

# 1. Introduction

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This is the first Circumpolar Biodiversity Monitoring Program (CBMP) report to summarize status and trends in key biotic elements of the Arctic marine environment, what the CBMP refers to as Focal Ecosystem Components (FECs). The results are based on efforts to locate, gather, integrate and interpret all available existing Arctic marine biodiversity monitoring datasets to improve the detection and understanding of changes in circumpolar marine biodiversity.

The process to produce this report has identified knowledge gaps in circumpolar biodiversity monitoring and adjustments to program design are needed to achieve additional implementation of the *Arctic Marine Biodiversity Monitoring Plan (CBMP Marine Plan)*; Gill et al. 2011). The *CBMP Marine Plan* has learned a lot from this process, which will inform additional program development, as new knowledge, improved conceptual models, new technologies and adjustment in design feed back into the adaptive integrated approach of the CBMP. This is just the beginning of a continued effort to further advance work in circumpolar biodiversity monitoring efforts and to understand the impact of changes on Arctic marine ecosystems and life in the oceans.

## 1.1 What is the Circumpolar Biodiversity Monitoring Program (CBMP)

The CBMP is the cornerstone program of the Conservation of Arctic Flora and Fauna (CAFF), the Arctic Council's biodiversity working group. The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States, Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular, on issues of sustainable development and environmental protection in the Arctic.

The CBMP is an international network of scientists, governments, Indigenous organizations, and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources and aims to incorporate Traditional Knowledge (TK) holders. Its goal is to facilitate more rapid detection, communication and response to significant biodiversity-related trends and pressures affecting the circumpolar world while also establishing international linkages to global biodiversity initiatives. The CBMP applies a question-driven and integrated ecosystem-based approach to long-term monitoring to describe ecosystem and biodiversity change, and to identify important trends (Fig. 1.1).

It does this by:

- compiling, harmonizing and enhancing Arctic biodiversity monitoring efforts, thereby improving the ability to detect and understand significant trends; and
- reporting to, and communicating with, key decision makers and stakeholders, thereby enabling effective conservation and adaptation responses to changes in Arctic biodiversity.

The CBMP facilitates monitoring through the implementation of four Arctic Biodiversity Monitoring Plans (marine, coastal, freshwater and terrestrial). A State of the Arctic Biodiversity Report will be created under each of these monitoring plans,

followed by regular combined reports in the future. The approach adopted in these plans follows the steps required for an effective and adaptive monitoring program (Lindenmayer and Likens 2009) and includes a consideration of what future priority questions and user needs the program should cover. While much work remains to integrate existing Arctic biodiversity monitoring, the continued implementation of the CBMP is a major achievement (Barry et al. 2013).

## 1.2 What is the State of the Arctic Marine Biodiversity Report (SAMBR)?

This *State of the Arctic Marine Biodiversity Report (SAMBR)* is the first integrated reporting outcome from the *CBMP Marine Plan*.

Where it has been possible, the SAMBR:

- describes current and/or historical baseline status of identified FECs;
- evaluates historical and contemporary trends;
- considers how changes in biodiversity may be linked to stressors;
- describes differences that have occurred within the Arctic Marine Areas (AMAs);
- describes status of Arctic biodiversity monitoring;
- identifies research priorities, knowledge gaps; and
- provides advice for monitoring and management.

The *Arctic Biodiversity Assessment (ABA)* (Meltofte 2013) provides the fundamental baseline to make trend assessments in SAMBR possible. Six Marine Expert Networks (Sea ice biota, Plankton, Benthos, Fishes, Seabirds and Marine mammals) provide the framework to implement the *CBMP Marine Plan* and generate the information required for SAMBR.

## 1.3 What is the Arctic Marine Biodiversity Monitoring Plan (CBMP Marine Plan)?

The *CBMP Marine Plan* (Gill et al. 2011) is an agreement across Arctic States to compile, harmonize and compare results from existing Arctic marine biodiversity and ecosystem monitoring efforts, across nations and oceans. The *CBMP Marine Plan* developed conceptual ecological models and identified recommended selected aspects of the environment to monitor at various trophic levels using specific parameters, methodologies and sampling designs.

