Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

National Capital Region

Canadian Science Advisory Secretariat
Science Advisory Report 2011/055

IDENTIFICATION OF ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSA) IN THE CANADIAN ARCTIC

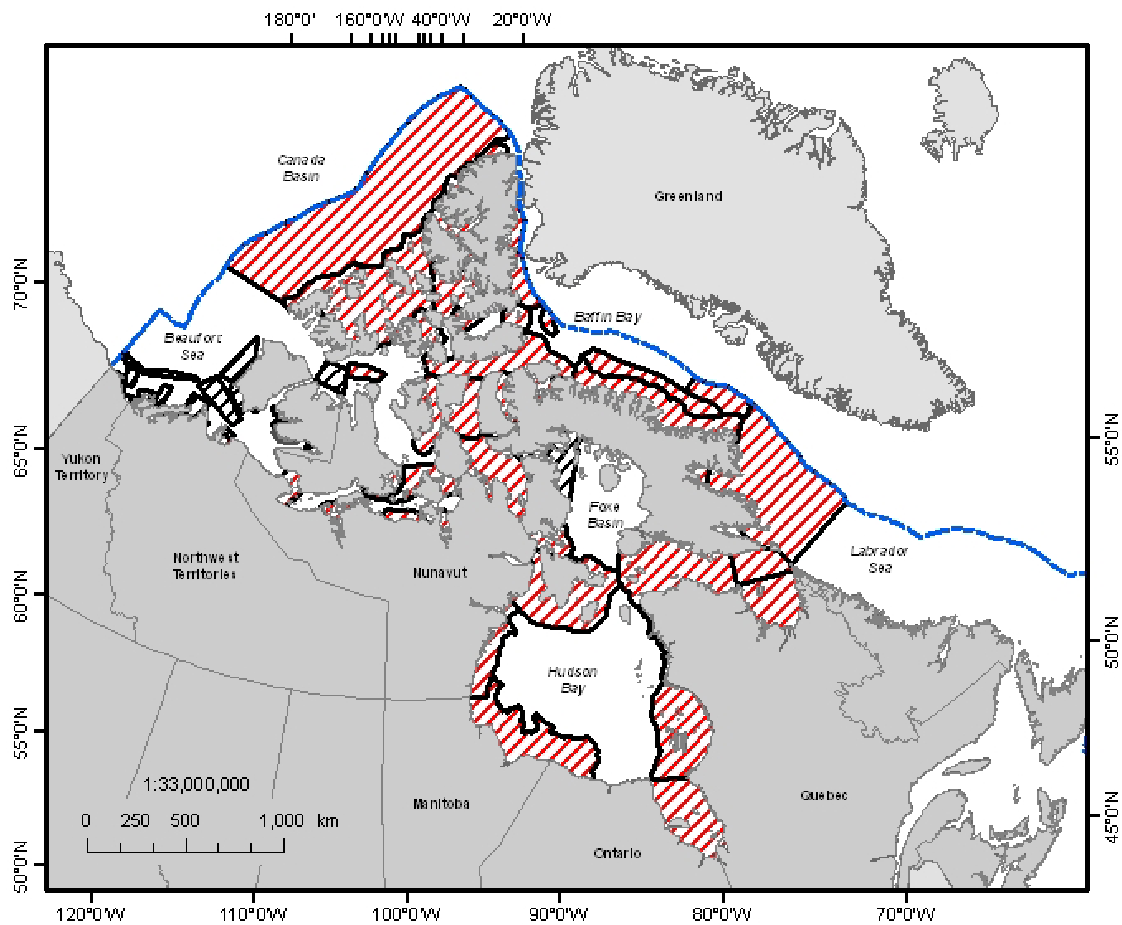

Figure 1: EBSAs identified within the five Arctic biogeographic regions (DFO 2009a) within Canadian Arctic waters, including those identified during this advisory meeting (red hatch marks) and those identified previously from the northern Foxe Basin and Beaufort Sea exercises (black hatch marks). The blue dashed line represents Canada's international boundary.

