering in the northern region. A variety of pinnipeds frequent the region, including bearded and ringed seals. The Barents Sea/White Sea stock of harp seals (*Pagophilus groenlandicus*), which concentrate in the central and northern White Sea for pupping and molting, is one of the three world stocks of this species. Grey seals frequent the northern part of the White Sea, and Atlantic walruses recently started to re-establish here. The White Sea is an important spawning area for the endemic herring, and Atlantic salmon support a traditional fishery.



Marine Areas for Further Consideration of Outstanding Universal Value in the Arctic

Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2017)

North Western Chukotka Coast

The North Western Chukotka Coast is bordered by the Chukchi Sea to the north and the Bering Strait to the east. The system of polynyas and leads along the Chukotka coast serves as a spring migration path for marine mammals and seabirds, and an estimated 3 million seabirds of 26 different species nest in the region. The critically endangered spoon-billed sandpiper (*Eurynorhynchus pygmeus*), nests and breeds along northern Chukotka. In winter, most of the Chukotka Peninsula, particularly in the north coastal zone and the polynyas, have high concentrations of marine mammals, including ringed and bearded seals, polar bears, and Pacific walrus. The coastal zone is also important to grey whales, orca and bowhead whales. Leads along the northern coast of Chukotka provide a migration corridor in spring or early summer for belugas.

Southern Chukotka Coast

The waters off the southern coast of the Chukotka Peninsula support very large numbers of marine mammals, fish and birds. The area is home to large rookeries of tens of thousands of walrus and seals. In spring, grey whales of the Californian-Chukchi population migrate from their wintering grounds through the polynyas and leads of the Anadyr – Sireniki polynya system along the eastern coast of Chukotka, along with bowhead and beluga whales. Grey whales gather in concentrations of more than 10,000 in the region during summer. The Southern Chukotka Coast and adjoining water areas support very large numbers of birds at various times of the year, including key areas of nesting, molting, and autumn congregations of the endangered emperor goose, endemic to the Bering Sea coast. An estimated 90% of the nesting population of spoon-billed sandpiper nest along the coast of Southern Chukotka.

Novaya Zemlya Archipelago

The Novaya Zemlya Archipelago, located off the northern coast of the Russian Federation, is bordered by the Barents Sea to the west and the Kara Sea to the east, dividing the European Arctic shelf and the Siberian shelf. The unique oceanographic features off the coast of Novaya Zemlya provide important habitat for a variety of birds, including common murres, black guillemots, Atlantic puffins, glaucous gulls, king eider, Steller's eider, long-tailed duck, ivory gulls and enormous colonies of thick-billed murre and black-legged kittiwakes. The west coast is an important wintering area for polar bears. The system of shore leads and drift ice along the west coast constitutes a spring migration route for belugas. In summer, waters west and north off Novaya Zemlya are important feeding grounds for minke and humpback whales and Atlantic walrus.

Chukchi and Beaufort Seas

Located along the north coast of North America, the Beaufort and Chukchi Sea coast provides habitat for many seabirds, including common and king eiders, long-tailed ducks, and red-throated, black-throated and white-billed phalaropes. It is believed that the entire population of breeding king eiders in Western North America use Ledyard Bay as a staging area. The Lisburne Peninsula hosts major breeding colonies of thick billed and common murres, as well as horned puffins and black-legged kittiwakes. In the spring, hundreds of thousands of eiders and long-tailed ducks use the open waters and leads of the Beaufort Sea as a staging area during their annual migration. Many of these species also utilize the bays and barrier islands of the southeastern Beaufort Sea for molting in the summertime. Marine mammals frequenting the Beaufort and Chukchi Seas include bowhead, grey, minke and beluga whales, walrus, ringed, bearded, spotted, and ribbon seals, and polar bears.

The High Seas of the Central Arctic Ocean

Approximately the size of the Mediterranean Sea, the international waters of the Central Arctic Ocean contain highly dynamic multi-year ice as well seasonal ice and shifting marginal ice zones. Multi-year ice (MYI) in the Arctic ocean is globally unique and shrinking rapidly as the climate warms, and is now found only in the Canadian Arctic Ocean Archipelago area and the adjoining area beyond national jurisdiction in the Central Arctic Ocean. MYI provides habitat for ice specialists that do not occur in younger sea ice. The MYI in this region and in the adjacent Canadian Arctic Archipelago is projected to persist longer than any other region of the Arctic, providing refugia for globally unique species dependent on multi-year ice. The marginal ice zone and seasonal ice cover over the deep (> 500m) basins of the Central Arctic Ocean beyond national jurisdiction occur over very deep water, unlike similar features in other parts of the Arctic. As such they represent globally and regionally significant habitat that is unique to the area beyond national jurisdiction. This type of habitat is found nowhere else in the Arctic.

Major Estuaries and Deltas

The estuaries and deltas of the Arctic's major river systems including the Mackenzie, Ob/Enisei and Lena Rivers, are extraordinarily rich and productive. Not strictly marine, these areas nevertheless should be assessed in the future.

ENDNOTES

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APPENDICES:
DETAILED SUMMARIES OF THE ARCTIC MARINE AREAS OF POTENTIAL OUTSTANDING UNIVERSAL VALUE

Table of Contents

BERING STRAIT ECOREGION
(INCLUDING ST. LAWRENCE ISLAND)

Reviewers: Brendan Kelly, Jacqueline Grebmeier, Anatoly Kochnev, and Maria Gavrilo

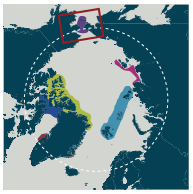
LOCATION

The Bering Strait is a narrow strait, 85 kilometers in width, separating the Russian Federation and Alaska (United States of America or U.S.A.), and bounded by the Chukchi Sea to the north and the Bering Sea to the south. The Bering Strait is the Pacific gateway to the Arctic, providing the only connection between the Pacific and Arctic Oceans. St. Lawrence Island is a large island located south of the Bering Strait in the northern Bering Sea. The island is part of Alaska, but is closer to Siberia than to the U.S.A. mainland. The Bering Strait Ecoregion is located within the maritime jurisdiction of both the U.S.A. and the Russian Federation. The Bering Strait Ecoregion, inclusive of St. Lawrence Island, encompasses an area between approximately 63ºN 173ºW and 66ºN 169ºW.

The Bering Strait Ecoregion

Area of Potential Outstanding Universal Value

Marine Boundary



Map: Marine Geospatial Ecology Lab, Duke University (2016)

SITE DESCRIPTION

Linking Arctic ecosystems to the north and subarctic ecosystems to the south, the Bering Strait region is one of the most productive biological regimes in the world.[1] Three major current systems transport relatively warm and nutrient rich waters from the Pacific through the shallow Strait into the Arctic Ocean. This warm, nutrient rich water in turn sustains a huge biomass of plankton and benthic invertebrates, which provide food for millions of birds and other animals.

The Bering Strait is one of the world's great migration corridors. An estimated 12 million seabirds nest, forage and breed in the Bering Strait region, and hundreds of thousands of marine mammals of several species migrate through the Strait in both spring and fall. Ice-dependent or ice-associated mammals that migrate through the Strait include bowhead, beluga, and grey whales; Pacific walrus; ringed, ribbon, spotted, and bearded seals; and occasionally polar bears.[2]

The Bering Strait Ecoregion is of great biological and cultural significance.[3] During the last ice age, the shallow sea bed of the Bering Strait was above sea level, forming a part of the Bering land bridge across which many species of plants and animals moved between Eurasia and North America.[4] The Bering land bridge was also important in the colonization of the Americas by human beings.[5] St. Lawrence Island is one of the last exposed portions of the Bering land bridge.[6]

The Strait provides a pathway for current and future connectivity between the Pacific and Arctic Oceans and is a critical pathway for climate-induced changes in both oceans. Arctic sea ice melt—a major accelerator of global warming—is itself enhanced by warm water flowing northward through the Bering Strait.[7] Recent increases in the volume of nutrient-rich water flowing northward through the Bering Strait has implications for the melting of sea ice and ecosystem productivity in the Chukchi Sea.[8]

PREVIOUS RECOGNITION

The Bering Strait Ecoregion was previously identified as significant by the following reports and workshops:

AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Program (AMAP). Oslo. 114 pp. *St. Lawrence Island and the Bering Strait are listed as Areas #7 & #8 within the Bering Sea Large Marine Ecosystem.*

Speer, L. and Laughlin, T. (Eds). 2011. IUCN/NRDC Workshop to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment, La Jolla, California. 02-04 November 2010. 37 pp. *Bering Strait is "Super EBSA" #2.*

KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

The Bering and Chukchi sea continental shelves (among the largest continental shelves in the world) are broad and shallow, and during periods of low sea level are emergent, blocking circulation between the Pacific and Arctic ocean basins.[9] As sea levels rose at the end of the last ice age, the Bering Strait formed as an essential link in the global hydrologic cycle, forming the Pacific gateway to the Arctic Ocean.[10]

Three distinct water masses, each with different origins, move northward through the Bering Strait and into the Chukchi Sea.[11] The Anadyr current originates in the Bering Sea basin, and moves the majority of water through the Bering Strait during summer. The Alaska Coastal Current originates in the Gulf of Alaska, and is influenced by freshwater runoff from major rivers. Bering Shelf Water is the resident water mass south of St. Lawrence Island, and it is advected northward through the Bering Strait. The convergence of three major currents is a unique feature of the Bering Strait Ecoregion. In addition, the Anadyr and Alaskan Coastal currents that flow through the Bering Strait exchange water between the northern Pacific and northern Atlantic Oceans.[12]

The Ecoregion is seasonally covered by sea ice, creating habitat for many ice-dependent species of seabirds, marine mammals, and fish, which move through the region as sea ice retreats and advances.[13] In winter and spring, northerly winds push the ice through the narrow Strait southward creating leads and polynyas, important habitat for mammals and birds. Characteristic and biologically important features of the sea ice regime of the area include the dynamic, meandering marginal ice zone as well as large reoccurring polynyas. Sea ice coverage varies greatly between years based on atmosphere circulation patterns.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The Bering Sea Ecoregion represents one of the most productive biological regimes in the world.[14] Circulation in North Pacific and the Bering Sea transports heat and freshwater poleward and replenishes nutrients that support biological productivity.[15] The Anadyr Current, which originates in the basin of the Bering Sea, is referred to as the "Green Belt", transporting nutrient rich waters and great numbers of oceanic zooplankton into the Bering Strait Ecoregion. This in turn sustains a huge biomass of benthic invertebrates, marine mammals and seabirds in the region.[16]

The presence of seasonal ice, together with shallow depth and productive plankton and benthos supports a unique diversity and high density of marine life.[17] Dynamic ice cover, marginal ice zone and polynyas provide important ice habitats for ice dependent and associated species of marine mammals and seabirds. Additionally, the physical constraints of the Bering Strait seasonally concentrate species associated with the ice edge, as the region is the only migration corridor for many species of fish, birds and marine mammals.[18]

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

Birds

Large populations of seabirds breed, nest, and forage along the coast of western Alaska and western Chukotka.[19] St. Lawrence Island and the Diomede Islands located within the Bering Strait, support some of the largest colonies in the world of least auklets (*Aethia pusilla*), crested auklets (*Aethia cristatella)* and parakeet auklets (*Aethia psittacula*) that feed on zooplankton in the water column, as well as common murres (*Uria aalge)* and thick-billed murres (*Uria lomvia)* that feed on fish.[20] The Kittlitz's murrelet (*Brachyramphus brevirostris*), a bird of international conservation concern, also feeds in this area during and after breeding. [21] Short-tailed albatross (*Phoebastria albatrus*), listed as endangered under the U.S.A. Endangered Species Act, also occurs in the region.[22] It is estimated that the inner shelf area of the Bering Sea, from St. Lawrence Island to the Bering Strait, supports more than 5 million seabirds during summer.[23]

Millions more seabirds migrate through the region in spring and fall. The Bering Strait serves as the only or the major migrating corridor for the several species of waterbirds breeding in the Arctic from the Laptev Sea in the west to the Beaufort Sea in the east. The entire global population of the threatened spectacled eider (*Somateria fischeri),* which breed on tundra of East Siberia, Chukotka and Alaska, migrate through the Bering Strait and winter in polynyas off St. Lawrence and St. Mathew islands. The core wintering grounds are restricted to a small area (about 50 × 75 km) centered at about 62°00'N, 173°00'W.[24] A majority of the Pacific eider (*Somateria mollissima v-nigrum*), Emperor goose (*Anser canagica*), as well as Pacific flyway populations of divers (*Gavia* spp.), king eider (*Somateris spectabilis*), long-tailed duck (*Clangula hyemalis*), globally threatened Steller's eider, kittiwake (*Rissa tridactyla*), thick-billed murre (*Uria lomvia*), jaegers (*Stercorarius* spp.), red phalaropes (*Phalaropus fulicariius*) and several shorebird species also migrate through. Endemic arctic gulls, i.e. ivory gull (*Pagophila eburnea*) and Ross's gull (*Rodostethia rosea*), migrate and partly overwinter in the Bering Strait.[25] The short-tailed puffin (*Puffinus tenuirostris*) and sooty (*Puffinus griseus*) shearwaters fly from the Southern Hemisphere to the Bering Sea to forage in summer, and many thousands of the birds migrate through the Bering Strait to the Chukchi Sea.

Marine Mammals

Marine mammal diversity and biomass are high in the Bering Sea, reflecting the high productivity of the region and the refuge from predation provided by sea ice.[26] The Bering Strait is a critical migration corridor with hundreds of thousands to millions of marine mammals passing through it in the spring and fall seasons.[27] Important marine mammals include the Beaufort and East Chukchi Sea stocks of beluga whales (*Delphinapterus leucas*), and the Bering-Chukchi-Beaufort stock of bowhead whales (*Balaena mysticetus*).[28] Pacific walrus (*Odobenus rosmarus divergens*) winter in the polynyas and drifting pack ice around St. Lawrence Island, and migrate north through the Bering Strait during the spring calving season.[29]

The Bering Strait Ecoregion, particularly north of St. Lawrence Island to the Diomede Islands, is a primary summer feeding grounds for grey whales (*Eschrichtius robustus*).[30] Minke whales (*Balaenoptera acutorostrata*), fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*), North Pacific right whale (*Eubalaena japonica),* Dall's porpoise (*Phocoenoides dalli*), and harbour porpoise (*Phocoena phocoena*), also frequent the region.[31] Portions of St. Lawrence Island and its surrounding waters are designated by the U.S.A. as Critical Habitat for endangered Steller sea lions (*Eumetopias jubatus*).[32] Ice dependent seals such as bearded seal (*Erignathus barbatus*), ringed seal (*Phoca hispida*), spotted seal (*Phoca largha*), and ribbon seal (*Phoca fasciata*) have important habitats in the Bering Strait.[33] Polar bears (*Ursus maritimus*) regularly breed on the Chukotka and Alaska coasts of the Bering Strait,

and the U.S.A. has designated the Bering Strait as Critical Habitat for the species.[34]

Fish

The high productivity of the region, combined with seasonal sea ice cover also account for enhanced pelagic productivity in the Bering Sea. The Bering Sea supports some of the largest commercial fisheries in the world,[35] including king crab, salmon, and walleye pollock. It is suspected that there is a large migratory stock of polar cod (*Boreogadus saida*) that migrates south to spawn in winter under the ice in the Bering Strait region.[36] Other important species, including Bering flounder (*Hippoglossoides robustus*) occur, although like polar cod, not at commercial levels for fishing, which is currently closed from Bering Strait northward.[37] The

Threatened or endangered species present in the Bering Strait Ecoregion:

Common Name *(Latin name)*	**Conservation Status**
Short-tailed albatross (*Phoebastria albatrus*)	• IUCN Red List (vulnerable) • U.S.A. Endangered Species Act (endangered) • Canada Species at Risk Act (threatened) • Russian Federation Red Data Book (listed)
Black brant (*Branta bernicla nigricans)*	• Russian Federation Red Data Book (listed)
Emperor goose (*Anser canagicus*)	• IUCN Red List (near threatened) • Russian Federation Red Data Book (listed)
Spectacled eider *(Somateria fischeri*)	• IUCN Red List (least concern), • U.S.A. Endangered Species Act (threatened)
Steller's eider (*Polysticta stelleri)*	• IUCN Red List (vulnerable) • U.S.A. Endangered Species Act (threatened)
Long-tailed duck (*Clangula hyemalis)*	• IUCN Red List (vulnerable)
Spoonbill sandpiper (*Calidris pygmaea)*	• IUCN Red List (critically endangered) • Russian Federation Red Data Book (listed)
Ivory gull (*Pagophila eburnea*)	• IUCN Red List (near threatened) • Russian Federation Red Data Book (listed)
Bowhead whale (*Balaena mysticetus)* Bering-Chukchi-Beaufort Sea stock	• IUCN Red List (least concern) • Canada Species at Risk Act (special concern) • U.S.A. Endangered Species Act (endangered)
Humpback whale (*Megaptera novaeangliae)*	• IUCN Red List (least concern) • U.S.A. Endangered Species Act (endangered) • Russian Federation Red Data Book (listed)
Grey whale (*Eschrichtius robustus)*	• IUCN Red List (least concern) • Russian Federation Red Data Book (listed)
Beluga whale (*Delphinapterus leucas)*	• IUCN Red List (near threatened)
Fin whale (*Balaenoptera physalus*)	• IUCN Red List (endangered) • U.S.A. Endangered Species Act (endangered)
North Pacific right whale (*Eubalaena japonica)*	• IUCN Red List (endangered) • U.S.A. Endangered Species Act (endangered)
Steller sea lion (*Eumetopias jubatus)*	• IUCN Red List (near threatened) • U.S.A. Endangered Species Act (endangered) • Russian Federation Red Data Book (listed)
Pacific walrus *(Odobenus rosmarus divergens)*	• IUCN Red List (vulnerable) • U.S.A. Endangered Species Act (candidate)
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable) • U.S.A. Endangered Species Act (threatened) • Russian Federation Red Data Book (listed)

Bering Strait may play an important role in connecting fish and invertebrate fauna between Pacific and Arctic populations as the climate warms.