This approach considers the integrity of ecosystems and their interactions and focuses on a series of FECs defined in the *CBMP Marine Plan*; these are subject to revisions based upon outcomes of this report. This approach aligns with other comparable initiatives, including the Essential Biodiversity Variables (Pereira et al. 2013), developed by the Group on Earth Observations Biodiversity Observation Network (GEOBON). The resulting information contributes directly to providing decision makers and other users with information to inform effective conservation, mitigation and actions in an Arctic context.

For the purposes of reporting and comparison, the *CBMP Marine Plan* identified eight physically and biogeochemically distinct AMAs (Fig. 1.2).

## 1.4 Traditional Knowledge (TK)

To have a thorough understanding of the state of the Arctic and how it is changing, it is necessary to consider both TK<sup>1</sup> and science. The *CBMP Marine Plan* endeavours to build a network based on both sources of knowledge and bring together TK holders and scientists to work collaboratively. However, a lack of funding support and capacity has hindered effective inclusion of TK holders within the *CBMP Marine Plan*. It is important for Arctic States to support the experts (both TK holders and scientists) needed to do this work.

<sup>1</sup> The Indigenous organisations who are Permanent Participants to the Arctic Council have defined TK as “a systematic way of thinking and knowing that is elaborated and applied to phenomena across biological, physical, cultural and linguistic systems. TK is owned by the holders of that knowledge, often collectively, and is uniquely expressed and transmitted through indigenous languages. It is a body of knowledge generated through cultural practices, lived experiences including extensive and multigenerational observations, lessons and skills. It has been developed and verified over millennia and is still developing in a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation” (Permanent Participants of the Arctic Council 2015). Indigenous peoples’ organizations have been granted Permanent Participant status in the Arctic Council. The Permanent Participants have full consultation rights in connection with the Council’s negotiations and decisions. The following organizations are Permanent Participants of the Arctic Council: Aleut International Association (AIA), Arctic Athabaskan Council (AAC), Gwich’in Council International (GCI), Inuit Circumpolar Council (ICC), Russian Association of Indigenous Peoples of the North (RAIPON) and the Saami Council (SC)

Although it is an imperfect treatment, this report provides examples to demonstrate the wealth and value of information that may be provided by TK. These case studies are derived from information found within published literature. As the CBMP progresses in its work, there is a continued effort and willingness to meaningfully engage TK, recognize TK monitoring methodologies and include TK holders throughout the process.

## 1.5 Arctic Biodiversity Data Service (ABDS)

Datasets compiled for SAMBR are available on the Arctic Biodiversity Data Service (ABDS), the online interoperable system for managing data generated via CAFF projects and activities. The goal of the ABDS is to facilitate access, integration, analysis and display of biodiversity information for scientists, managers, policy makers and others working to understand, conserve and manage the Arctic’s wildlife and ecosystems. It ensures that biodiversity data provided to CAFF are organised to guarantee a legacy in a manner that facilitates: data discovery; increased understanding; informed and rapid decision-making; and ongoing research.



Figure 1.1: Work flow of the Circumpolar Biodiversity Monitoring Program (CBMP).

## Box 1.1 Focal Ecosystem Components (FECs)

The CBMP uses the term FECs to describe biological elements that are considered central to the functioning of an ecosystem, of major importance to Arctic residents, and/or are likely to be good proxies of change in the environment. Marine FECs addressed in the SAMBR are:

### Marine mammal

Beluga	<i>Delphinapterus leucas</i>
Narwhal	<i>Monodon monoceros</i>
Bowhead whale	<i>Balaena mysticetus</i>
Spotted seal	<i>Phoca largha</i>
Ringed seal	<i>Pusa hispida</i>
Bearded seal	<i>Erignathus barbatus</i>
Ribbon seal	<i>Phoca fasciata</i>
Harp seal	<i>Phoca groenlandica</i>
Hooded seal	<i>Cystophora cristata</i>
Walrus	<i>Odobenus rosmarus</i>
Polar bear	<i>Ursus maritimus</i>

### Seabirds

Glaucous gull	<i>Larus hyperboreus</i>
Ivory gull	<i>Pagophila eburnea</i>
Least auklet	<i>Aethia pusilla</i>
Little auk	<i>Alle alle</i>
Common murre	<i>Uria aalge</i>
Thick-billed murre	<i>Uria lomvia</i>
Black-legged kittiwake	<i>Rissa tridactyla</i>
Common eider	<i>Somateria mollissima</i>