Context :

A national Canadian Science Advisory Secretariat (CSAS) science advisory process was held in Winnipeg, Manitoba from June 14-17, 2011 to provide science advice on the identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic based on guidance developed by Fisheries and Oceans Canada (http://www.dfo-mpo.gc.ca/csas/Csas/status/2004/ESR2004_006_E.pdf). This science advisory process focused on the identification of EBSAs within the following marine biogeographic units: the Hudson Bay Complex, the Arctic Basin, the Western Arctic, the Canadian Arctic Archipelago and the Eastern Arctic. Identification of EBSAs did not include the Beaufort Sea and northern Foxe Basin as those areas had been done previously.

Additional publications from this process will be posted as they become available on the DFO Science Advisory Schedule at http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

SUMMARY

- Identifying Ecologically and Biologically Significant Areas (EBSAs) is an important step in assessing the state of marine ecosystems.
- A total of 38 EBSAs were broadly identified, mapped and described within five of Canada's Arctic marine biogeographic units: the Hudson Bay Complex, Eastern Arctic, Western Arctic, Arctic Basin and Arctic Archipelago.
- Within each of the five biogeographic units, some EBSAs were given greater priority due to their ecological significance and, in some cases, their national and/or global significance.
- In some cases the ecological or biological feature extended either outside of Canadian waters or into the Newfoundland-Labrador Shelves biogeographic region. For these, the EBSA boundaries were defined by political or regional boundaries.
- The rationale provided for each EBSA should be considered when making management decisions in Canadian Arctic marine waters. Heterogeneity and underlying ecological properties within the broadly described EBSAs needs to be taken into account.
- This evaluation considered a number of published local and traditional ecological knowledge (LEK/TEK) reports. However, it was recognized that more detailed knowledge held by the Aboriginal peoples in the North would likely add to or further refine the boundaries of Arctic EBSAs.
- Given the limitations of the current process and the array of changes that are expected to occur in Arctic ecosystems (e.g. climate change), further work is needed to refine boundaries and potentially identify more specific areas within each of these broadly identified EBSAs. Future re-evaluations are critical to ensure management decisions are made with the best available information.

BACKGROUND

Canada has committed domestically and internationally to the sustainable development of the Arctic marine environment. Under Canada's *Oceans Act* (1997) Fisheries and Oceans Canada (DFO) is authorized to provide enhanced management to areas of the oceans and coasts which are ecologically and biologically significant (DFO 2004). Under the Health of the Oceans Initiative, DFO Science sector has been asked to provide advice in support of the identification and prioritization of Ecologically and Biologically Significant Areas (EBSAs) within each of the Canadian Arctic marine biogeographic units for which this exercise has not yet been conducted (DFO 2009a). EBSAs that were previously identified for the Beaufort Sea Large Ocean Management Area (LOMA) (Paulic et al. 2009) and northern Foxe Basin (DFO 2010) were not re-evaluated. Those EBSA identification processes have already been completed, including community consultation and boundary delineation.

The identification of EBSAs in the Canadian Arctic will serve as a key component for the development of ecosystem-based management in the marine environment, the knowledge base for the development of the Arctic component of Canada's network of marine protected areas (MPAs) called for in the *Oceans Act*; and will facilitate the implementation of DFO's Sustainable Fisheries Framework under the *Fisheries Act*. In addition, this information will be of direct use to other federal Departments, Canadian provinces and territories, Aboriginal organizations, co-management bodies that are responsible for the management of activities in the North (e.g. resource extraction, marine shipping, ocean dumping, spill response, cable or pipeline laying, land and resource use planning, etc.), companies operating in the North and the establishment of MPAs/enhanced marine protection measures.