MAJOR THREATS

Shipping

As the only connection between the Arctic Ocean and the Pacific, the Bering Strait is the only shipping gateway between the two oceans. Shipping through the Strait has increased over time and is likely to continue to do so with continued sea ice retreat, although at an uncertain rate. The narrowness of the strait amplifies the effect of shipping on the ecoregion.

The 2009 Arctic Marine Shipping Assessment (AMSA) concluded that increased vessel traffic in the region may result in greater incidence of damage to the environment from ships, including pollutant discharges, and an increase in the risk of disturbance effects such as ship noise and ship strikes on migrating and foraging marine mammals.[38]

Marine mammals that migrate through the Bering Strait are physically constricted to a relatively small corridor, increasing their interactions with vessels.[39] The narrowness of the Bering Strait means that options for redirecting ships to avoid migrating animals are limited. Alternative shipping routes that avoid marine animals are relatively few.

Oil and Gas

The United States Bureau of Ocean and Energy Management (BOEM) is responsible for leasing policy and program development issues for oil and gas in the Outer Continental Shelf (OCS), which includes United States federal waters of the Arctic.[40] Until very recently, active oil exploration was occurring in the region.

On September 28, 2015, Royal Dutch Shell officially halted its drilling program in the Chukchi and Beaufort Seas.[41] On October 16, 2015, the U.S. Department of the Interior announced that it will cancel two potential Arctic offshore lease sales scheduled under the current 2012-2017 five year leasing program (Chukchi Sea Lease Sale 237 was scheduled for 2016, Beaufort Sea Lease Sale 242 was scheduled for 2017).[42] On November 18, 2016, the U.S. Interior Department released the final five year leasing program for the period 2017-2022. No new lease sales in the Arctic Ocean or Bering Sea were included.

While there is currently no new federal leasing planned in the region, if oil drilling were to restart in the OCS in the future, shipping and related effects would be amplified in the Bering Strait.[43] On the Russian side, there is a Rosneft license just north-west off the Bering Strait. If oil exploration in the Chukchi and Beaufort Seas resumes in the future, it would present a serious threat to the Bering Strait ecosystem, especially if a catastrophic oil spill occurred during transit or other operations.

Climate Change

Studies have documented that sea ice in the Bering and Chukchi seas continues to change, diminish, and retreat, compounded by changes in prevailing wind conditions.[44] These changes, along with increasing seawater temperatures, are driving shifts in marine species composition.[45]

Changes in ocean temperature, salinity and pH may further stress marine species, causing physiological impacts or even changes in migration routes for upper trophic level organisms.[46] The Bering Sea has been shown to respond to the large-scale climate regime shifts, which have impacted all levels of the Bering Sea food web.[47]

PROTECTION AND MANAGEMENT STATUS

National Jurisdiction

The Bering Strait is located within the territorial waters and Exclusive Economic Zones of the U.S.A. and of the Russian Federation. St. Lawrence Island is within the Exclusive Economic Zone of the U.S.A., and is part of the state of Alaska. In 2016, the U.S.A. federal government transferred permanent title to St. Lawrence Island to two native Alaska villages, Gambell and Savoonga.

Protected Areas

The Beringia National Park (Russian Federation) was established in 2013. The Park protects spawning grounds of commercially valuable salmonid populations, large seabird colonies, Pacific walrus haul-out sites, and populations of ice-dependent marine mammals, including Chukotka-Alaska population of polar bears and their habitats including maternity dens. The total area is 1,819,454 hectares, including 332,180 hectares of sea waters.

International Laws and Treaties

Bilateral Pollution Control Agreement: In 2001, the Russian Federation and the U.S.A. signed the "Agreement between Government of the Russian Federation and United States of America on Cooperation in Combating Pollution in the Bering and Chukchi Seas in Emergency Situations".[48]

IMO Polar Code:[49] The Polar Code and SOLAS amendments were adopted during the 94th session of IMO's Maritime Safety Committee (MSC), in November 2014, and are

intended to protect ships and people aboard them in the harsh polar environment. The environmental provisions and MARPOL amendments were adopted during the 68th session of the Marine Environment Protection Committee (MEPC) in May 2015. The Polar Code is expected to enter into force on 1 January 2017.

The Bering Strait is a recognized "international strait" under the United Nations Convention on the Law of the Sea (UNCLOS). As such, the Bering Strait subject to special rules designed to ensure that vessels of all nations have relatively unimpaired access.[50]

The United States-Russian Federation Agreement on Cooperation in the Field of Environmental Protection (1972): Provides a framework under which the two nations can collaborate on environmental issues of mutual interest and concern.[51]

The United States-Russian Federation Agreement on conservation of the Chukotka-Alaska polar bear population (effective 2007): An agreement to protect the shared Alaska-Chukotka polar bear population, containing specific protections for females with cubs.[52]

Fisheries Management

In waters under the jurisdiction of the United States, fisheries are managed by the North Pacific Fishery Management Council.[53] The Council has established the 7,000 nm^2 St. Lawrence Island Habitat Conservation Area, which prohibits fishing with nonpelagic trawl gear in waters surrounding St. Lawrence Island, to protect bottom habitat and to minimize interactions with community use and subsistence fisheries of the islanders.

The Federal Agency for Fishery regulates fisheries in the federal waters of the Russian Federation.

Indigenous Management and traditional environmental knowledge (TEK) is important in this region.[54]

The International Whaling Commission regulates whaling.

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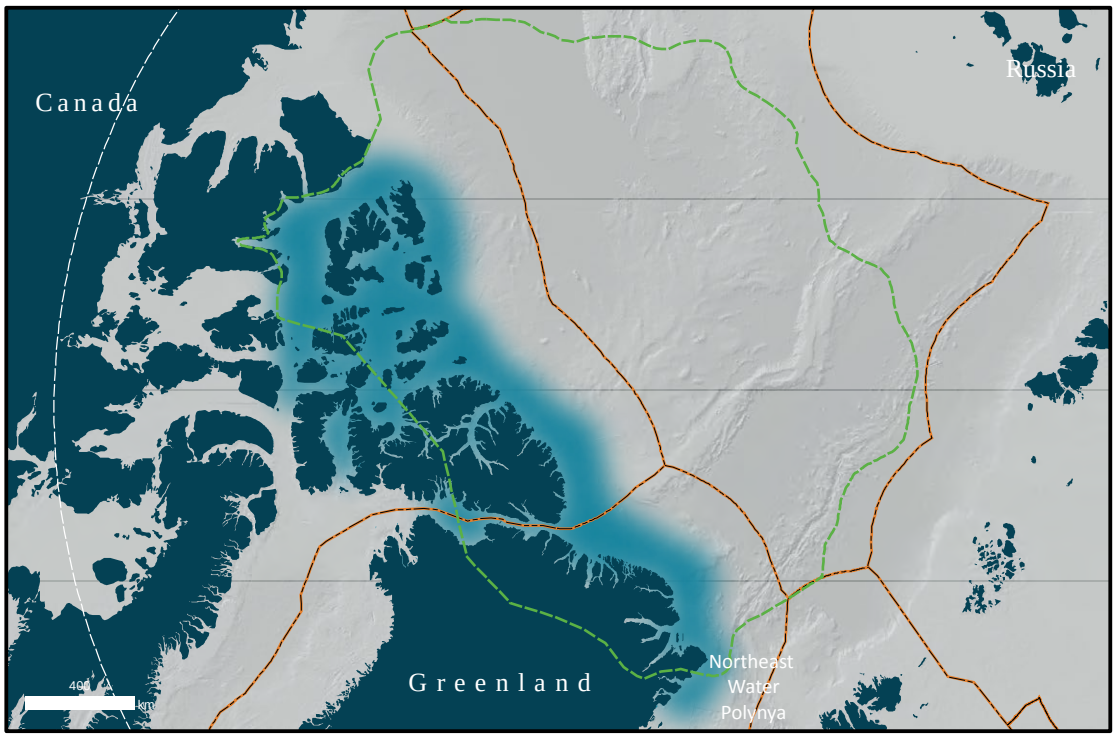
REMNANT ARCTIC MULTI-YEAR SEA ICE AND THE NORTHEAST WATER POLYNYA ECOREGION

Reviewers: Jake Rice, Francine Mercier, Bruno Tremblay, Stephanie Pfirman, Clive Tesar, Anders Mosbech, David Boertman, Tenna Boye, Tom Christensen

LOCATION

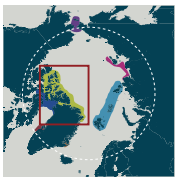
The heaviest ice conditions in the Arctic Ocean can be found to the north of mainland Canada and northwest Greenland, bordered by the Beaufort Sea to the west and Fram Strait to the east. This region of thick multi-year sea ice extends from within the northwestern Canadian Arctic Archipelago (located north of 75° N) out into the Central Arctic Ocean beyond national jurisdiction. Models of future ice distribution as the Arctic warms project that multi-year sea ice in this region is likely to persist for the longest period of time, and is expected to provide the only remaining multi-year sea ice conditions in the Arctic by mid-century.[55]



Remnant Arctic Multi-Year Sea Ice and the Northeast Water Polynya Ecoregion

- Area of Potential Outstanding Universal Value
- Recent Extent of Multi-Year Sea Ice
- Marine Boundary

Map: Marine Geospatial Ecology Lab, Duke University (2016)



The Remnant Arctic Multi-Year Sea Ice site includes the Northeast Water (NEW) Polynya ecosystem, which is situated off the coast of northeast Greenland. The polynya's maximum extent to the north can reach high latitudes up to 83° N, and to the east can occupy the entire northeast Greenland shelf.[56] To the south, the NEW Polynya is bounded by shelf ice at about 79 30'N.[57]

SITE DESCRIPTION

Wind-driven circulation in the Arctic results in a concentration of older, multi-year sea ice in the area north of the Canadian Arctic Archipelago and northern Greenland.[58] The Remnant Arctic Multi-Year Sea Ice site is defined by the waters within and adjacent to the Canadian Arctic Archipelago and northern Greenland where multiyear ice is projected to persist the longest as the Arctic transitions to ice-free summers (Figure 1).[59]

The NEW Polynya is a recurring polynya that is kept open for a major part of every year.[60] In winter, the area is covered with unstable and relatively thin ice formed locally, as well as a number of leads. The polynya begins to open in April/May and reaches its maximum extent (~45,000 square kilometers) in September.[61]

The Remnant Arctic Multi-Year Sea Ice and NEW Polynya are largely formed over the continental shelves surrounding the Canadian Arctic Archipelago and Greenland. The NEW polynya is characterized by two shallow banks: the Ob Bank to the north and connected to the shore and the Belgica Bank to the south separated from the coast by Norske Trough. Between the two banks and in the center of the polynya is the Westwind Trough.[62]

PREVIOUS RECOGNITION

The Remnant Multi-Year Sea Ice and NEW Polynya region of northern Canada/Greenland was previously identified by the following processes:

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AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Programme (AMAP). Oslo. 114 pp. *Archipelago multi-year pack ice is listed as Area 8 within Canadian Arctic Archipelago LME. Arctic Basin multi-year pack ice is listed as Area 10 within Canadian Arctic Archipelago LME. The Northeast Water Polynya is Area 1 within the Greenland Sea LME.*

CAFF, 2015. Actions for Arctic Biodiversity, 2013-2021: Implementing the recommendations of the Arctic Biodiversity Assessment. Conservation of Arctic Flora and Fauna, Akureyri, Iceland. http://www.caff.is/administrative-series/293-actions-for-arctic-biodiversity-2013-2021-implementing-the-recommendations-of-th/download *Protection of multi-year sea ice as refugia is found in action items listed on pp. 20, 22, 23.*

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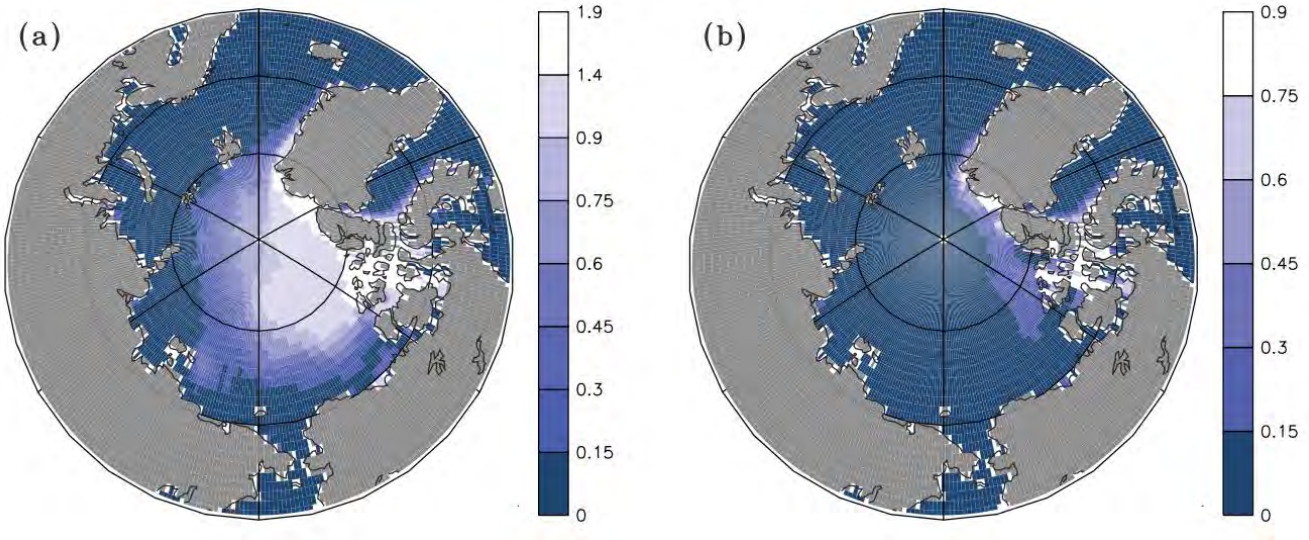

Figure 1: Mean September sea ice thickness averaged over seven selected models (a) at present and (b) by the time the Arctic is nearly sea ice free. Units are in m. Note the scale differences between a and b. (Source: Wang and Overland 2012)

Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi. 72 pp. (In Danish). http://www2.dmu.dk/Pub/SR43.pdf North East Water Polynya is ranked as Priority 2 "ecologically sensitive marine area".

Eamer, J., Donaldson, G.M., Gaston, A.J. et al. 2013. Life Linked to Ice: A guide to sea-ice-associated biodiversity in this time of rapid change. CAFF Assessment Series No. 10. Conservation of Arctic Flora and Fauna, Iceland. http://www.caff.is/assessment-series/254-life-linked-to-ice-a-guide-to-sea-ice-associated-biodiversity-in-this-time-of-ra/download *A recommendation for establishing a protected area refuge for ice-associated species in Northwest Greenland/Northeast Canadian Archipelago is made on p. 86.*

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Pfirman, S., Fowler, C., Tremblay, B. and Newton, R. 2009. The Last Arctic Sea Ice Refuge. *The Circle,* Vol. 4, pp. 6-8.

Speer, L. and Laughlin, T. (Eds). 2011. IUCN/NRDC Workshop to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment, La Jolla, California. 02-04 November 2010. 37 pp. *"Polar Pack Ice" is Super EBSA #6, and Northeast Water Polynya is Area #7.*

Portions of the Remnant Multi-Year Sea Ice site are covered by the property Quttinirpaaq, submitted by Canada on its World Heritage Tentative List in 2004. (A Tentative List is an inventory of those properties which each State Party intends to consider for nomination.)

KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VII – SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

The Beaufort Gyre and the Transpolar Drift Stream together account for the concentration of multi-year sea ice present in the Canadian Arctic Archipelago and Greenland.[63] Ice that forms or is trapped in the Beaufort Gyre may circulate for several years or more, where it can accumulate in thickness both from ice growth and from collisions between wind-driven ice floes.[64] The Transpolar Drift propels ice against the Archipelago and northern Greenland, where it stacks up and compresses, forming the thickest ice in the Arctic.[65] Once in place, the thickness and persistence of this ice is influenced by surface temperature, cloud cover, snow accumulation, oceanic heat flux, ice ridging and transport.[66] By the time the Arctic is nearly ice free in the summer, the Remnant Multi-Year Sea Ice site is expected to be the last remaining sea ice refuge, with ice still present in the summer.[67]

The Northeast Water Polynya is a striking counterpoint within the region of multi-year sea ice. The NEW Polynya is maintained as thin ice in the winter as a result of ice barriers both to the north and south of the polynya that limit heavy ice intrusion, coupled with strong and persistent northerly winds advecting sea ice away from the coast.[68] The growth of the summer polynya results from ice melt as well as ice being exported out of the polynya by a local anticyclonic gyre, with the ice barriers to the north and south again playing a role in limiting the invasion of ice.[69]

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The Remnant Multi-Year Sea Ice site is extraordinary for its concentration of multi-year sea ice communities.[70] Multi-year sea ice hosts perennial communities (i.e. it does not need to be colonized annually) of algae, bacteria, other single-celled organisms, and ice fauna, and some specialized types of algae that do not normally occur in younger sea ice.[71] As the Remnant Multi-year Sea Ice site is projected to maintain the last multi-year ice in the Arctic, it represents a globally important and unique habitat for Arctic biodiversity, particularly Arctic endemic species, under changing environmental conditions. Additionally, the area will serve a refuge for biological processes dependent on permanent ice and its fringe of seasonal ice.