### Fishes

Capelin	<i>Mallotus villosus</i> spp.
Polar cod	<i>Boreogadus saida</i>
Greenland halibut	<i>Reinhardtius hippoglossoides</i>

### Benthos

Macrobenthos  
Megabenthos

### Plankton

Phytoplankton and larger protists  
Microbial eukaryotes  
Bacteria and Archaea  
Zooplankton

### Sea ice biota

Prokaryotic microbes, including Archaea and Bacteria  
Ice algae and other single-celled eukaryotes  
Ice meiofauna  
Macrofauna: Under-ice amphipods

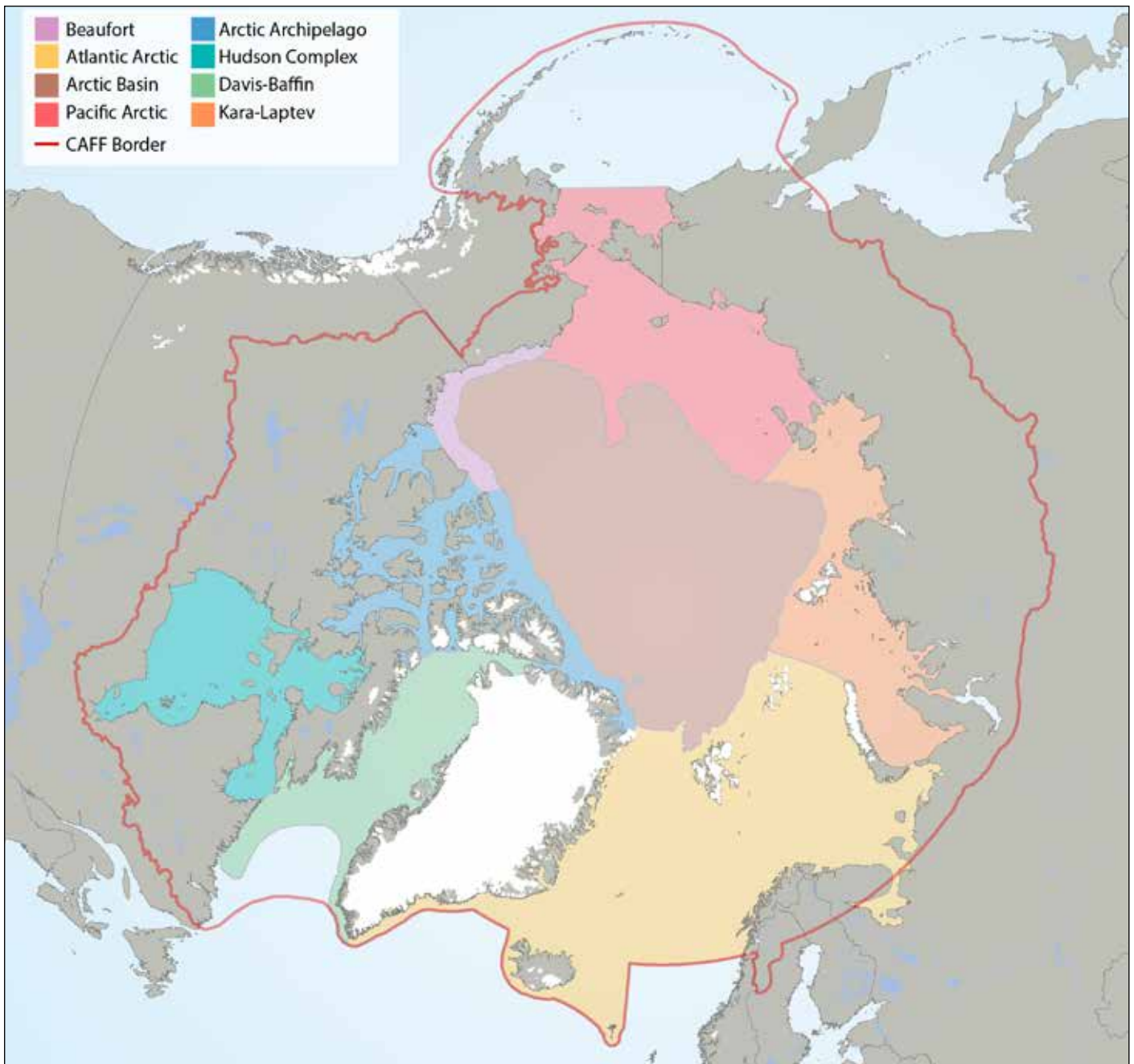


Figure 1.2. Arctic Marine Areas (AMAs) as defined in the CBMP Marine Plan.