INTRODUCTION

The identification of EBSAs is not meant to be a general strategy for protecting all habitats and marine communities; rather it is a tool to call attention to areas that have particularly high ecological or biological significance to allow appropriate management. The identification of EBSAs in Canadian waters according to the guidance provided by the DFO EBSA criteria (DFO 2004) have proven valuable for DFO Science and management sectors, as well as other federal departments, in all three of Canada's ocean areas. Each region in which EBSA identification processes have been undertaken has important contextual characteristics, and that is particularly true for the Canadian Arctic. Several important factors need to be taken into account for the EBSA identification process, the communication of the results, and the use of EBSAs in policy and management decision-making.

Canadian Arctic ecosystems and habitats are often considered globally and/or nationally significant and/or unique. Although all areas identified as EBSAs should receive enhanced risk adverse management, areas that are highlighted as globally or nationally important areas should warrant higher priority and the application of precautionary management to spatial planning and decision-making.

In the coming years and decades the Canadian Arctic will experience an accelerated rate of change due to global warming. The Intergovernmental Panel on Climate Change (IPCC) global projections indicate that the rate of change will be greater in polar regions than at lower latitudes. Rapid warming of the Arctic climate will undoubtedly have an impact on one of the most important habitat features of Arctic marine ecosystems, the sea ice. For example, within the Canadian Arctic, the extent and presence of multi-year sea-ice is considered unique and an important physical and habitat feature of Arctic ecosystems. However, the size and resilience of this feature will continue to decrease as the climate warms, making it the last refuge for organisms that rely on this feature in the Arctic. This makes these globally significant ecosystems and EBSAs linked to multi-year sea ice a legacy for all humanity, and a global responsibility for Canada.

Given the limitations of the available data and the array of changes that are expected to occur in Arctic ecosystems it is particularly important to revisit these EBSA delineations in the future, as more information becomes available from scientific research and monitoring and LEK/TEK. Such future re-evaluations are critical to ensure that management decisions are made with the best possible information.

For most of the Arctic, and typical of scientific data collection, many of the information sources used for EBSA delineation may be somewhat incomplete (e.g. marine fish). This has a number of implications on both the identification process and the use of results. With regard to EBSA identification, these implications include:

- Oceanographic and bathymetric covariates of important ecological properties were often given greater weight in identifying areas that were likely to meet EBSA criteria, but for which the necessary data on the biological properties were not available; such cases are clearly identified in the advice. These areas should receive precautionary management, with careful study of the local conditions prior to any decision to allow new activities.
- Remote sensing information on ocean colour was important to the evaluation of productivity levels in many areas where *in situ* measurements have not been made. However, it is recognized that ocean colour remote sensing data in Arctic regions have some inherent limitations, because the instruments cannot see through ice, clouds, sediment contamination (associated with freshwater discharge in coastal waters) and/or sub-surface production and

the sensor requires daylight to function, which for much of the year, the nights are long and dark.

- The process relied heavily on data from a small subset of species for which information was readily available and/or prepared in advance of the meeting. Often species that are socially, culturally, and economically important have a larger number of data sets associated with them and there is often more knowledge associated to their life history and distribution (e.g. Beluga (*Delphinapterus leucas*), Bowhead (*Balaena mysticetus*), Arctic Char (*Salvelinus alpinus*)).
- Another obvious bias, in such a large, remote region, is that our knowledge, as in many other coastal regions, is often focused heavily on the coastal areas that are within close proximity of established communities or camps. As the process of EBSA identification moves farther from the communities the evaluation process (i.e. scale and comparison) becomes increasingly difficult.
- Species which do not aggregate in large numbers (e.g. Ringed Seal (*Phoca hispida*), Polar Bear (*Ursus maritimus*)) are less conspicuous in the information sources used for application of the criteria (not just "Aggregation"), and *de facto* many of their ecological requirements may have received less weight in decisions about EBSA locations.
- There is also very little information on some ecologically important species (e.g. Arctic Cod (*Boreogadus saida*)). Therefore areas of high functional consequences for these key species and the ecosystems in which they are found may not have been captured in this EBSA identification process and will not be identifiable until appropriate information becomes available.