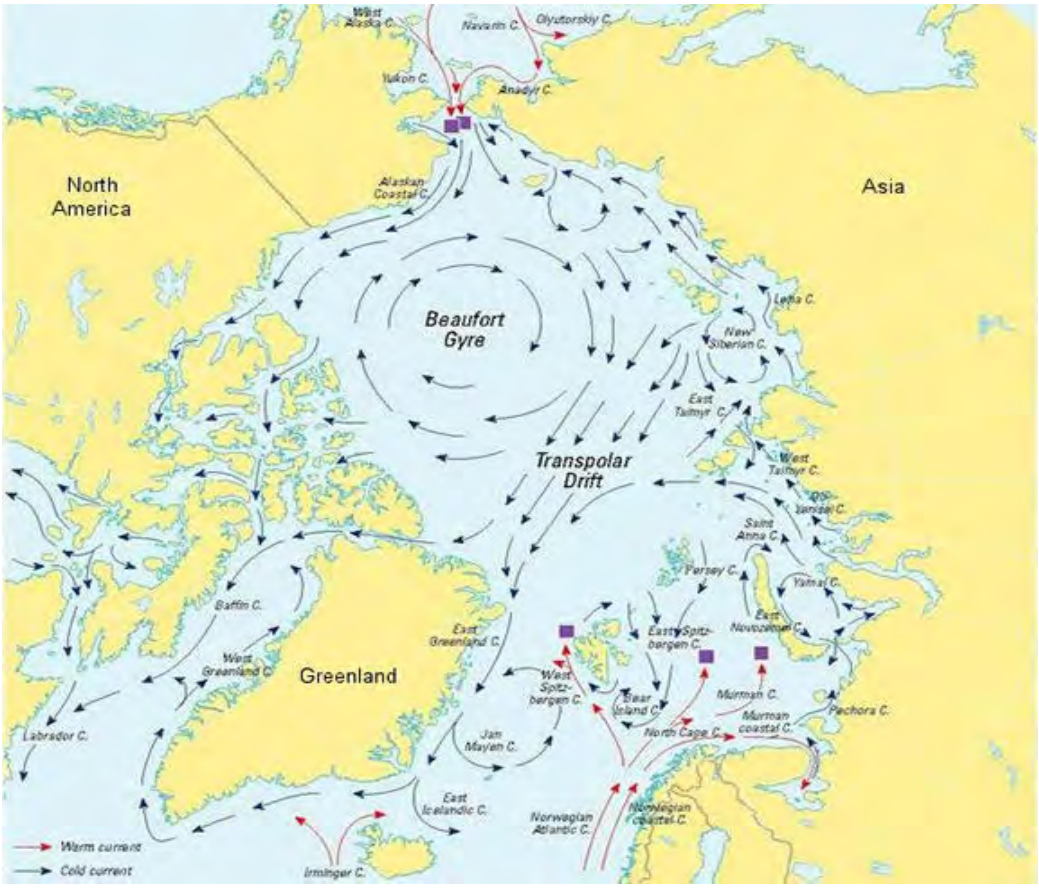

Figure 2: The anticyclonic Beaufort Gyre and the Transpolar Drift push ice against northern Greenland and the Canadian Arctic Archipelago. (Source: AMAP)

CRITERION X – SIGNFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

Birds

The largest known breeding colony of ivory gull (*Pagophila eburnea*) in Greenland is found on the Henrik Kroyer Holme islands within the NEW Polynya.[72] Additionally, there are several colonies on adjacent land areas and there have even been colonies located on gravel covered ice floes and ice bergs.[73] The New Polynya is considered a key-area for the small and threatened population of ivory gull.[74] Other species important in a conservation context breeding in the area include Sabine's gull (*Xema sabini)* and light bellied brent goose (*Branta bernicla)*.

The northernmost breeding colonies of black-legged kittiwake (*Rissa tridactyla)* and northern fulmar (*Fulmarus glacialis)* are found along the coastline of the NEW polynya.[75] In spring, the shallow coasts provide important habitat for staging king and common eiders (*Somateria spectabilis* and *mollissima*), and thousands are found there in May/June.[76] These birds represent probably the entire breeding population of northern East Greenland. The islands of Henrik Krøyer and the low coast of Kilen are important habitats for breeding Arctic terns (*Sterna paradisaea*), common eiders, Sabine's gulls (*Xema sabini*) and light bellied brent geese.[77]

Marine mammals

The NEW polynya may be one of the most important summering grounds for the critically endangered Spitsbergen stock of bowhead whale (*Balaena mysticetus).*[78] Recent observations have noted the largest abundance of bowhead whales reported from the Greenland Sea in centuries in the polynya. High numbers of Atlantic walrus (*Odobenus rosmarus)* rest on the coast and on ice floes in summer.[79] It is the most important calving area for the NE Greenland stock of walrus and there is an important terrestrial haul-out site in Dijmphna Sund.[80] In winter the polynya is also important to walruses, especially the females.[81] Polar bears (*Ursus maritimus*) roam the ice edges and ice fields surrounding the polynya.[82] Narwhals (*Monodon monoceros)* assemble along the ice edge of the semi-permanent ice barrier to the south.[83] Ringed seals (*Pusa hispida)* and bearded seals *(Erignathus barbatus)* are common in the polynya.[84]

The thick, permanent ice found in the Remnant Arctic Multi-Year Sea Ice site, along with first year ice present between multi-year ice floes, make this area good habitat for ice seals and polar bears.[85] It is thought to have the greatest likelihood of sustaining polar bears through the 21st century,[86] along with its main prey, ice dependent seals, especially ringed seals.[87] At times of the year when this area contains the only significant concentration of sea

ice in the Arctic, it may also be used by other ice-associated species such as narwhals, whose major populations are currently found on the fringes of this area.[88]

Other

Though biological observations of species that live in or under the ice is limited in this site, multi-year ice is thought to be important for long-lived ice amphipods (e.g., *Gammarus wilkitzkii*) and diatoms (e.g. *Melosira arctica*), which are typically associated with Arctic under-ice communities.[89] It is known that polar cod (*Boreogadus saida*) are closely associated with ice, although little is known about its distribution under multi-year ice.[90]

Threatened and endangered species at this site:

Common Name (Latin name)	Conservation Status
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable)[91] • Canada Species at Risk Act (special concern)[92]
Bowhead whale (*Balaena mysticetus)* Spitsbergen stock	• IUCN Red List (critically endangered)[93]
Ivory gull (*Pagophila eburnea*)	• IUCN Red List (near threatened)[94] • Canada Species at Risk Act (endangered)[95] • Greenland Red List (vulnerable)[96]
Atlantic walrus (*Odobenus rosmarus rosmarus)*	• IUCN Red List (vulnerable)
Narwhal (*Monodon monoceros)*	• IUCN Red List (near threatened)[97]
Common eider (*Somateria mollissima)*	• IUCN Red List (near threatened)

The Remnant Arctic Multi-Year Sea Ice site is expected to provide the only remaining multi-year ice conditions in the Arctic by mid-century, according to modeled projections.[98] Many species in ice communities depend on sea ice over all or part of their life cycle. Uncertainty persists regarding the ability of ice-dependent species to adapt to changes in sea ice extent and characteristics.[99] Yet, safeguarding the Remnant Arctic Multi-Year Sea Ice site would provide a refuge for Arctic biodiversity, particularly Arctic endemic species, under changing environmental conditions.[100]

MAJOR THREATS

Climate Change & Loss of Sea Ice

Large inter-annual variations in ice properties have been observed in the Canadian Arctic,[101] with a broad trend of long-term reductions in age and thickness of sea ice in the Canadian Arctic Archipelago.[102] Because sea ice often thickens over time due to under-ice accretion and ridging, multiyear ice tends to be thicker and can withstand more prolonged melting.[103] However, in the past decade, multi-year sea ice was reduced at three times the rate that had been the norm in the previous three decades.[104]

The Beaufort Gyre has recently played a role in Arctic sea ice loss. In the past, ice within the Gyre circulated for years within the Arctic Basin while it aged and thickened. However, in recent years, ice typically has not survived the transit through the southern portions of the Beaufort Gyre.[105] Under warming conditions, the Gyre is aiding in the transition to a younger and smaller extent of multi-year sea ice. Furthermore, a warmer Arctic with less ice will promote export of freshwater stored in the Beaufort Gyre out of the Arctic into the Greenland Sea via Fram Strait and the Canadian Archipelago, potentially impacting deep water formation and global climate.[106]

Shipping

The Northwest Passage (NWP) has seen increased vessel transits over the past three decades, especially since 2008.[107] An increase of shipping traffic through the NWP has the potential to cause significant impacts on the Arctic environment and its people.[108] Shipping accidents that release oil pollutants may impact the multi-year ice in ways that are particularly damaging due to the long-time scales of the system dynamics inherent in these ecosystems. The introduction of new species (invasive species) resulting from increased shipping in waters near the Remnant Arctic Multi-Year Sea Ice and NEW Polynya might eventually affect its species and ecosystems.

PROTECTION AND MANAGEMENT STATUS

Jurisdiction

The Remnant Arctic Multi-Year Sea Ice site includes waters within the Exclusive Economic Zones (EEZ) of both Canada and Greenland (Kingdom of Denmark), and extends northward into the area beyond national jurisdiction. Ice-covered areas beyond national jurisdiction are subject to requirements contained within the United Nations Convention on the Law of the Sea (UNCLOS).[109] The Northeast Water Polynya is located entirely within the Exclusive Economic Zone (EEZ) of Greenland.

Protected Areas

In the Remnant Arctic Multi-Year Sea Ice site, 2,400 km^2 of marine waters are protected within Quttinirpaaq National Park on Ellesmere Island, and an additional 1200 km^2 in Qausuittuq National Park on Bathurst Island.[110]

The area within the three nautical miles zone off the coast in the Northeast Water Polynya and north of Greenland is part of the National Park of North East Greenland and are protected, as are the adjacent land areas. Kilen and the coastal part of the polynya are designated as "area important to wildlife" where activities related to exploration for minerals and petroleum are regulated to minimize impacts on wildlife.[111] Additionally, Birdlife International has recognized Kilen and Henrik Krøyer Holme as Important Bird Areas.[112]

Shipping

The Canadian Ice Service provides historical and current sea ice data about Canada's navigable waters in the Arctic.[113] At this time, there is little to no shipping at this site.

Greenlandic legislation applies the "generally accepted international rules and standards" adopted by the IMO (European Commission 2010).

Arctic shipping in Canada is governed by the following Acts and regulations: [114]

- Arctic Waters Pollution Prevention Act
- Canada Shipping Act of 2001 and Navigation Safety Regulations
- Marine Liability Act
- Marine Transportation Security Act
- Charts and Nautical Publications Regulations of 1995

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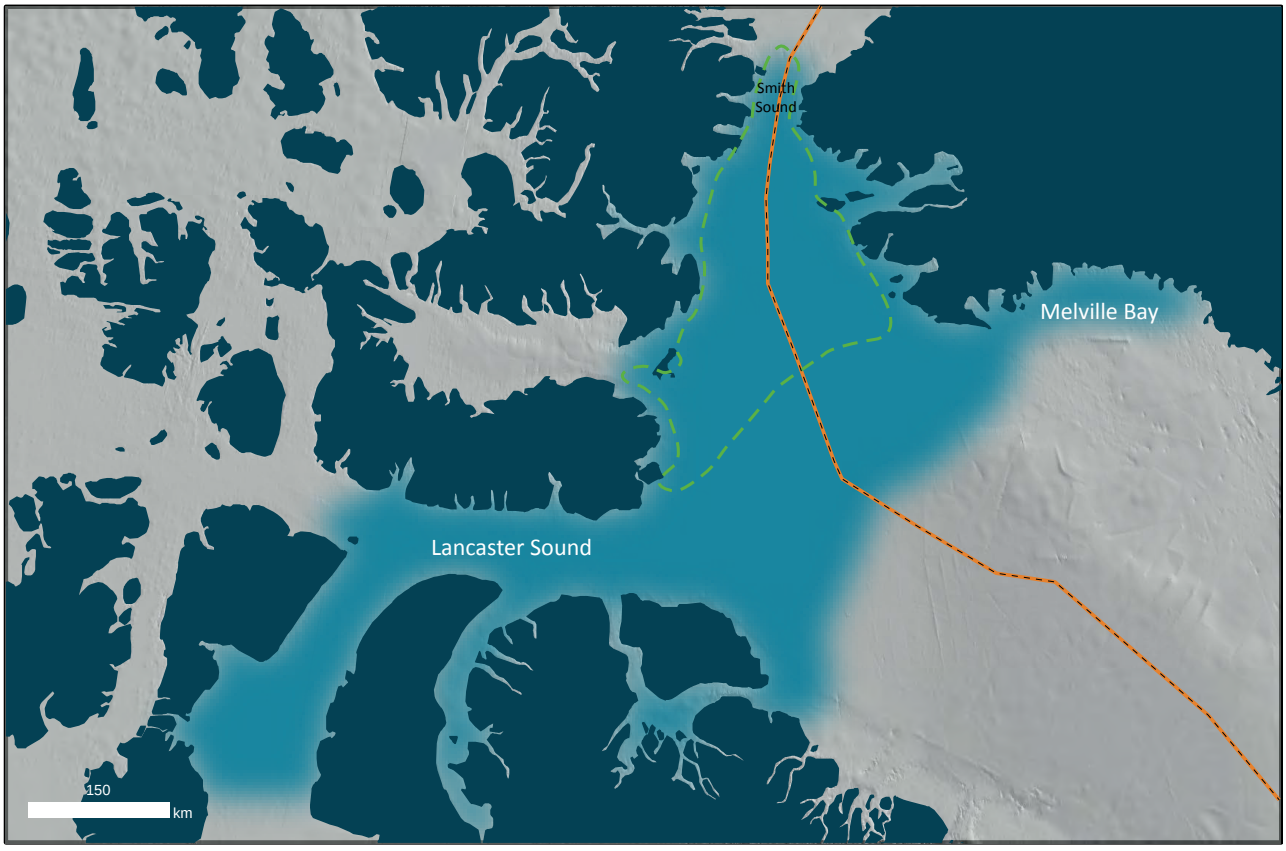
THE NORTHERN BAFFIN BAY ECOREGION

Reviewers: Francine Mercier, Anders Mosbech, Tom Christensen, David Boertmann, Tenna Boye, Jake Rice

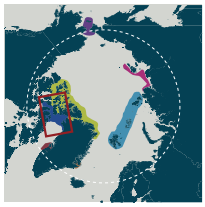
LOCATION

The North Water Polynya (*Pikialasorsuaq)* lies between Greenland and Canada in Smith Sound in northern Baffin Bay, with an approximate range of 76°N to 79°N and 70°W to 80°W.[115] Lancaster Sound *(Tallurutiup Tariunga),* located in Canadian waters south of Devon Island at approximately 74° N 84° W, sits at the eastern entrance of the Northwest Passage. Melville Bay (*Qimusseriarsuaq*), located at approximately 75.75° N, 61° W, is located southeast of the North Water Polynya along the northwest coast of Greenland. The North Water Polynya, Smith Sound, Lancaster Sound and Melville Bay comprise the Northern Baffin Bay Ecoregion.



The Northern Baffin Bay Ecoregion

- Area of Potential Outstanding Universal Value
- Marine Boundary
- North Water Polynya - Spring extent



Map: Marine Geospatial Ecology Lab, Duke University (2016)

SITE DESCRIPTION

The North Water Polynya is the largest recurrent polynya in the Canadian/Greenlandic Arctic,[116] ranging from 50,000 to 80,000 square kilometers situated mainly in Smith Sound, and is the most northerly polynya of its size.[117] Its formation is controlled in part by the annual formation of an ice bridge in the narrow channel of Nares Strait, below Kane Basin.[118] Lancaster Sound is connected to the North Water Polynya through Baffin Bay. Melville Bay is oceanographically connected to the North Water Polynya via Baffin Bay.

PREVIOUS RECOGNITION

The North Water Polynya, Lancaster Sound and Melville Bay were previously identified as significant by the following reports and workshops:

AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Programme (AMAP). Oslo. 114 pp. *North Water is Area 1 within Baffin Bay-Davis Strait LME, Lancaster Sound is Area #3 within Beaufort Sea LME, and Melville Bay listed as Area #5 within Baffin Bay-Davis Strait LME.*

Speer L. and Laughlin T. (Eds). 2011. IUCN/NRDC Workshop to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment, La Jolla, California. 02-04 November 2010. 37 p. *North Water/Lancaster Sound is Area #7.*

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Fisheries and Oceans Canada. 2011. Identification of Ecologically and Biologically Significant Areas (EBSA) in the Canadian Arctic. Canadian Science Advisory Secretariat Science Advisory Report 2011/055. *North Water Polynya is Area 2.14 and Lancaster Sound is Area 2.6.*

Boertmann, D. and Mosbech, A. (Eds). 2011. Eastern Baffin Bay. A strategic environmental impact assessment of hydrocarbon activities. DCE – Danish Centre for Environment and Energy, Aarhus University, Roskilde. DCE Scientific Report No. 9, 270 pp.