## 1.6 Global linkages

The size and nature of Arctic ecosystems make them critically important to the biological, chemical and physical balance of the globe (Meltotte 2013). CAFF makes significant efforts to develop strategic partnerships and ensure that Arctic biodiversity information contributes to other Arctic Council activities and to the attainment of global biodiversity goals, targets and commitments of biodiversity-related Multilateral Environmental Agreements (MEAs) and other relevant international biodiversity fora<sup>2</sup>.

The CBMP has been endorsed by the Arctic Council and the United Nations Convention on Biological Diversity (CBD) (CBD 2010, 2012, Barry et al. 2013, Arctic Regional Workshop 2014, Arctic Council 1996-2015) and is the biodiversity component of the Sustaining Arctic Observing Networks (SAON). The CBMP is the official Arctic Biodiversity Observation Network (Arctic BON) of GEOBON and a partner to the Global Biodiversity Indicators Partnership (BIP).

The outputs of the SAMBR will contribute to these partnerships—for example, by helping to measure progress towards the CBD Aichi Biodiversity Targets<sup>3</sup>—and will ensure that relevant and reliable information on Arctic biodiversity informs regional and global processes that affect Arctic biodiversity.

<sup>2</sup> CAFF has signed Resolutions of Cooperation with the Global Biodiversity Information Facility (2016), the East Asian-Australasian Flyway Partnership (2013), the Ramsar Convention on Wetlands (2012), the United Nations Convention on Migratory Species (2013), the African-Eurasian Waterbird Agreement (2012), United Nations Convention on Biological Diversity (2010) and the Association of Polar Early Career Scientists (2009).

<sup>3</sup> The Aichi targets were agreed at the 10<sup>th</sup> meeting of the UN CBD Conference of the Parties, October 2010. These targets are a means to evaluate progress towards halting biodiversity loss by 2020



## Box 1.2 Marine sensitive and significant areas in the Arctic

Several recent initiatives have focused on the identification of marine areas of ecological importance and/or sensitive to pressures from specific activities. In 2013, the Arctic Council identified ecologically and culturally significant marine areas vulnerable to marine vessel activities changing climate conditions and increasing multiple marine uses (AMAP/CAFF/SDWG, 2013) as a follow up to the Arctic Marine Shipping Assessment (PAME 2009). This process entailed compiling existing information and identification of significant areas, which were then overlapped with existing information on Arctic marine vessel activity to assess their vulnerability. The outcomes informed consideration of “Specially Designated Marine Areas in the Arctic High Seas” (Det Norske Veritas 2014), which explored the need for internationally designated areas that might warrant protection from risks posed by international shipping activities, such as the potential application of Special Areas (SA) and Particularly Sensitive Sea Area (PSSA) measures under the International Maritime Organisation (IMO) (Barry et al. 2016).

Informed by these efforts, and as part of a global effort to identify Ecologically or Biologically Significant Marine Areas (EBSAs), in 2014 the CBD convened a workshop to identify Arctic EBSAs and focus future conservation and management efforts. This process collected a broad range of data in differing formats, scales and details relevant to identifying areas meeting the criteria to qualify as EBSAs (Arctic Regional Workshop, 2014). These data were analysed and used to identify and define Arctic EBSAs (Box. Fig. 1.1). The outcomes will be relevant in any subsequent steps of selecting conservation and management measures by states and intergovernmental organizations, for example, within the United Nations Convention on the Law of the Sea (UNCLOS) (Barry et al. 2016).



Box figure 1.1: Arctic Ecologically and Biologically Significant Areas (EBSAs) and Arctic Marine Areas of Heightened Ecological and Cultural Significance as identified in the Arctic Marine Shipping Assessment (AMSA) IIC report.