With regard to use of the EBSA results:

- Unlike regions in lower latitudes, the Arctic EBSA identification process often had to work at larger spatial scales due to the patchy and incomplete nature of the available data. This means that many large EBSAs have important internal heterogeneity, with subareas having different ecological characteristics. The full areas should be treated as ecologically and biologically significant, but different parts are significant for different reasons and will have different vulnerabilities to various human activities. Within these large EBSAs good planning and management should not be homogeneous; rather planners and managers will have to work at finer scales within each of these areas.

- Although this evaluation process used a number of publications (e.g. Government of Nunavut 2008, 2010) and information from a recent community tour (DFO 2011a), information taken from the traditional knowledge of Aboriginal peoples in the North for this EBSA identification process is incomplete. This knowledge is critical to the success of a full EBSA identification, particularly for insights on a changing environment, for areas that are remote and not often visited by researchers, and to add information with respect to seasonal changes in habitat and species use. Unfortunately, the timeframe available to deliver advice for international processes did not allow for the attendance of many of the invited participants from the North. To account for this, a parallel process has been established to complement this advice with traditional knowledge. Very high priority is attached to the communication of this EBSA process to Aboriginal peoples and to ensuring these results are augmented and extended by their knowledge.

The Canadian Arctic holds a number of unique or distinctive features which are either not typical or not as prominent in other Canadian regions. For this reason, there are a number of differences between the results of this EBSA identification process and the processes that have been undertaken in Canadian Atlantic and Pacific marine systems. Key differences include:

- In many of the Arctic sub-regions, sea ice is a key structural and/or physical oceanographic feature which may qualify as an EBSA for Resilience and/or the Fitness Consequences of the diversity of species which aggregate within or at the sea ice-edge (e.g. polynyas). The location and boundaries for an ice-edge are dynamic and there is a high degree of inter-annual and seasonal variability; thus precise geographical definitions can be misleading. In some cases, the location of the oceanographic and ecological processes associated with this habitat can be predicted based on bathymetry, currents, winds, and historical information and knowledge, but this is not always the case. In situations where the seasonal ice-edge can be spatially delineated, the usual practices in EBSA identification could capture the location on a static map. In cases of more spatially mobile ice-edges, the EBSA represented on the map is larger in order to capture seasonal variability. The mobile property of ice-edges applies to many other features of ice, including multi-year ice. Policy and management in the entire area needs to take into account the likelihood that an ecologically significant feature will be present there in some years and seasons, but many shorter-term tactical management measures should be targeted on the area in proximity to the ice-edge, wherever it happens to be in the specific year and season.

- In the Canadian Arctic migration routes of marine mammals and seabirds are often performed over large distances (e.g. distance between overwintering and summer habitats). These migration routes were considered more important than in many other EBSA identification processes. Migration routes are often affected by local-scale positions of sea ice that varies inter-annually. Such variability also adds complications for delineating EBSA boundaries and for appropriate risk adverse management within these EBSAs. Again strategic planning and cumulative effects assessments at a large scale will likely be necessary, but tactical management on a more local scale will also be important.

- A number of the identified Arctic EBSAs have strong seasonal biases associated with the sources of information and often many areas are lacking winter data. In addition to this temporal data bias, the ecological and biological features may also be seasonal (e.g. annual sea ice). Seasonal management measures will be appropriate in some cases. However, decisions with respect to the temporal management within EBSAs should be based on full consideration of the reasons for the EBSA delineation and not just because information is only available for a particular season.

Information Sources and Process

The identification of EBSAs in the Arctic was based on several sources of information. A key source was a working paper prepared for this meeting (Cobb 2011). The goal of the working paper was to comprehensively compile as much current published information, including primary and secondary scientific and technical publications and available published LEK/TEK within the short timeframe available. To the fullest extent possible data and information on each ecological property that was used to propose candidate EBSAs were initially mapped as separate spatial layers (e.g. oceanographic and bathymetric features, migration routes, and wintering areas by species). The working paper also included integrative maps of each biogeographic sub-region (i.e. an overlay exercise). These latter maps formed the initial basis for discussion of each EBSA in all regions.