Annex to the report of the CBD Arctic EBSA workshop includes a strong case for the North Water Polynya being an EBSA, based wholly on indigenous knowledge and written wholly by indigenous people.

KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VII – SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

The North Water Polynya evolves seasonally,[119] as both sensible heat (either from the ocean or the atmosphere) and latent heat (new ice formation and wind-driven removal) mechanisms contribute to the opening and maintenance of the polynya.[120] Formation is influenced by a strong southward flow of cold water and ice from the Arctic Ocean, and a modest flow of warmer Atlantic water directed from the southeast by the West Greenland Current.[121] The recurrent open water is primarily maintained by the prevailing strong northerly wind that clears the area to the south of newly formed sea ice.[122] There is strong agreement that the existence of the North Water Polynya depends on the formation of a seasonally recurrent ice bridge that develops between Greenland and Ellesmere Island, where the main driving mechanism is the wind-forced advection of sea ice downwind of the ice bridge.[123]

The annual retreat and advance of sea ice indirectly influences biotic and abiotic sedimentation by altering irradiance levels, stratification and the habitat for primary producers.[124] Additionally, the advection of ice from the polynya by wind and currents, along with inflow of warm water beneath the polynya and upwelling of heat from this inflow to the surface layer, together create unique oceanographic conditions.[125] Similar conditions are evident in the northern Baffin Bay complex of polynyas which are linked to the North Water Polynya. Polynyas like the North Water are likely "sentinels of the effects of recent change in ice climate."[126]

The North Water Polynya ecosystem extends southward into Lancaster Sound, as a flaw lead with variable amounts of thin ice or ice-free water.[127] Polynyas which form near Coburg Island in Jones Sound, adjacent to Bylot Island in Lancaster Sound and within Lancaster Sound itself are joined by leads to the North Water Polynya and eventually join up with the latter, forming a complex of polynyas in Northern Baffin Bay.[128] The ocean currents of Lancaster Sound are dominated by southward and eastward flow out of the Polar Basin into Baffin Bay, and

the counterclockwise current in north Baffin Bay gives rise to large eddies at the mouth of the Sound.[129]

At a broader scale, the Northern Baffin Bay Ecoregion derives water from the Pacific, Arctic, and Atlantic Oceans. The distribution and structure of these water masses may vary with surface forcing, topographically-induced mixing, and bottom water friction, which in turn may influence nutrient source and availability, primary production, and the length and timing of the sea-ice seasons.[130]

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The North Water Polynya is one of the most productive marine environments in the entire Arctic and North Atlantic,[131] if not the entire Northern Hemisphere.[132] Upwelling during polynya events plays an important role in phytoplankton blooms in the early spring.[133] This exceptionally high level of primary production sustains a variety of copepods (*Calanus spp.*), which in turn support predators further up the trophic web.[134] The production and southward transportation of sea ice also brings water and nutrients to the surface, which helps create a highly productive food web.[135]

Relative to other areas in the Canadian Arctic, Lancaster Sound has a high rate of productivity, estimated at 60 gCm^{-2} fixed annually, primarily in the form of phytoplankton.[136] The North Water Polynya and Lancaster Sound constitute hot spots of ecosystem functioning, with pelagic-benthic coupling and recycling of nutrients at the seafloor[137] and from the strong East Ellesmere current.[138] Lancaster Sound plays a crucial role as a migration corridor and summer aggregation area for huge numbers of seabirds and marine mammals.[139]

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

Fish

Polar cod (*Boreogadus saida*) are numerous in the region, channeling the energy flux between plankton and vertebrates.[140] Polar cod in all life stages can be found year-round in Lancaster Sound.[141]

Birds

The North Water Polynya supports high numbers of seabirds, dominated by a colony of tens of millions of little auks (*Alle alle*) in Northern Greenland, which time their arrival to coincide with the availability of copepods.[142] This returning colony of little auks is the largest single-species aggregation of marine birds anywhere on earth, corresponding to approximately 80% of the global population.[143] The polynya may also be a crucial feeding ground for ivory gulls (*Pagophila eburnea)* at the northernmost extent of the range during breeding season.[144] Black guillemot (*Cepphus grille*), black-legged kittiwake (*Rissa tridactyla*), thick-billed murre (*Uria lomvia*), and glaucous gull (*Larus hyperboreus*) are other common species in the region.[145]

Many seabird colonies are also concentrated in and around Lancaster Sound,[146] including those of ivory gulls[147] as well as thick-billed murres, northern fulmars (*Fulmarus glacialis*), and black-legged kittiwakes.[148] Outer Melville Bay serves as a migration corridor for many seabirds. In early spring, the partially open waters in the outer Bay act as an extension of the ice break-up zone, which is important to thick-billed murres during migration to their breeding grounds in the North Water Polynya.[149] One of Greenland's largest colonies of Sabine's gull (*Xema sabini)* is in the Melville Bay nature reserve,[150] adjacent to the North Water Polynya.

The Northern Baffin Bay Ecoregion supports a significant proportion of the populations of several seabird species for breeding and migration including thick-billed murre (27% Canadian population), northern fulmar (40% Canadian population), black-legged kittiwake (40% Canadian population) and little auk.[151]

Marine Mammals

The open water of the polynya also provides vital feeding areas for several species of marine mammals. An aerial survey of top predators documented an abundance of belugas (*Delphinapterus leucas*), narwhals (*Monodon monoceros*), and Atlantic walruses (*Odobenus rosmarus*) within the polynya.[152] Bearded (*Erignathus barbatus*) and ringed seals (*Phoca hispida*) used the large floes of ice in the southeastern part of the North Water Polynya for hauling out, and polar bears (*Ursus maritimus*) and bowhead whales (*Balaena mysticetus*) were detected in the southern part of the polynya.[153]

Lancaster Sound is an important migration corridor for a variety of marine mammals, including bowhead whale, narwhal, beluga, killer whales (*Orcinus orca*), and seals, and is an important summering ground for belugas and narwhal.[154] Lancaster Sound also contains a high density of polar bears.[155]

Melville Bay, adjacent to the North Water Polynya area, provides critical habitat for Baffin Bay populations of narwhals and polar bears, and the inner parts of the Bay are an important breeding area for ringed seals.[156]

Threatened and Endangered species present in the Northern Baffin Bay Ecoregion:

Common name *(Latin name)*	**Conservation Status**
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable) • Greenland Red List (vulnerable) • Canada Species at Risk Act (special concern)
Narwhal (*Monodon monoceros)*	• IUCN Red List (near threatened)[160] • Greenland Red List (critically endangered)
Beluga (*Delphinapterus leucas)*	• IUCN Red List (near threatened) • Greenland Red List (critically endangered)
Bowhead whale (*Balaena mysticetus)* Eastern Canada-West Greenland Stock	• IUCN Red List (least concern) • Greenland Red List (near threatened)
Atlantic walrus (*Odobenus rosmarus rosmarus)*	• IUCN Red List (vulnerable) • Greenland Red List (endangered)
Common eider (*Somateria mollissima)*	• IUCN Red List (near threatened) • Greenland Red List (vulnerable)
Atlantic puffin (*Fratercula arctica)*	• IUCN Red List (vulnerable) • Greenland Red List (near threatened)
Ivory gull (*Pagophila eburnea)*	• IUCN Red List (near threatened) • Canada Species at Risk Act (endangered)[161] • Greenland Red List (vulnerable)
Black legged kittiwake (*Rissa tridactyla*)	• IUCN Red List (least concern) • Greenland Red List (vulnerable)
Sabine's gull *(Xema sabini)*	• IUCN Red List (least concern) • Greenland Red List (near threatened)
Arctic tern (*Sterna paradisaea)*	• IUCN Red List (least concern) • Greenland Red List (near threatened)
Thick-billed murre (*Uria lomvia)*	• IUCN Red List (least concern) • Greenland Red List (vulnerable)

More broadly, the Northern Baffin Bay Ecoregion is of critical importance to most of the global population of narwhal,[157] the entire Eastern High Arctic/Baffin Bay beluga population,[158] and a significant proportion of the Eastern Canada-West Greenland bowhead whale population.[159]

In Canada, the independent Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has made the following (non-legally binding) findings of conservation status:

- Ivory gull (*Pagophila eburnea)*: endangered[162]
- Narwhals (*Monodon monoceros*) (Baffin Bay population): special concern[163]
- Belugas (*Delphinapterus leucas)* (Eastern High Arctic/ Baffin Bay population): special concern[164]
- Bowhead whale (*Balaena mysticetus*) (Eastern Canada-West Greenland population): special concern[165]
- Orca whales (*Orcinus orca*) (Northwest Atlantic/ Eastern Arctic population): special concern[166]
- Polar bear (*Ursus maritimus)*: special concern[167]
- Atlantic walrus (*Odobenus rosmarus rosmarus)*: special concern.[168]

MAJOR THREATS

Climate Change and Loss of Sea Ice

The Northern Baffin Bay Ecoregion is a climate-sensitive area,[169] and the potential alteration or disappearance of the North Water Polynya as a result of climate change has profound implications for the entire ecosystem.[170] A continued decline in Arctic sea ice will likely cause major changes in its use by marine top predators, which is further complicated by differences in vulnerability. It is expected that these climate change effects will decrease the stock of the Baffin Bay population of polar bears.[171] Shrinking ice cover and earlier break-up of sea ice has been observed in the outer parts of Melville Bay in recent decades.[172] If the ice bridge at the southern boundary on the polynya ever fully disappears, it could result in a significant strengthening of flow of cold, fresh Arctic waters southward, and strengthening of the Labrador Current, with profound implications for the oceanography of the whole Northwest Atlantic. However, the mixing of Pacific, Arctic and Atlantic waters, combined with warm water upwellings, ensures that the Northern Baffin Bay Ecoregion will remain a vitally important part of the Arctic.

Shipping

Lancaster Sound is a part of the Northwest Passage (NWP), which extends along the northern North American coast and through the Canadian Arctic Archipelago. The NWP was completely free of ice for the first time in recorded modern history in September 2007, allowing unhindered ship navigation.[173] An increase in shipping in the NWP will likely lead to an increase in built infrastructure, such as deep water ports. This is an important consideration because the creation of additional infrastructure will likely foster even more shipping, tourism, and development. The 2009 Arctic Marine Shipping Assessment identified Lancaster Sound as an area vulnerable to new developments in shipping.[174] Adverse impacts associated with shipping activity include the discharge of pollutants into the marine environment, invasive species, and the disruption or disturbance of migratory patterns of wildlife.[175] Narwhals and belugas are sensitive to noise and disturbance caused by shipping in the North Water region.[176] Continued change in sea ice conditions will alter the timing and movements of the whales, making predictions of the potential interactions between shipping and animals increasingly complex.[177]

Oil Exploration

Parts of the Northern Baffin Bay Ecoregion fall within the KANUMAS (Kalaallit Nunaat Marine Seismic) West area, which the Bureau of Minerals and Petroleum of Greenland opened to exploratory activities in 2007.[178] Additionally, a number of licenses bordering the Ecoregion have been granted, but as of yet the main activity has been seismic surveys in this area.[179] It is expected that the licenses will be returned (and activities terminated) in 2017. According to its 2014-2018 oil and mineral strategy, the Government of Greenland will encourage oil exploration activities in different regions of Greenland by offering new license areas on a continuous basis.[180] In the period from 2014 to 2018, the Government of Greenland will conduct licensing rounds or open door procedures for areas of particular geological interest, including Baffin Bay (2016/2017) and Davis Strait west of Nuuk (2018).[181] The major threats from exploration are disturbance and displacement of fish and marine mammals due to seismic surveys and drilling, the release of drilling mud and cuttings, and the risk of oil spills from blowouts during exploratory or production drilling.[182] In Canada, the only existing petroleum exploration permits are in a single large block at the entrance to Lancaster Sound. Granted in the 1970s, these permits – and all other petroleum activity in this part of the Canadian Arctic – have been under a de facto drilling moratorium, a decision reached following Inuit and Canadian public opposition and which remains in effect to this day.

PROTECTION AND MANAGEMENT STATUS

National Jurisdiction

Melville Bay is located entirely within the Exclusive Economic Zone (EEZ) of Greenland, governed by autonomous self-rule under the Kingdom of Denmark. Lancaster Sound is located entirely within the EEZ of Canada, but has been a contentious area for many years, due to disagreements over indigenous land claims.[183]

Canada and Greenland share jurisdiction in the North Water Polynya, which has implications for international conservation and management of marine mammals and seabirds.[184] Consequently, the "Agreement between the Government of Canada and the Government of the Kingdom of Denmark for Cooperation Relating to the Marine Environment" a bilateral treaty signed in 1983 between Canada and Denmark, is of importance to joint-management of this region. The Agreement aims to develop "cooperation in respect of the protection of the marine environment," especially regarding "preparedness measures as a contingency against pollution incidents."[185] The Agreement includes Joint Contingency Plans for pollution resulting from hydrocarbon exploration and shipping activities. Greenland and Canada have also established a bilateral management body, the Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga, which provides conservation and management advice to guide whaling activities related to shared stocks of these two species.[186]

Marine Protections

The Melville Bay coastal area is protected as a nature reserve by Greenland.[187] In the nature reserve, all hunting, fishing, egg collecting, passage, sailing or air transport below the altitude of 500 meters, is prohibited.[188] However, permanent resident hunters in either Upernavik or Avanersuaq may continue traditional hunting and fishing in the area between Protection Border I and Protection Border II.

In Canada, a large portion of Lancaster Sound is a proposed national marine conservation area.[189] If established, exploration and development of oil and gas will be prohibited.[190] Sirmilik National Park of Canada protects coastal areas at the mouth of Lancaster Sound, including a marine component of 220 square kilometers, and includes the Bylot Island Migratory Bird Sanctuary, one of several Important Bird Areas (IBAs) in the region identified by BirdLife International.[191] The Canadian Government has also identified numerous key marine habitat sites for migratory birds in the North Water Polynya and Lancaster Sound area.[192]

Shipping Regulations

Arctic shipping in Canada is governed by several pieces of legislation,[193] including the Arctic Waters Pollution Prevention Act, the Canada Shipping Act, the Marine Liability Act, and the Marine Transportation Security Act. In terms of shipping, Greenlandic legislation applies the "generally accepted international rules and standards" adopted by the IMO.[194] Sailing or passage through the Melville Bay Nature Reserve is prohibited.[195]

Subsistence Harvesting

Both regions are important areas for indigenous subsistence harvests. Quotas for the harvest of marine mammals in the Greenland part of the North Water Polynya and Melville Bay are set by the Greenland Government,[196] while the Nunavut Wildlife Management Board, in collaboration with the Canadian Government, is responsible for setting quotas in Canadian waters within the region, including Lancaster Sound. The Canada-Greenland Joint Commission on Beluga and Narwhal provides advice and recommendation to the appropriate authorities of both countries on the conservation and management of narwhal and beluga shared stocks, which aids in the sustainable management of the shared stocks.[197]

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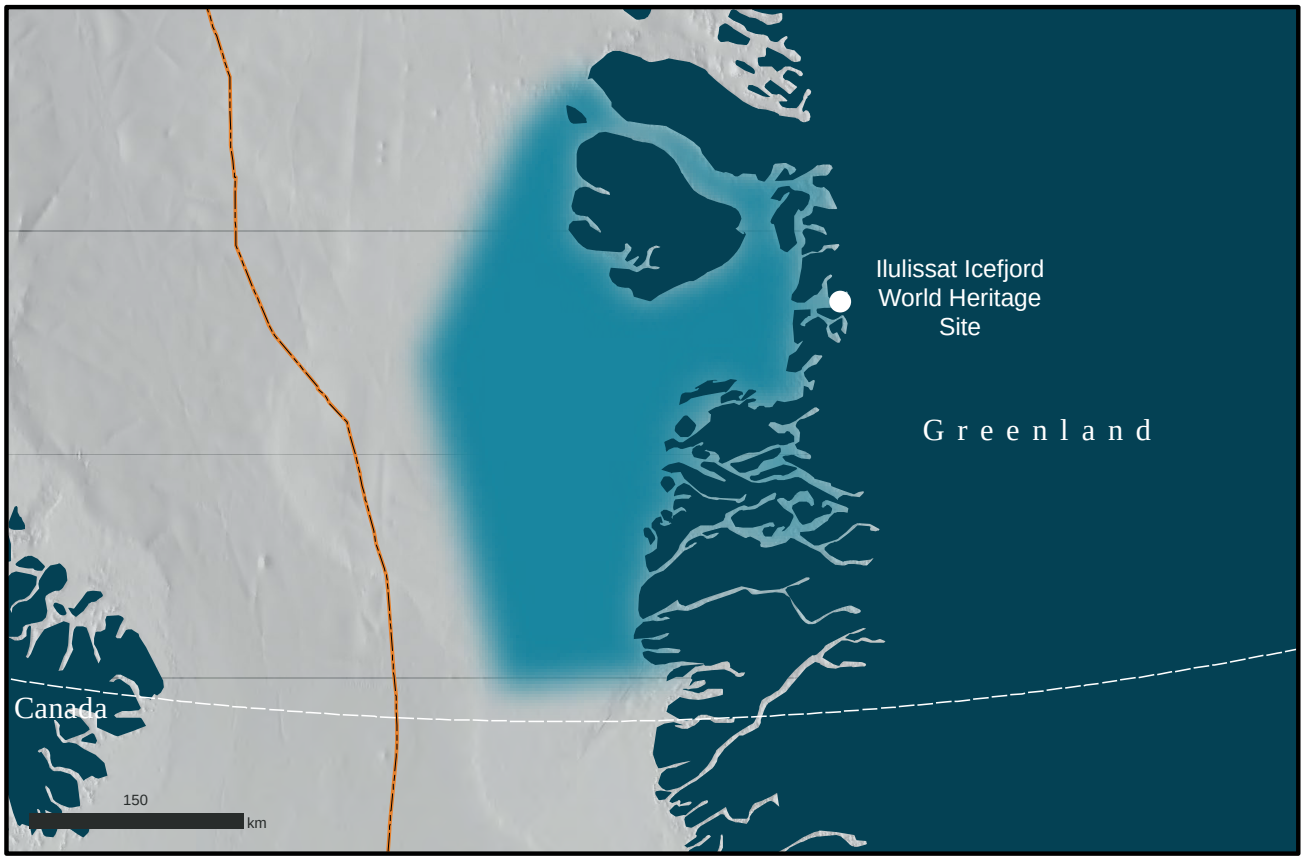
DISKO BAY AND STORE HELLEFISKEBANKE ECOREGION

Reviewers: Tom Christensen, Anders Mosbech, Tenna Boye and David Boertmann

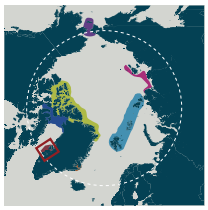
LOCATION

The Disko Bay and Store Hellefiskebanke Ecoregion is located off central West Greenland between approximately 67° 30' N and 71° N.[198] The area is composed of a large bay and shallow offshore bank on the West Greenland Shelf of the Davis Strait/Baffin Bay. The Disko Bay is delineated by the Greenland mainland to the south, east and north, while to the west the large island of Disko divides the opening of the bay into a narrow northern strait (the Vaigat) and a wide opening in the south to the Baffin Bay. The shelf to the west of the bay – Disko Bank – is also included. The Jakobshavn Glacier (*Sermeq Kujalleq*) through the Ilulissat Icefjord (already a UNESCO World Heritage Site) are also significant features of the ecoregion, contributing enormous fresh water input.