## References

- AMAP, CAFF, SDWG. 2013. [Identification of Arctic marine areas of heightened ecological and cultural significance: Arctic Marine Shipping Assessment \(AMSA\) IIC](#). Arctic Council.
- Arctic Council. 1996-2015. [Arctic Council Declarations 1996-2015](#). Arctic Council.
- Arctic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas. 2014. [Report of the Arctic regional workshop to facilitate the description of Ecologically or Biologically Significant Marine Areas. United Nations Convention on Biological Diversity](#). Helsinki, Finland. UNEP/CBD/EBSA/WS/2014/1/5.
- Barry, T., Christensen, T., Guðmundsdóttir, S., Lárusson, K.F., Price, C. and Mosbech, A. 2016. Spatial Information and Ecosystem-Based Management in the Marine Arctic. *In*: D.J. Bartlett and L. Celliers. (eds). [Geoinformatics for Marine and Coastal Management](#). CRC Press, Taylor & Francis Group, pp 253-268.
- Barry, T., Christensen, T., Payne, J. and Gill, M. 2013. [CBMP Strategic Plan 2013-2017: Phase 2 implementation of the Circumpolar Biodiversity Monitoring Program](#). CAFF Monitoring Series No. 8, Conservation of Arctic Flora and Fauna International Secretariat, Akureyri, Iceland.
- Conference of the Parties to the Convention on Biological Diversity (CBD). 2010. [Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting](#). United Nations Convention on Biological Diversity. October 2010, Nagoya, Japan. UNEP/CBD/COP/DEC/X/13.
- Conference of the Parties to the Convention on Biological Diversity (CBD). 2012. [Report of the Eleventh Meeting of the Conference of the Parties to the Convention on Biological Diversity](#). United Nations Convention on Biological Diversity. October 2012. Hyderabad, India. UNEP/CBD/COP/11/35.
- Det Norske Veritas. 2014. [Specially designated marine areas in the Arctic High Seas](#). Det Norske Veritas, Norwegian Environment Agency, Oslo, Norway.
- Gill, M.J., Crane, K., Hindrum, R., Arneberg, P., Bysveen, I., Denisenko, N.V., Gofman, V., Grant-Friedman, A., Guðmundsson, G., Hopcroft, R.R., Iken, K., Labansen, A., Liubina, O.S., Melnikov, I.A., Moore, S.E., Reist, J.D., Sirenko, B.I., Stow, J., Ugarte, F., Vongraven, D. and Watkins, J. 2011. [Arctic Marine Biodiversity Monitoring Plan. CAFF Monitoring Series Report No.3](#), Conservation of Arctic Flora and Fauna International Secretariat, Akureyri, Iceland.
- Lindenmayer, D.B. and Likens, G.E. 2009. [Adaptive monitoring: a new paradigm for long-term research and monitoring](#). *Trends in Ecology & Evolution*, 24(9): 482-486.
- Meltofte, H. (ed.) 2013. [Arctic Biodiversity Assessment Status and Trends in Arctic Biodiversity](#). Conservation of Arctic Flora and Fauna, Akureyri, Iceland.
- Pereira, H., Ferrier, S., Walters, M., Geller, G.N., Jongman, R.H.G., Scholes, R.J., Bruford, M.W., Brummitt, N., Butchart, S.M.H., Cardoso, A.C., Coops, N.C., Dulloo, E., Faith, D.P., Freyhof, J., Gregory, R.D., Heip, C., Höft, R., Hurtt, G., Jetz, W., Karp, D.S., McGeoch, M.A., Obura, D., Onoda, Y., Pettorelli, N., Reyers, B., Sayre, R., Scharlemann, J.P.W., Stuart, S.N., Turak, E., Walpole, M. and Wegmann, M. 2013. [Essential biodiversity variables](#). *Science*, 339(6117): 277-278.
- Permanent Participants of the Arctic Council. 2015. [Ottawa Traditional Knowledge Principles](#). Permanent Participants of the Arctic Council, Ottawa, Canada.
- Protection of the Arctic Marine Environment (PAME). 2009. [Arctic Marine Shipping Assessment Report](#). Protection of the Arctic Marine Environment, Akureyri, Iceland.



*A crane lands researchers onto the sea ice.*  
Photo: Caitlin Bailey, GFOE, The Hidden Ocean, NOAA