Disko Bay and Store Hellefiskebanke Ecoregion

- Area of Potential Outstanding Universal Value
- Marine Boundary



Map: Marine Geospatial Ecology Lab, Duke University (2016)

SITE DESCRIPTION

The Store Hellefiskebanke and Disko Bay are connected, with the West Greenland Current transporting relatively warm Atlantic water from the south across the bank and partly into Disko Bay. This Atlantic water keeps the coastal waters north to 67° free of winter ice. Sea ice usually covers the rest of the area from January to April, although the extent of this ice has decreased in recent decades. There are several small polynyas along the coast in winter, for example in the mouths of the large fjords Arfersiorfik and Nordre Strømfjord and off West Disko. On the eastern side of Disko Bay, the most productive glacier on the northern hemisphere – Jakobshavn Glacier (*Sermeq Kujalleq*) – produces numerous icebergs, which are carried across the bay to the Vaigat and along the south coast of Disko Island and further on to Baffin Bay.

The Store Hellefiskebanke is one of the largest offshore shelf areas in the Greenland part of Davis Strait. It covers approx. 30,000 km^2 and an estimated third of this has water depths below 50 m. The Disko Bay covers approx. 20,000 km^2 (Disko Bank inclusive) has a deep central part surrounded by shallow coastal waters.

PREVIOUS RECOGNITION

Disko Bay and Store Hellefiskebanke were previously identified as significant by the following reports and workshops:

AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Programme (AMAP). Oslo. 114 pp. *Disko Bay and Store Hellefiskebanke is listed as Area 8 within the Baffin Bay-Davis Strait LME.*

Speer L. and Laughlin T. (Eds). 2011. IUCN/NRDC Workshop to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment, La Jolla, California. 02-04 November 2010. 37 p. *Disko Bay and Store Hellefiskebanke is listed as Super EBSA #8.*

Christensen, T., Falk, K., Boye, T., Ugarte. F., Boertmann, D., and Mosbech, A. 2012. Identifikation af sårbare marine områder i den grønlandske/danske del af Arktis. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi. 72 pp. (In Danish). *Disko Bay/Store Hellefiskebanke is listed as Area 5, a priority 1 "ecologically sensitive marine area."*

Christensen, T., Mosbech, A., Geertz-Hansen, O., Johansen, K.L., Wegeberg, S., Boertmann, D., Clausen, D.S., Zinglersen, K.B. & Linnebjerg, J.F. 2015. Analyse af mulig økosystembaseret tilgang til forvaltning af skibstrafik i Disko Bugt og Store Hellefiskebanke. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi, 102 s. - Teknisk rapport fra DCE - Nationalt Center for Miljø og Energi nr. 61 http://dce2.au.dk/pub/TR61.pdf

KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

Arctic waters and Atlantic waters transported northwards in the West Greenland Current are the two major sources of subsurface waters in the Disko Bay region.[199] As in many parts of the Arctic, annual sea ice cover influences stratification, nutrient availability, water temperature, and productivity during the spring phytoplankton bloom.[200] The banks of Store Hellefiskebanke and the related upwellings have a major influence on wintering and migrating seabirds and marine mammals.[201] Upwelling events inside the Disko Bay and along the west coast of Disko Island are mainly wind driven during northerly and north-westerly winds.[202]

The Jakobshavn Glacier and the connected icefjord (already a UNESCO World Heritage Site due to the presence of massive ice calving from the Sermeq Kujalleq) are also significant features of the ecoregion, contributing enormous fresh water input.

The vertical structure of water masses in Disko Bay involves at least three layers:[203] a thin surface layer with fresh water from glacial melt and runoff with significant seasonal temperature changes; an intermediate layer of cold polar water and a deep layer comprised warmer and saltier Atlantic waters.[204]

The geology of the adjacent land areas shows marked differences. Disko Island and Nuussuaq Peninsula are dominated by sedimentary rocks and tertian basalts, resulting in long, straight coastlines, while the parts to the east and south of Disko Bay are gneissic bedrock with extensive archipelagoes and many narrow straits and fjords. There are a couple of discrete archipelagoes in the southern part of the bay and in the wide entrance to the south of Disko Island.

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The cycle of primary production in Disko Bay is highly pulse-like in nature, which is characteristic for Arctic marine ecoregions.[205] Tide-driven upwelling creates very high biological productivity in the spring, creating favorable breeding conditions for many marine mammals and seabirds.[206] At sites where upwelling or fronts continuously bring nutrients to the uppermost water layers, primary production may remain high throughout the summer. [207] Besides enhanced primary production, these upwelling areas may also retain copepods and other plankton over the banks.[208] Feeding conditions of herbivorous copepods are a critical component in the link between sea ice and the production of fisheries resources.[209] The area provides important connectivity for the cetaceans in Disko Bay with the rest of the Baffin Bay-Davis Strait areas.

Ice melt in the spring enhances stratification of the water column. This results in a productive phytoplankton bloom, which again supports a multitude of zooplankton, such as the ecological key component, the copepods of the genus *Calanus.*[210] Primary production is also enhanced by upwelling along the edges of Store Hellefiskebanke,[211] and local current phenomena contribute to retain waters with high nutrient contents on the bank. Other essential zooplankton species in the region are the crustaceans krill and *Parathemisto*. Benthos, fish, seabirds and marine mammals benefit from this rich secondary production of zooplankton.[212]

The fauna on the seabed (benthos) of Store Hellefiskebanke is very rich, with high densities (average 3300 indvs m^{-2} at 500-100 m depths) and number of species (> 600), which is why the area is characterized as a biodiversity hotspot.[213]

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

Parts of the Disko Bay and Store Hellefiskebanke are biodiversity hot spots with many arctic species present.[214]

Birds

The Disko Bay and Store Hellefiskebanke Ecoregion has a high diversity of breeding seabirds, including thick-billed murre (*Uria lomvia*), black-legged kittiwake (*Rissa tridactyla*), great cormorant (*Phalacrocorax carbo*), northern fulmar (*Fulmarus glacialis*), Atlantic puffin (*Fratercula arctica*), little auk (*Alle alle*) and the rare Ross's gull (*Rhodostethia rosea*).[215] The largest Arctic tern (*Sterna paradisaea*) colony in Greenland is found in Disko Bay, where about 21,800 pairs were recorded in 2006.[216] In winter, Store Hellefiskebanke is a critical staging and winter habitat for nearly 500,000 king eiders (*Somateria spectabilis*) mainly from breeding areas in Arctic Canada. The small polynyas off the fjords to the east of Store Hellefiskebanke are very important winter habitats for thousands of common eiders (*Somateria mollissima*), hundreds of great cormorants and gulls (*Larus* spp). Thousands of king eiders assemble to moult in some of the fjords of Disko Island in late summer and autumn, and even more common eiders moult in the coastal waters along west Disko Island. Other seaducks such as harlequin duck (*Histrionicus histrionicus*) and red-breasted merganser (*Mergus serrator*) moult also in the coastal areas.[217] The area is part of the wintering area for the Arctic endemic ivory gull.[218]

Marine mammals

The Disko Bay and Store Hellefiskebanke Ecoregion is also important for a variety of marine mammals. Ringed seals (*Phoca hispida*) are abundant especially when ice is present. In late May and early June, harp seals (*Phoca groenlandicus)* return to the area from the whelping sites on the sea ice further south.[219] The entire area is part of the threatened beluga (*Delphinapterus leucas*) winter range in West Greenland, where about 9,000 animals rely on the marginal ice zone.[220] In summer and autumn the area serves as foraging grounds for other marine mammals, including harbour porpoise (*Phocoena phocoena*), minke (*Balaenoptera acutorostrata*), fin (*B. physalus*), and humpback whales (*Megaptera novaeanglia*).[221] Disko Bay serves as a foraging, staging, and probably mating area for the Eastern Canada-West Greenland stock of bowhead whales (*Balaena mysticetus*) in spring.[222] Narwhals (*Monodon monoceros)* are abundant during winter in the deeper drift ice covered basins of the area.[223] Store Hellefiskebanke is a critical winter habitat for the West Greenland/Baffin Island walrus population (around 1,400 animals estimated in 2012)[224] and at least as an important winter habitat for bearded seals (*Erignathus barbatus*).[225]

Fish

Important fish species in the ecoregion include capelin (*Mallotus villosus*), sandeel (*Ammodytes dubius*), polar cod (*Boreogadus saida*), Arctic char (*Salvelinus alpinus*) and Greenland halibut (*Reinhardtius ophioglossoides*). Capelin, sandeel and polar cod are schooling fish all very important as food resource for higher trophic levels in the ecoregion. High densities (up to 24 m^{-2}) of sandeel were found on the Store Hellefiskebanke in 2009. Northern shrimp is very numerous on the edges of the banks and in the troughs of the bay, and Store Hellefiskebanke is considered as a nursery area for shrimp larvae because of the retention areas.[226]

Threatened and Endangered Species present in the Disko Bay and Hellefiskebanke Ecoregion:

Common name *(Latin name)*	Conservation Status
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable) • Greenland Red List (vulnerable)
Narwhal (*Monodon monoceros)*	• IUCN Red List (near threatened)[227] • Greenland Red List (critically endangered)
Beluga (*Delphinapterus leucas)*	• IUCN Red List (near threatened) • Greenland Red List (critically endangered)
Bowhead whale (*Balaena mysticetus)* Eastern Canada-West Greenland Stock	• IUCN Red List (least concern) • Greenland Red List (near threatened)
Atlantic walrus (*Odobenus rosmarus rosmarus)*	• IUCN Red List (vulnerable) • Greenland Red List (endangered)
Ivory gull (*Pagophila eburnea)*	• IUCN Red List (near threatened) • Greenland Red List (vulnerable)
Atlantic puffin (*Fratercula arctica)*	• IUCN Red List (vulnerable) • Greenland Red List (near threatened)
Common eider (*Somateria mollissima)*	• IUCN Red List (near threatened) • Greenland Red List (vulnerable)
Black legged kittiwake (*Rissa tridactyla*)	• IUCN Red List (least concern) • Greenland Red List (vulnerable)
Thick-billed murre (*Uria lomvia)*	• IUCN Red List (least concern) • Greenland Red List (vulnerable)
Arctic tern (*Sterna paradisaea)*	• IUCN Red List (least concern) • Greenland Red List (near threatened)
Harlequin duck (*Histrionicus histrionicus*)	• IUCN Red List (least concern) • Greenland Red List (near threatened)

MAJOR THREATS

Climate Change, including changes in sea ice

A study of data from a long time series of temperature, salinity, and nutrient measurements in Disko Bay reveal a marked change in the water characteristics during recent years.[228] Change in the ice cover in Arctic areas can potentially create a mismatch between spring primary production and feeding copepods.[229] The changes in the physical forcing factors of Disko Bay potentially impair the productivity of the pelagic food web, which has implications for both society and industry in Greenland.

Oil and Gas Development

Seven license blocks for petroleum exploration and exploitation in the waters west of central Greenland were granted in 2006 to a number of oil companies. Some of the blocks overlap the Disko Bay and Store Hellefiskebanke Ecoregion. Extensive seismic surveys were carried out, and in 2010/2011 five exploration wells were drilled. All were dry, and presently it is expected that the license holders will hand back the licenses in 2017. A license round for land-based petroleum exploration on Disko and Nuussuaq Peninsula was conducted in 2016 but no applications were received. A study on the potential for minimizing oil spill risk has recently been published.[230]

Tourism

Western Greenland has an active tourist industry that is growing rapidly: The National Tourism Strategy 2016-2019 plans a 5% annual increase in the number of tourists arriving by plane.[231] Tourist activities pose a potential threat to some environmental elements of the ecoregion by disturbance of wildlife, but such impacts will be local and effects can be effectively mitigated by regulation of activities.

Shipping

Rising global temperatures and estimated decreases in Arctic sea ice are likely to increase access to new sea areas and in general expand the navigation season. These changes facilitate new possibilities for shipping, including transport of passengers (cruise ships) and freight, fisheries and activities related to resource development. Environmental impacts from shipping include disturbances of marine mammals and seabirds, introduction of invasive species and accidental or illegal discharge of oil, chemicals and waste. A large oil spill in these areas will be serious hazard to the environment

and have the potential to cause population level impacts for some seabird species.[232] Five sub-areas within this region are identified as areas where there may be a need for heightened awareness in relation to impacts from shipping.[233]

Commercial Fisheries

Commercial fisheries represent the most important export industry in Greenland, and the main commercially exploited species within this region are Greenland halibut, northern shrimp and snow crab.[234] The fishery for northern shrimp in the Ecoregion constitutes about 60-75% (82.000 t-96.000 tons) of the total West Greenland catches. The fishery for Greenland halibut takes place both in inshore areas around Disko Bay (longlines) and offshore in Baffin Bay (trawlers).[235] Bottom trawling may cause severe damage to seafloor structure and benthic communities.[236] The use of trawls is only feasible in largely ice-free areas, which are becoming more abundant in the Arctic,[237] and as such this threat is likely to increase with climate change.

PROTECTION AND MANAGEMENT STATUS

National Jurisdiction and Management Regime

The Disko Bay region is located entirely within the Exclusive Economic Zone of Greenland, a self-governing territory of the Kingdom of Denmark.[238] However, because many of the Arctic fauna in this region migrate across country borders, there are bilateral agreements which are important in the management and protection of the area. The Canada-Greenland Joint Commission on Beluga and Narwhal, signed in 1991 under terms of a Memorandum of Understanding (MOU) between Canada and the Greenland Home Rule Government, was established to responsibly manage the shared stocks of narwhal and beluga.[239]

The high productivity of this ecoregion is reflected in rich commercial fisheries. These target primarily northern shrimp and Greenland halibut (*Reinhardtius hippoglossoides*). Other species such as snow crab (*Chionoecetes opilio*) and scallops (*Pecten opercularis*) are also fished on commercial bases but to a much lesser degree.[240] Besides the commercial fishery, local people fish for their households and to sell at local markets. Hunting is an important occupation, which targets seals, whales and seabirds.

Existing Protections

Nature protection is regulated by Greenland's Nature Protection Act (Landsting Act no 29 of 18 December 2003), which protects two areas within the Disko Bay and Store Hellesfiskebanke Ecoregion: The archipelago Kitsissunnguit (also a Ramsar site), and the Ilulissat Icefjord (also a UNESCO World Heritage site). Three more areas are designated as seabird breeding sanctuaries and disturbing activities are in general regulated near and at seabird breeding colonies in the breeding season.

Mineral and petroleum exploration in Greenland is regulated by the Mineral Act, which specifies rules and guidelines that aim to protect the environment. These rules and guidelines include regulation of noisy activities, in areas important for certain species such as sensitive marine mammals (walrus, narwhal, beluga and bowhead whale). Some of these areas overlap with the Disko Bay and Store Hellefiskebanke Ecoregion.

The Ramsar Convention on Wetlands of International Importance is an intergovernmental treaty with provides framework for national action for the conservation of wetlands and their resources.[241] There are five Ramsar sites in the Disko Bay and Store Hellefiskebanke Ecoregion. These cover primarily land areas, but also include adjacent coastal waters.

The UNESCO World Heritage Site Ilulissat Icefjord, notable for its icebergs that calve from the fastest moving glacier in the world, is also important in this protection context.[242]

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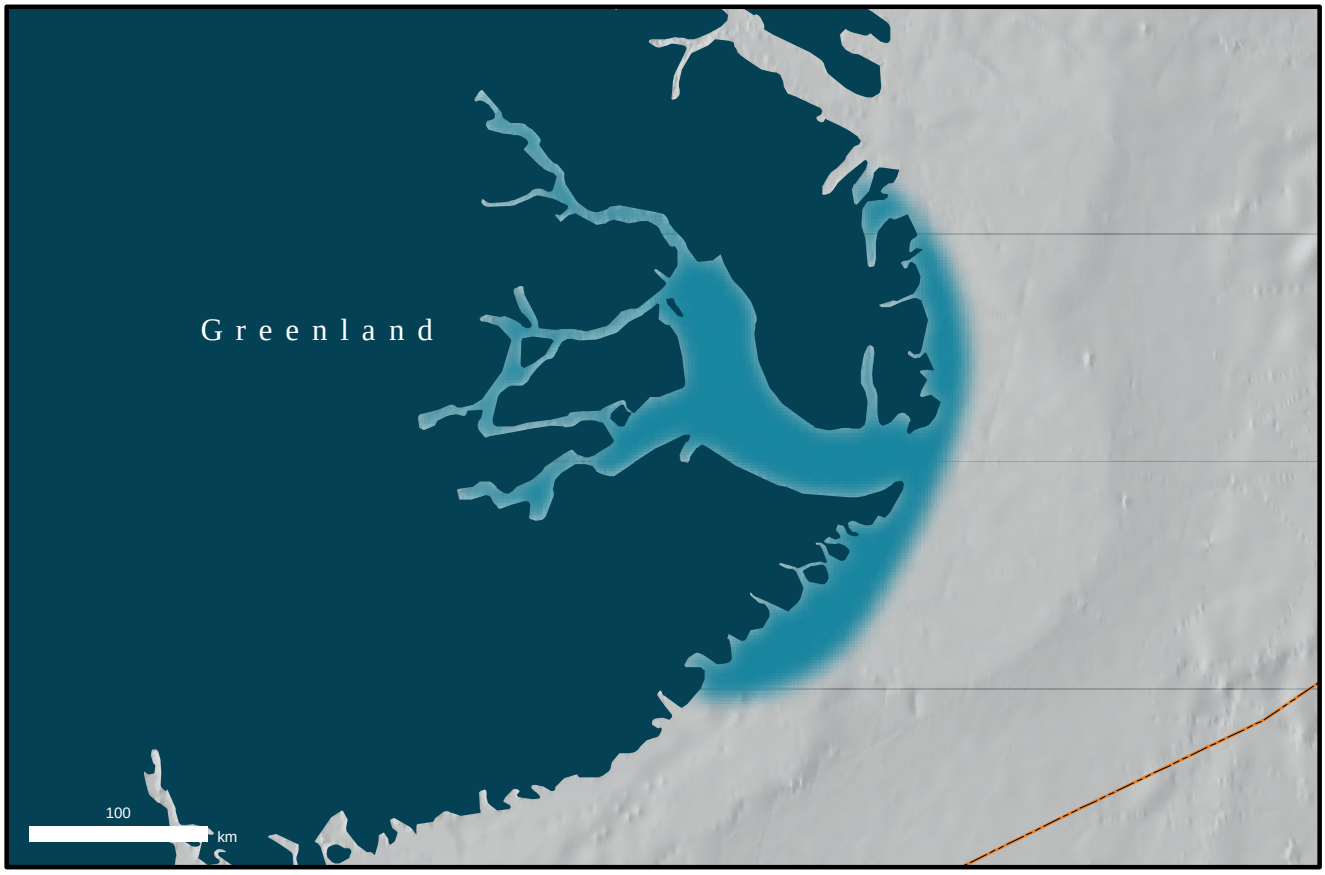
THE SCORESBY SOUND POLYNYA ECOREGION

Reviewers: David Boertmann, Anders Mosbech, Tom Christensen, Tenna Boye

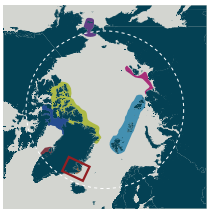
LOCATION

The Scoresby Sound Polynya Ecoregion is located on the east coast of Greenland, with an approximate range of 69°N to 72°N at30°W. It includes the Scoresby Sound Polynya, the fjord system of Scoresby Sound (the world's largest fjord), and the waters off Liverpool Land and off the northern part of Blosseville Coast. The Scoresby Sound Polynya is situated at the mouth of Scoresby Sound.



The Scoresby Sound Polynya Ecoregion

- Area of Potential Outstanding Universal Value
- Marine Boundary



Map: Marine Geospatial Ecology Lab, Duke University (2016)

SITE DESCRIPTION

The Scoresby Sound Polynya is present in the ice season (October- June), and has a well-defined border (the ice edge) to the west. The position of this ice edge across the sound varies between years and through the year, but is usually found to the south of the region between Kap Hope and Kap Tobin, although it can be situated much further to the west early in the winter. The delineation to the offshore side (the Greenland Sea) is more diffuse and varies with the amounts of ice in the East Greenland Current. The polynya usually also includes waters on the northernmost part of the Blosseville Coast.

The polynya is very prominent in March and April, and typically covers around 3000 square kilometers although there is considerable variation in size, from almost completely covered by drift ice to a huge ice free area far into Scoresby Sound. The sea ice usually is gone from the region in July-October.

PREVIOUS RECOGNITION

The Scoresby Sound Polynya Ecosystem was previously identified as significant by the following reports and workshops:

AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Programme (AMAP). Oslo. 114 pp. *The Scoresby Sound Polynya is Area 2 Greenland Sea.*

Christensen, T., Falk, K., Boye, T., Ugarte. F., Boertmann, D., and Mosbech, A. 2012. Identifikation af sårbare marine områder i den grønlandske/danske del af Arktis. Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi. 72 pp. (In Danish). http://www2.dmu.dk/Pub/SR43.pdf. *Scoresby Sound Polynya is here ranked as Priority 2 "ecologically sensitive marine area".*

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KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VII – SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

Scoresby Sound is the world's largest fjord system, a vast and spectacular region comprised of steep and striking cliffs that plummet into deep water. In the summer, large icebergs float through the system, while in winter the Scoresby Sound polynya provides an area of open water, contrasting with the ice that fills the fjord. Limited human development and high marine productivity attract a large diversity of seabirds and marine mammals.

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

Scoresby Sound is the largest fjord system in the world, covering an area of 13,700 square kilometers.[243] The narrow inner fjords are characterized by steep slopes separating deep basins, and water depths range from 800 to >1500 meters, whereas the wide, outer fjord has a flat, shallow floor with depths ranging from 200 to 650 meters. Several large, fast-flowing outlet glaciers drain the east side of the Greenland Ice Sheet into inner Scoresby Sound, calving large icebergs that scour the seabed and drift toward the mouth of the fjord.

Scoresby Sound Polynya is situated at the mouth of Scoresby Sound. Very little has been published on the physical and oceanographic features of the waters of the Scoresby Sound Polynya ecosystem. The polynya is most likely formed by strong tidal currents in combination with the presence of a gyre in the fjord mouth.[244]

The coasts of the Liverpool Land are generally rocky and made from bedrock and there are several fjords along this coast. A large part of the Blosseville Coast and the Wolquart Boon Coast are basaltic, and there are many fjords also on the Blosseville Coast, some with glaciers in the head. Inside the Scoresby Sound system, there are many narrow fjords and sounds, and glaciers are found in the head of some of these fjords. The Jameson Land coast deviates from all the other coasts, being low and sedimentary.

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

The Scoresby Sound Polynya Ecoregion is very important to a range of arctic marine mammals. The critically endangered Spitsbergen stock of bowhead whale (*Balaena mysticetus)* forages east of the Scoresby Sound.[245]

There is a local and discrete stock of narwhal (*Monodon monoceros)* which winter off Blosseville Coast and migrate to the summer grounds inside the fjord complex and the fjords on the Blosseville Coast.[246] Polar bears (*Ursus maritimus)* are frequently on the ice around the polynya, and maternity dens have been located on Blosseville Coast and inside the inner branches of the fjord system.[247] Atlantic walrus (*Odobenus rosmarus*) are primarily winter visitors to the polynya, but a summer stock hauling out just east of the town Ittoqqortoormiit was exterminated a few years after the town was established in 1925.[248]

The polynya provides seabirds with feeding opportunities in spring and early summer - much earlier than along the ice blocked coasts further north and south. The polynya is the foundation for huge breeding colonies of little auks *(Alle alle)* along the coasts of Liverpool Land and Wolquart Boons Coast. An estimated 3.5 million pairs breed here,[249] and this is probably the third largest breeding aggregation of this species after NW Greenland and Svalbard. Moreover, the northernmost part of the Blosseville Coast supports many more breeding seabirds than generally found in Southeast Greenland, with kittiwakes, Arctic terns, and gulls. This is probably also a result of the polynya.[250]

Thick-billed murre (*Uria lomvia)* have two breeding colonies near the polynya, one at Kap Brewster and one on Raffles Island.[251] Kittiwakes (*Rissa tridactyla)* breed in smaller numbers along the coasts facing the Greenland Sea.[252] Inside the fjord system there are colonies of Arctic terns (*Sterna paradisaea*), Sabine's gulls (*Xema sabinii*), glaucous gulls (*Larus hyperboreus)*, and common eiders (*Somateria mollissima)*.[253]

The threatened ivory gull (*Pagophila eburnea)* have a few breeding colonies in the area on nunataks, often far from the coast. The birds from these colonies forage in the glacier fjords on the Blosseville Coast in the summer.[254]

The polynya is also an important spring staging area for waterbirds migrating along the east Greenland coast, including common eiders, long-tailed ducks, and red-throated divers.[255]

Threatened and Endangered Species present in the Scoresby Sound Ecoregion:

Common name *(Latin name)*	**Conservation Status**
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable)[256] • Greenland Red List (vulnerable)
Narwhal (*Monodon monoceros)*	• IUCN Red List (near threatened)[257] • Greenland Red List (critically endangered)
Bowhead whale (*Balaena mysticetus)* Spitsbergen stock	• IUCN Red List (critically endangered)[258] • Greenland Red List (critically endangered)
Atlantic walrus (*Odobenus rosmarus rosmarus)*	• IUCN Red List (vulnerable) • Greenland Red List (endangered)
Ivory gull (*Pagophila eburnea)*	• IUCN Red List (near threatened)[259] • Greenland Red List (vulnerable)[260]
Black legged kittiwake (*Rissa tridactyla*)	• IUCN Red List (least concern) • Greenland Red List (vulnerable)
Thick-billed murre (*Uria lomvia)*	• IUCN Red List (least concern) • Greenland Red List (vulnerable)
Arctic tern (*Sterna paradisaea)*	• IUCN Red List (least concern) • Greenland Red List (near threatened)
Sabine's gull (*Xema sabini)*	• IUCN Red List (least concern) • Greenland Red List (near threatened)

MAJOR THREATS

There are only few human threats to the area. One is the hunt carried out by the population of Ittoqqortoormiit, whom rely on subsistence hunting of marine mammals such as narwhal, polar bear and seals. Shipping is limited annually to a few cargo ships providing the town of Ittoqqortoormiit with supplies and to an increasing number of cruise ships. Offshore oil exploration is taking place more than 600 km to the north and oil spills from this area may impact the ecoregion. However, so far only seismic surveys have taken place here. Climate change naturally will impact the region, but how is difficult to assess as both oceanographic and physical properties of the polynya are largely unknown.

PROTECTION AND MANAGEMENT STATUS

National Jurisdiction

The Scoresby Sound Polynya Ecoregion is located entirely within the Exclusive Economic Zone (EEZ) of Greenland, a self-governing territory of the Kingdom of Denmark.[261] There are no marine protections in place.

Shipping Regulations

In terms of shipping, Greenlandic legislation applies the "generally accepted international rules and standards" adopted by the IMO.[262]

Subsistence Harvesting

The Scoresby Sound Polynya is an important area for subsistence harvest. Quotas for the harvest of some marine mammals (narwhal, polar bear, walrus) are set by the Greenland Government. The town of Ittoqqortoormiit was founded in 1925 at the entrance to Scoresby Sound. Two minor settlements (now abandoned) were established close to the town at the edge of the polynya. The reason for the establishment was the optimal hunting conditions created by the polynya and the associated ice edges. The hunt is primarily aimed at marine mammals; polar bear, walrus, narwhal, seals and occasionally minke whale, while seabirds only are hunted to a limited degree. The hunting patterns have been described in some reports.[263]

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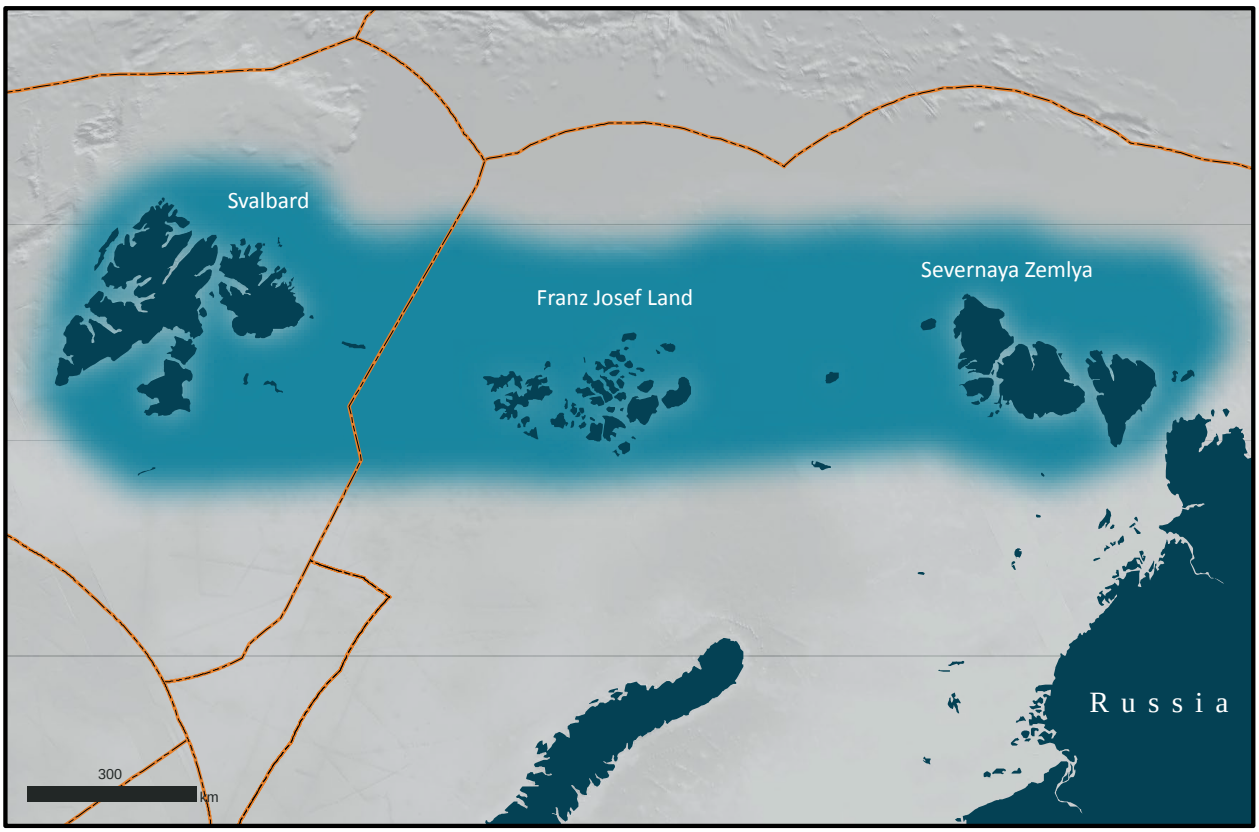
HIGH ARCTIC ARCHIPELAGOS

Reviewers: Cecilie von Quillfeldt, Maria Gavrilo, Vadim Mokievsky, Natalia Chernova, Ksenia Kosobokova

LOCATION

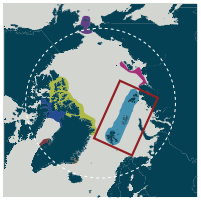
Three ecologically linked archipelagos form the boundary between the shallow Kara and Barents Sea shelves and the deep Nansen Basin. The Svalbard archipelago is located at the northern boundary of the Greenland and Barents Seas. To the east of Svalbard is the Franz Josef Land which forms a land barrier between the Arctic Ocean and the NE Barents Sea. It is also the northernmost Eurasian terrain with its northernmost Cape Fligely being just 900 km from the North Pole. East of Franz Josef Land is the Severnaya Zemlya Archipelago, located at the boundary of the Kara and Laptev Seas.[264] Small offshore islands - Victoria Island between Svalbard and Franz Josef Land, together with Ushakov and Vize Islands located between Franz Josef Land and Severnaya Zemlya - are included in the area, along with the adjacent shelf break and slope.



High Arctic Archipelagos

Area of Potential Outstanding Universal Value

Marine Boundary



Map: Marine Geospatial Ecology Lab, Duke University (2016)

SITE DESCRIPTION

The Svalbard archipelago consists of four main islands surrounded by smaller islands. About 60% of the archipelago is covered by glaciers.[265] Despite Svalbard's high-latitude location, its climate can be relatively mild due to the influence of the West Spitsbergen Current.[266] Franz Josef Land is composed of 192 islands with 85% glacier cover, and is typically surrounded by ice year-round.[267] Severnaya Zemlya consists of five big islands and several smaller islands. About half the archipelago terrain is covered by glaciers.[268] Situated in the middle of the Siberian shelf, Severnaya Zemlya divides the western and eastern Russian Arctic shelf and serves as the boundary between its western and eastern parts; thus it is a northern extension of the so-called Yenisei zoogeographic divide for birds and mammals.[269] Three small islands in between the archipelagos are similar in size but differ in glacier cover – Ushakov Island is fully under the ice, Vize Island is ice free, and Victoria Island has a small ice-free cape.[270]

COMMON FEATURES

The chain of the three archipelagos together with isolated Victoria, Ushakov and Vize Islands between them serves as the boundary between the shallow zone of the Kara and Barents Sea shelf and the deep-water Arctic Nansen Basin. Shelf break and shelf slope are distinct topographic features joining Svalbard, Franz Josef and Severnaya Zemlya, separating shelf zone from deep-water Nansen Basin and steering boundary currents thus accounting for subsurface inflow of warm Atlantic waters from the west along outer limits of the archipelagos.

The highest zooplankton biomass is found within or close to the core of the Atlantic Boundary Current along the continental slope, which supports a diverse food web of species.[271]

The region's ecological unity is reflected in common populations of key Arctic species. These include the Kara and Barents Sea polar bear population, which has two subpopulations that inhabit the territory of Svalbard to Franz Josef Land (the Barents Sea subpopulation) and the territory from Franz Josef Land to Severnaya Zemlya (the Kara Sea subpopulation).[272] This region is also home to Atlantic walrus (*Odobenus rosmarus rosmarus)*,[273] the critically endangered Spitsbergen stock of bowhead whales (*Balaena mysticetus*),[274] and the ivory gull (*Pagophila eburnea)*.[275] High Arctic archipelagos and islands are interconnected by the migratory routes of the shared populations of walrus, polar bears and seabirds across the surrounding waters. Additionally, the region is unified by migrations of seabirds that nest in the north-eastern Atlantic and forage in the waters from northern Svalbard, Franz Josef Land and further in the northeast of the Kara Sea like ivory gull[276], or little auk and kittiwake nesting in Svalbard and Franz Josef Land and shifting east to forage after breeding is completed.[277]

PREVIOUS RECOGNITION

Each of the High Arctic Archipelagos were previously identified as significant in the following reports and workshops:

AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA) IIc. Arctic Monitoring and Assessment Program (AMAP). Oslo. 114 pp. *Svalbard is Area #4 within the Barents Sea LME; Franz Josef Land is Area #6 within the Barents Sea LME; Severnaya Zemlya is Area #3 within the Kara Sea LME, and Area #1 within the Laptev Sea LME.*

Speer L. and Laughlin T. (Eds) 2011. IUCN/NRDC Workshop to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment, La Jolla, California. 02-04 November 2010. *Svalbard falls within Super EBSA #12 High Arctic Islands and Shelf; Franz Josef Land falls within Super EBSA #12 High Arctic Islands and Shelf; Severnaya Zemlya falls within Super EBSA #12 High Arctic Islands and Shelf.*

United Nations Environment Program (UNEP) Convention on Biological Diversity (CBD). 2014. Report of the Arctic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas. Helsinki. UNEP/CBD/EBSA/WS/2014/1/5. *Franz Josef Land falls within Area #7: North-eastern Barents-Kara Sea; Severnaya Zemlya falls within Area #7: North-eastern Barents-Kara Sea.*

Svalbard is on Norway's tentative list for nomination as a UNESCO World Heritage Site: "*Svalbard differs significantly from existing World Heritage Areas in the Arctic (the Wrangel Islands and Ilulissat Icefjord). Svalbard has qualities within themes like landforms, bedrock geology, Quaternary geology, flora, fauna and the marine environment that will be a substantial contribution towards achieving a representative selection of high-Arctic environments on the World Heritage List.*"[278]

KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

Oceanography

The three High Arctic archipelagos, together with Victoria, Ushakov and Vize Islands between them, separate the shallow zone of the Kara and Barents Sea shelf from the deep-water Arctic Nansen Basin. Unlike the Amerasian part of the Arctic Basin, the continental shelf is very close to the archipelagos, and plays a crucial role in forming the circulation and structure of the region's water masses. Atlantic waters coming from the Fram Strait and modified Barents Sea waters coming via the Saint Anna Trough move along the slope in a subsurface layer from the west eastwards and form the cyclonic Arctic Circumpolar Boundary Current.[279] The dynamic entrance of these warm waters into the Arctic Basin plays a central role in the oceanography and ecology of the central Arctic Ocean and northern parts of the Eurasian shelf seas. The shelf topography of the region is extremely diverse and includes archipelagos and islands, insular shelves, shallow and deep-water fjords, edge and cross troughs, and sea-bottom edge glacial formations.[280]

A system of stationary polynyas that form beyond the shore-fast ice of the archipelagos and islands is a distinctive feature of the region's ice regime. Their development and, correspondingly, relative ecological significance for supporting biological productivity, intensify when moving from Svalbard to Severnaya Zemlya.[281]

Spatial overlap of the shelf slope steering Atlantic Waters and polynya system in winter and spring or marginal ice zone in summer is a unique oceanographic feature in the Arctic Ocean that provides conditions for the enhanced biological productivity and ecological processes.

Geology

The Barents Sea has been tectonically affected by major continental collisions and a complex rifting history leading to continental break-up.[282] Recent plate tectonic interpretations of Severnaya Zemlya geology suggest that the archipelago, when considered with northern Tajmyr, forms an independent microcontinent.[283]

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The large range in primary productivity throughout the Barents Sea supports rich and varied benthic communities and important feeding grounds for fish, sea birds and marine mammals.[284]

The North Atlantic Current along the shelf and slope account for the advection of biomass and species from the Atlantic Ocean,[285] which is reflected in elevated zooplankton biomass over the entire continental slope from Svalbard to Severnaya Zemlya.[286] Upwelling along the shelf slope also supports primary production and the area is an important feeding area for whales. In the second half of the summer the whole region becomes a dynamic Marginal Ice Zone (MIZ), which supports enhanced biological productivity. Some of the largest biomass concentrations of zoobenthos in Russia's Arctic seas have been recorded along the continental slope to the east of the Severnaya Zemlya.[287] The High Arctic archipelagos are an important feeding area for marine top predators (i.e. ivory gulls[288] and polar bears[289]), providing further evidence of the increased productivity of lower trophic levels.

The Svalbard archipelago is significantly influenced by warm Atlantic waters. Local factors –fjord coasts, glacier-derived runoff and presence of outlet glaciers – also play an important role. The presence of fjords with glaciers influences the benthic environment, as inorganic material generally increases towards the head of the fjords where major glacier melt-water outflows are usually located.[290] River meltwater pours into the fjords of Svalbard, making the water less saline and depositing large quantities of mud, which strongly influences the benthos.[291] Some persistently well-mixed areas that receive a continual supply of nutrients exhibit extra high annual production levels, e.g. Spitsbergenbanken, which is probably one of the most productive areas in the Atlantic sector of the Arctic.[292]

The insular shelf of the Franz Josef Land is a semi-closed ecosystem with high phytoplankton production throughout the entire summer season, high biodiversity of zooplankton and increased macrophytobenthos productivity, which is maintained by intense hydrodynamic processes involving many local fronts and upwelling zones. These, in turn, ensure a vertical mixing of the water masses and supply of nutrients to surface layers of the sea.[293]

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

Marine Mammals

The main breeding places of polar bears that belong to the common Kara and Barents Sea population are located on the Svalbard, Franz Josef Land and Severnaya Zemlya archipelagos.[294] The nature reserves on Svalbard provide important breeding and migratory areas for polar bears (*Ursus maritimus*).[295] Franz Josef Land is an important denning area for polar bears, and the summer density of

polar bears is much greater in the Franz Josef Land area than to the west and in Svalbard.[296] The polynya edge and fast ice off Eastern Severnaya Zemlya also provides good foraging opportunity for polar bears in spring and summer.[297]

Franz Josef Land and Svalbard share a common population of Atlantic walrus.[298] Franz Josef Land and Svalbard archipelagos, as well as Victoria, Vize and Ushakov Islands and adjacent pack ice areas, provide principal haul-out areas for the northern stock of the East Atlantic metapopulation of Atlantic walrus.

Franz Josef Land and Victoria Island provide important feeding and haul-out areas for Atlantic walrus females and juveniles. The population's primary breeding area is the drift-ice area between Svalbard and Franz Josef Land, where animals from each archipelago meet to mate.[299] The habitat of Atlantic walrus stretches to the western coast of the Severnaya Zemlya Archipelago, while the westernmost part of the Laptev population of the Pacific walrus occurs along its eastern coasts.[300]

The northernmost global population of the harbor seal (*Phoca vitulina*) resides in western Svalbard. Ringed (*Pusa hispida*) and bearded (*Erignatus barbatus*) seals are common in all three archipelagos. Ringed seals breed in shore-fast ice in fjords around Svalbard archipelago.[301] They also have important breeding and moulting areas in Franz Josef Land straits and coastal waters,[302] as well as along the coasts of Severnaya Zemlya, especially along its eastern side next to the polynya.[303] Bearded seals are found at low densities in all of Svalbard's fjords on a year-round basis, and in coastal regions wherever there is drifting ice.[304]

Franz Josef Land and Svalbard area, and adjacent north-eastern Barents and northern Kara seas are an important habitat for the critically endangered Spitsbergen stock of bowhead whales (*Balaena mysticetus*).[305] Flaw polynyas and marginal ice zone off the Franz Josef Land in spring[306] as well as various habitats within and around archipelago are the key places for their summer foraging.[307]

Beluga whales[308] (*Delphinapterus leucas*) dwell in the waters around Svalbard throughout the year,[309] and have important summer feeding grounds in Franz Josef Land Archipelago. They also forage in summer in Severnaya Zemlya waters. Several species of whales including blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), and humpback whale (*Megaptera novaeangliae*) (all Red listed either nationally or under IUCN) as well as a more abundant minke whale (*Balaenoptera acutorostrata*) move into Svalbard waters during the summer to feed.[310] Minke whales also use Franz Josef Land waters for summer feeding,[311] while fin whale or humpbacks are only occasional visitors here.[312]

Seabirds

The High Arctic Archipelagos support important populations of seabirds.[313] Up to 85% of the global ivory gull population (*Pagophila eburnea)* nest on the Svalbard, Franz Josef Land and Severnaya Zemlya archipelagos, as well as Victoria, Ushakov and Vize Islands.[314] The key places for post-breeding foraging by all north-eastern Atlantic populations that nest from Greenland to the Severnaya Zemlya are located on the waters around these archipelagos, especially on the Arctic Basin side.[315]

Some 200 bird species are recorded in Svalbard, and this remarkable number is built up by the presence of many Atlantic and low Arctic species due to the influence of the North Atlantic Current. Bird fauna is quite diverse in the archipelagos, but numbers of species and their populations decrease from west to east, except for ivory gulls, whose highest population occurs in the Kara Sea.

The most ecologically important and numerous are seabirds.[316] Svalbard provides nesting sites for large numbers of thick-billed murres (*Uria lomvia*), brent geese (*Branta bernicla)*, Sabine's gulls (*Xema sabini*) and ivory gulls (*Pagophila eburnea*).[317]Large breeding colonies of little auks (*Alle alle*), northern fulmar (*Fulmarus glacialis*), Atlantic puffin (*Fratercula arctica*), and black-legged kittiwake (*Rissa tridactyla)* are also found in parts of the archipelago. [318]

Severnaya Zemlya forms the easternmost boundary of the breeding range for Atlantic marine bird species and populations, including little auks, ivory gull, and the nominative race of brant goose (*Branta bernicla bernicla)*.[319] The unique insular habitats and favorable summer ice conditions support the world's largest breeding population of the endemic ivory gull.[320] Large colonies of little auks, black-legged kittiwake and black guillemot (*Cepphus grylle)* breed here and make extensive use of polynyas off Severnaya Zemlya.[321] Franz Josef Land and Severnaya Zemlya support a distinct race of little auk (*Alle polaris*) which, at least in Franz Josef Land, differs in its breeding biology from *Alle* found elsewhere.[322]

Fish

This region supports the north-easternmost habitat of the threatened Greenland shark (*Somniosus microcephalus)*.[323] One of the Barents Sea stocks of polar cod (*Boreogadus saida*), a key species of the Arctic marine ecosystem, lives and spawns here.[324]

The Svalbard – Franz Josef Land region is important nursery ground for a number of commercial fish species.

Threatened and Endangered species present in the High Arctic Archipelagos:

Common Name *(Latin name)*	Conservation Status
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable) • Russian Federation Red Data Book (listed)
Bowhead whale (*Balaena mysticetus)* Spitsbergen stock	• IUCN Red List (critically endangered) • Russian Federation Red Data Book (listed)
Blue whale (*Balaenoptera musculus)*	• IUCN Red List (endangered)
Walrus (*Odobenus rosmarus)* both Pacific and Atlantic stocks	• IUCN Red List (vulnerable) • Russian Federation Red Data Book (listed)
Narwhal (*Monodon monoceros)*	• IUCN Red List (near threatened) • Russian Federation Red Data Book (listed)
Beluga whale (*Delphinapterus leucas)*	• IUCN Red List (near threatened)
Ivory gull (*Pagophila eburnea*)	• IUCN Red List (near threatened) • Russian Federation Red Data Book (listed)
Atlantic puffin (*Fratercula arctica)*	• IUCN Red List (vulnerable)
Greenland shark (*Somniosus microcephalus)*	• IUCN Red List (near threatened)
Thick-billed murre (*Uria lomvia)*	• IUCN Red List (least concern)

Deep-water troughs and the continental slope around Svalbard and Franz Josef Land serve as principal nursery grounds for the Norwegian-Barents Sea stock of the Greenland halibut (*Reinhardtius hippoglossoides*).[325] Young stages of the halibut migrate from the spawning grounds at the shelf slope off Bear Island and disperse with warm Atlantic waters from western and northern Svalbard further eastwards to the Saint Anna Trough.[326]

A total of 43 species from 15 families are known from Franz Josef Land area.[327] Resident species are mainly cold water Arctic species, some also endemic, while transient species visit the archipelago to feed (e.g., Atlantic cod (*Gadus morhua)* and capelin (*Mallotus villosus).* Another species group includes warmer-water fishes that are rare waifs (e.g., glacier lanternfish (*Benthosema glaciale*) and white barracudina (*Arctozenus rissoi*). Tape-body pout (*Gymnelus taeniatus*), has been described from the Franz Josef Land[328] and is likely locally endemic to the archipelago.

Threatened and Endangered Species

The archipelagos together with the surrounding waters play a key role in maintaining the populations of endemic, threatened and endangered Arctic species that depend on ice habitats.

In total, 55 threatened species inscribed on the Norwegian Red List,[329] including 16 species of seabirds,[330] inhabit the Svalbard territory and surrounding waters; eight species of seabirds and mammals inscribed on the Red Data Book of the Russian Federation inhabit Franz Josef Land archipelago and its surrounding waters, and four Arctic red listed species inhabit Severnaya Zemlya Archipelago.[331]

MAJOR THREATS

Climate Change

The rapid warming of the Arctic will likely result in significant changes to the entire High Arctic region.[332] Fall freeze-up of sea ice is occurring later in the season, and the extent and thickness of sea ice in the Barents Sea and the Kara Sea has decreased over recent decades. These trends are projected to continue.[333] Near Severnaya Zemlya, the largest changes have occurred in the eastern basins.[334]

Reduced summer sea ice increases the time and extent of pelagic primary production and reduces the relative contribution of ice algae to primary production,[335] which can influence interdependencies among the pelagic and benthic communities.[336] As changes in extent, thickness and timing of sea ice intensify, rearrangement of the entire local ecosystem is possible, as higher trophic links are mainly represented by ice-dependent species.[337]

As the Arctic Ocean warms, new patterns of species distribution will emerge as boreal species and populations will be able to invade northern waters and compete with functionally similar resident species.[338] Already, boreal fish species have moved into the northern parts of the Barents Sea in large numbers, which has pushed local Arctic communities out of the shelf area.[339]

Invasive species both marine and terrestrial including invertebrates such as snow crab or king crab, different plankton species, fungi and microbes have better potential to spread and establish themselves on the high

Arctic islands under conditions of a warming climate and rapid development of the region (shipping, tourism etc.).

Tourism

Svalbard is an easily accessible area, with daily flights from the mainland and a well-developed infrastructure.[340] The cruise ship tourism volume is significant and growing. A marine checkpoint established on Franz Josef Land in 2015 allows cruise ships from Svalbard to come to the Russian waters of the archipelago directly. This is expected to increase tourism significantly. Severnaya Zemlya is the least involved in the tourism sphere, but interest in this region is also increasing, as ice conditions become milder.

Cruise ships bring thousands of visitors to coastal areas. Human disturbance along the coast can negatively impact vulnerable species including rare and threatened Atlantic walruses, polar bears, and ivory gulls.[341] There is an increasing risk of dispersal of alien species of plankton, invertebrates, and microbiota with increasing visitation of the islands, especially between the archipelagos.[342] Demand for coastal infrastructure to serve rising numbers of tourists is also increasing.

Pollution

The High Arctic Archipelagos are located within a transboundary zone of ocean currents and air flows that transport pollutants into the region. A pilot comparative study of ivory gull eggs from Svalbard, Franz Josef Land and Severnaya Zemlya colonies showed presence of high concentrations of persistent organic pollutants, such as polychlorinated biphenyls and DDE: their levels exceeded the known values for seabirds from all other Arctic regions.[343] One study of organic pollution in Svalbard found PAHs and PCBs present in the remote Fuglebekken Basin.[344] This basin is thousands of kilometers from an industrial human activity, which provides evidence that compounds are transported over vast distances.

Local sources of pollution are an additional concern, in some areas. The increasing number of visitors and the intensification of commercial shipping has increased marine waste, noise pollution and debris. A dramatic increase in volumes of litter was recorded at a depth of down to 2.5 km near western Svalbard.[345]

Industrial development of the Arctic shelf areas

Shelf areas adjacent to all archipelagos are the subject of prospecting for petroleum deposits, and several oil production licenses have been issued in areas next to or overlapping the area. Intense sound from seismic surveys associated with petroleum deposit development may pose a serious threat to marine mammals, especially whales.[346] Risk of oil spills is the major potential threat for numerous seabirds and marine mammals, especially in ice filled waters.[347]

Shipping

The volume of ships is increasing along the Northern Sea Route and in the Barents Sea as a result of petroleum development and transportation of oil, gas and other mineral recourses from Siberia to Western Europe. Ships threaten the marine environment through the risk of oil spills, marine mammal strikes, noise disturbance, introduction of invasive species and through greenhouse gas emissions.[348]

Commercial fishing

Commercial fishing is shifting north- and eastwards. This new activity will influence trophic webs of the High Arctic waters which have been previously undisturbed by fishing.[349]

Military activity

Re-establishment of military bases on the Arctic archipelagos of Franz Josef Land and Severnaya Zemlya claim some areas. Construction activity and further operational activities will increase disturbance to vegetation, wildlife and habitats, increase the risk of dispersal of alien and invasive species, and increase pollution.

PROTECTION AND MANAGEMENT STATUS

National Jurisdiction

Svalbard has been entirely under Norway's jurisdiction since The Svalbard Treaty was signed in February 1920.[350] The archipelago has a relatively developed infrastructure and a resident population. Norway has established a 200-nautical mile fishery protection zone around Svalbard.

Franz Josef Land, the Severnaya Zemlya Archipelago, and smaller surrounding islands belong to the Russian Federation. Neither Franz Josef Land nor the Severnaya Zemlya Archipelago has a resident population, although State border outpost officers and employees of the meteorological and research stations reside there. At present, new military facilities are being developed near the existing State border outposts on both archipelagos.

Management Regime

The Governor of Svalbard is responsible for managing the protected areas of Svalbard, under the direction of the Ministry of Climate and Environment & the Norwegian Directorate for Nature Management.[351] Several Norwegian monitoring programs and research

projects are directly dedicated to the management of the protected areas.[352]

The Franz Josef Land Archipelago and its surrounding waters within 12 nautical miles is part of the National Park Russian Arctic, which is managed by the administration headquartered in Archangelsk.[353] Four separate parts of the Severnaya Zemlya Archipelago belong to the Severozemelsky State Wildlife Sanctuary or *zakaznik,* which is managed by the Administration of the United Directorate of Taimyr Reserves, with headquarters in Norilsk.

Though the Russian Federation has historically established coastal and marine protected areas in the Arctic, only a few are designed to focus on protecting marine ecosystems.[354]

Protected Areas

In Svalbard, 86.5% of the archipelago's territorial waters (extending to 12 nautical miles) are protected.[355] The marine portions of seven national parks and four nature reserves in Svalbard are designated as OSPAR Marine Protected Areas. Six of Svalbard's 15 bird sanctuaries, (Dunøyane, Isøyane, Forlandsøyane, Gåsøyane Kongsfjorden and Sørkapp (with Stormbukta and Sørkappland - parts of a national park), two nature reserves (Bear Island and Hopen), and parts of a national park (Nordenskiöldkysten with Ingeborgfellet), are on the Ramsar list of wetlands of international importance.[356]

The Franz Josef Land Archipelago and its surrounding waters were first assigned protected status as a State Wildlife Sanctuary or *zakaznik* (corresponding to IUCN category IV) in 1994. In August 2016, Franz Josef Land and its surrounding territorial waters (extending to 12 nautical miles) became part of the Russian Arctic National Park. With the addition of Franz Josef Land to the Russian Arctic National Park, which also includes the northern tip of Novaya Zemlya and its surrounding territorial waters, the park, at nearly 8.8 million hectares, became the largest land and marine nature reserve in Russia.[357] There is an ongoing project of further expansion of the park to include Victoria Island and its surrounding territorial waters.

Severnaya Zemlya is mostly uninhabited and represents a vast pristine area largely undisturbed by human development. Four small land areas of the archipelago with adjacent coastal waters were designated as the Severnaya Zemlya State Wildlife Sanctuary (*Severozemelsky zakaznik)* in 1996. This sanctuary amounts to a total area of 421,701 hectares, which includes 53,930 hectares of protected marine waters.[358]

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THE GREAT SIBERIAN POLYNYA

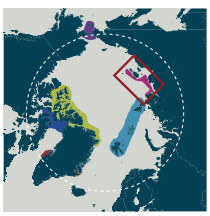
Reviewers: Vadium Mokievsky and V.A. Spiridonov

LOCATION

The Great Siberian Polynya is a historic name for a large, relatively stable system of flaw polynyas that occurs each winter over the shallow shelves of the Laptev and East Siberian seas. The exact location of the Great Siberian Polynya and its size changes throughout the season and between years depending on atmospheric circulation patterns. The area described here corresponds to the maximal north-south extent of this polynya system between 110 and 160° E.[359]

The Great Siberian Polynya

- Area of Potential Outstanding Universal Value
- Marine Boundary



Map: Marine Geospatial Ecology Lab, Duke University (2016)

SITE DESCRIPTION

Recurring flaw polynyas in the Russian Arctic as well as in other Arctic seas are of a great significance for marine biological diversity and ecosystem function.[360] Most species of fish and almost all the seabirds and marine mammals in the Laptev Sea are dependent on the Great Siberian Polynya System to a certain extent.[361] The ice that forms in the Great Siberian Polynya is continually transported away by currents, and the Laptev Sea has been recognized as one of the most important ice-exporting regions in the Arctic.[362]

PREVIOUS RECOGNITION

The Great Siberian Polynya waters have been recognized as ecologically significant by the following reports and workshops:

Speer, L. and Laughlin, T. (Eds). 2011. IUCN/NRDC Workshop to Identify Areas of Ecological and Biological Significance or Vulnerability in the Arctic Marine Environment. La Jolla, California. November 2–4 2010. 37 pp. *The Great Siberian Polynya is Super EBSA No 13.*

AMAP/CAFF/SDWG. 2013. Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment (AMSA). IIc. Arctic Monitoring and Assessment Programme (AMAP), Oslo. 114 pp. *The Great Siberian Polynya is area 3 in the large marine ecosystem of the Laptev Sea.*

United Nations Environment Programme Convention on Biological Diversity. 2014. A Report of the Arctic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas. Helsinki. UNEP/CBD/EBSA/WS/2014/1/5. *The Great Siberian Polynya is area 9.*

KEY FEATURES RELEVANT TO THE NATURAL WORLD HERITAGE CRITERIA

CRITERION VII - SUPERLATIVE NATURAL PHENOMENA OR NATURAL BEAUTY AND AESTHETIC IMPORTANCE

The size and location of recurring flaw polynyas change from year to year, depending on the peculiarities of atmospheric circulation.[363] Though polynyas are usually very dynamic, the Great Siberian Polynya system is notable for its regular recurrence, and is considered a stable polynya that opens approximately in the same place each year.[364]

CRITERION VIII – MAJOR STAGES IN EARTH'S HISTORY AND GEOLOGICAL PROCESSES

Oceanography

The persistent Great Siberian flaw polynya system plays a key role in the oceanographic conditions of the Laptev Sea.[365] Stable polynyas considerably influence the formation and melting of sea ice.[366] The ice that forms in the Great Siberian Polynya is continually transported away by currents, and the Laptev Sea has been recognized as one of the most important ice-exporting regions in the Arctic with an annual ice outflow of 540 km^3.[367] Via the Transpolar Drift, the sea ice formed over the Laptev Sea shelf transits the Arctic Ocean to Fram Strait between Greenland and Spitsbergen within a couple of years, resulting in a substantial export of freshwater and sediments.[368]

Persistent vertical stratification of the water column is a general characteristic of the Laptev Sea shelf, despite its shallow depths, in areas outside the Great Siberian Polynya.[369] The dynamic processes within the polynya permits vertical mixing, resulting in the transport of nutrients from the bottom into the water column.[370]

Intense ice formation in the flaw polynyas increases the salinity of the surface water layer.[371] This exerts further influence on large-scale processes in the Arctic Ocean, since the increased salinity causes convection in the underlying water layers and the water masses mix.[372] The Great Siberian Polynya may be a source of not only a significant volume of drifting ice, but also of saline shelf waters in the Arctic Ocean.[373]

Geology

The New Siberian Islands archipelago located in the Great Siberian Polynya region has a unique geological history, with diverse magmatic and sedimentary rocks.[374] Along the islands' coasts there are gigantic ice cliffs dating from the Pleistocene that contain a large quantity of paleofauna bones. The New Siberian Islands represent the largest area in the world that still contains such diverse and abundant mammoth fauna in the permafrost.[375]

CRITERION IX – SIGNIFICANT ECOLOGICAL AND BIOLOGICAL PROCESSES IN THE EVOLUTION OF ECOSYSTEMS, COMMUNITIES OF PLANTS AND ANIMALS

The Great Siberian Polynya is the most stable and ecologically significant of all the polynyas in the Siberia shelf seas.[376] It forms an ecologically and biologically significant region important to a variety of species.[377]

In polynya waters, seasonal development of plankton usually begins earlier, and the more abundant primary production compared to surrounding habitats attract planktivorous invertebrates, which in turn attract fish, marine mammals and birds.[378] The Great Siberian Polynya in the Laptev Sea supports high primary productivity, significant growth of zooplankton and stability in the high trophic level populations.[379] By virtue of the strong vertical circulation of the water and inflow of organic material to the near-bottom water layers and bottom sediments, benthic communities are also characterized by a high productivity and wealth of species in the polynya waters.[380]

CRITERION X – SIGNIFICANT BIOLOGICAL DIVERSITY AND THREATENED SPECIES OF OUV

Marine mammals

The Great Siberian Polynya waters provide key winter habitat for the endemic Laptev walrus population, once considered a distinct subspecies (*Odobenus rosmarus laptevi*), but recently identified as a population of Pacific walrus (*O. rosmarus divergens*).[381] The Laptev walrus population is unique, characterized by the absence of seasonal migrations. The persistence of the Great Siberian Polynya system allows walruses to stay in the Laptev Sea all year round, and Laptev walruses do not perform long-distance seasonal migrations as do other Pacific walrus populations.[382] The Great Siberian Polynya system is also important habitat for ringed seal populations (*Phoca hispida)* and their main predator, the polar bear (*Ursus maritimus*).[383]

Under modern conditions of a warming climate and the retreat of sea ice, some large cetaceans are beginning to penetrate further westward and reach the Great Siberian Polynya waters in the summer season. The Bering-Chukchi-Beaufort Sea subpopulation of Bowhead whale (*Balaena mysticetus*)[384] and grey whales (*Eschrichtius robustus*) are two populations reaching these previously inaccessible areas.[385]

Seabirds

The Great Siberian Polynya System serves as a major spring migration stopover site for seabirds, including the thick-billed murre (*Uria lomvia*), black-legged kittiwake (*Rissa tridactyla*), king eider (*Somateria spectabilis*) and long-tailed duck (*Clangula hyemalis*).[386] All cliff-breeding seabirds in the area are ecologically tied to polynyas.[387] In summer and autumn, the shallows around the New Siberian Islands are important feeding and moulting habitats for waterfowl such as the Pacific eider (*Somateria mollissima v-nigra*), long-tailed duck (*Clangula hyemalis*) and red phalarope (*Phalaropus fulicarius*).[388]

Fish

The polynya waters play an important role in the reproduction of polar cod (*Boreogadus saida*), an important prey species for many predators in Arctic marine ecosystems.[389]

Threatened or endangered species present in the Great Siberian Polynya:

Common name *(Latin name)*	Conservation Status
Polar bear (*Ursus maritimus)*	• IUCN Red List (vulnerable) • Russian Federation Red Data Book (listed)
Beluga whale (*Delphinapterus leucas)*	• IUCN Red List (near threatened)
Bowhead whale (*Balaena mysticetus)* Bering-Chukchi-Beaufort Sea subpopulation	• IUCN Red List (least concern) • Russian Federation Red Data Book (listed)
Grey whale (*Eschrichtius robustus)*	• IUCN Red List (least concern) • Russian Federation Red Data Book (listed)
Pacific walrus (Laptev population) (*Odobenus rosmarus divergens)*	• IUCN Red List (vulnerable) • Russian Federation Red Data Book (listed)
Ivory gull (*Pagophila eburnea*)	• IUCN Red List (near threatened) • Russian Federation Red Data Book (listed)
Long-tailed duck (*Clangula hyemalis*)	• IUCN Red List (vulnerable)
Siberian (Steller's) eider *(Polysticta stelleri)*	• IUCN Red List (vulnerable)

MAJOR THREATS

Climate change

Global climatic models show that the Arctic is one of the region's most sensitive to climate change.[390] In general, the summer extent and average ice thickness is decreasing in the Laptev Sea.[391] Changes in the ice and in oceanographic regimes, including the river runoff regime and increasing intrusion of Atlantic water caused by global processes, may also change the area and duration of the polynya or even make it disappear, which may significantly affect

the functioning of the whole local marine ecosystem and result in its radical rearrangement.[392]

Shipping

The Northern Sea Route passes through the Great Siberian Polynya system. Research within the framework of the International Northern Sea Route Programme showed that international shipping along the Northern Sea Route is economically reasonable, especially for exporting Russian Arctic oil and gas.[393] By 2020, 40 million tons of oil and gas per year are projected to be transported by sea along the Northern Sea Route.[394]

Shrinking Arctic sea ice may result in increasing shipping along the Northern Sea Route, especially in summer, when there is no or little sea ice. The species that inhabit the polynyas used by both the vessels and the wild animals are sensitive to the threats associated with intense shipping, including noise pollution of the marine environment, disturbance of the ice habitats, and the increasing risk of accidental oil spills.[395]

Oil and Gas

Almost the entire area of the Great Siberian Polynya System is covered with oil licenses recently issued and belonging to Rosneft Oil Company. Major threats include the risks of accidental oil spills, and the use of seismic surveys, which may have significant adverse impacts on the cetaceans and other marine life in the shallow waters of polynyas.

PROTECTION AND MANAGEMENT STATUS

National jurisdiction

The Great Siberian Polynya waters are fully located within the territorial waters and exclusive economic zone of the Russian Federation.

Protected areas

The Great Siberian Polynya has no special protected status, but two natures reserves exist within adjacent areas.

- The Arctic cluster of the Taimyrsky State Nature Biosphere Reserve near Maria Pronchishcheva Bay was established in 1994. It is the only coastal area of the reserve, and is situated near the western portion of the Great Siberian Polynya System. This cluster is 433,220 hectares, which includes 37,018 hectares of sea waters. Major conservation values of this area are Laptev walrus haul-out sites, populations of ice-dependent seals, the Laptev population of polar bears and their habitats, and waterbird populations and their marine habitats.[396]
- Ust'-Lensky State Nature Reserve*:* Founded in 1985 to protect the unique ecosystem of the largest Arctic river delta, the reserve includes 1.43 million hectares of delta islands and channels. The reserve does not include any marine waters. The reserve formerly had a buffer zone which covered the New Siberian Islands and their surrounding waters, and had a status of regional (Yakutian) natural resources reserve, but it was declined in 2012.[397] There is a plan and ongoing process to establish a specially protected area on the New Siberian Islands which will include the marine area partly covering the Great Siberian Polynya portion north of the archipelago.[398]

International Laws and Treaties

The area lies within the Northern Sea Route area, which has special legal status and is regulated under the Russian Federal Law on the Northern Sea Route adopted in 2012.

IMO Polar Code:[399] The Polar Code and SOLAS amendments were adopted during the 94th session of IMO's Maritime Safety Committee (MSC), in November 2014, and were intended to protect ships and people aboard them in the harsh polar environment. The environmental provisions and MARPOL amendments were adopted during the 68th session of the Marine Environment Protection Committee (MEPC) in May 2015. The Polar Code is expected to enter in to force on 1 January 2017.

Fisheries Management

The Federal Agency for Fishery regulates fishery in the federal waters of the Russian Federation. The Great Siberian Polynya waters now are not included into commercial fishery grounds due to low pelagic fish productivity and low accessibility.

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Report of an expert workshop and review process

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