Meeting participants provided additional and/or more detailed documentation of existing information and knowledge for a variety of ecological features as well. Some of this information is available in the published literature and is referenced while a few of the features are described in other working papers that will be published in the future and will be made available on the CSAS website. The following are a number of key ecological pieces of information supplementary to the original working paper (Cobb 2011) that were either presented at the meeting and/or as a source of added documentation:

Productivity

Rapid Assessment of Circum-Arctic Ecosystem Resilience (RACER)

1. RACER resilience assessment approach: The World Wildlife Fund (WWF)-led RACER project aims to identify those key features of Arctic ecosystems/ecoregions that contribute most significantly to the current resilience of the system, and that are considered likely to persist as significant components of future resilience, under climate change as modeled through to the end of this Century (WWF 2011). This new approach emphasizes the alignment of key drivers of system function in such areas, which are generally found to give rise to relatively highly biological production. Diversity of habitats and biota is also considered to be a critical dimension to future system resilience.

2. General Circulation Models (GCMs): The RACER analysis extracted decadal projections to 2100, by month for key variables/drivers of Arctic marine systems function, using the A2 emissions scenario for four GCMs that have been found to work well in Arctic ice systems (ECHO, CNRM, HADGEM, CCSM). Based on expert advice, projections were made of persistent prospects for current key features, under shifts for key variables this century.

3. Remote Sensing using the Sea-viewing Wide Field-of-view Sensor (SeaWiFS sensor satellite): Although not published yet, the RACER project used cutting-edge analysis conducted by Belanger & Babin et al. (Rimouski, Quebec) to investigate spatial variability in the index of primary productivity in the near surface open water. These analyses were based on the 13 years of data (1998-2010) available from the SeaWiFS satellite, corrected for chromospheric dissolved organic material (e.g., Mackenzie River plume). By examining 2 km pixels for reflectance accumulated over the entire open-water period, it was possible to generate maps by ecoregion showing distribution of the 80^{th} and 90^{th} percentiles for net primary production. In this way, via extensive coverage of the poorly studied marine areas, we have a good indicator of areas of relatively high near-surface marine productivity, aggregated over months of open water.

A number of publications will be presented in the primary literature in the future and the full handbook release of the WWF RACER project will be available in November 2011.

Ice Features

Three sources of information were summarized:

1. Weekly and bi-weekly maps of typical sea ice concentration based on 29 years of data taken from the ‘Sea Ice Climatic Atlas for Northern Canadian Waters 1971-2000’ published by the Canadian Ice Service[1].
2. Weekly and bi-weekly maps of the Frequency of Presence of Old Ice: 4 to 10/10 (%) (Canadian Ice Service).
3. Maps of tidal currents and information on the relationship between tidal currents and polynyas taken from Hannah et al. (2009).

The maps of typical sea ice concentration were used to provide the meeting participants with the information on seasonal cycle of sea ice in the Canadian Arctic and to show the location and

[1] www.ec.gc.ca/glaces-ice

timing of many of the polynyas necessary for decisions on EBSA identification. Maps of the frequency of old ice were used to provide the meeting participants with the necessary information on source and extent of multi-year ice. These maps are based on data from about 1980 to 2000. The topic of tidal currents and their relationship to polynyas and other features arose several times during the meeting. Information on this topic was extracted from Hannah et al. (2008, 2009). The tidal model information is available as part of the WebTide Tidal Prediction package[2].

Benthic Features

Data for the benthos were taken from a variety of sources. The primary data sources for coral and sponge biomass and distribution were based on bycatch data from the DFO multi-species surveys conducted by the Central and Arctic Region (1999-2010). Some data from the Newfoundland Region multispecies trawl surveys were also assessed (1996-1999). These surveys are conducted with three gear types, following a depth-stratified random design. Similar data were collected from the joint industry/government shrimp surveys in NAFO Divisions 2G and 0B (Northern Shrimp Survey 2005-2008) and from commercial fishing vessel logbook data (1998-2009). Data for the macrofauna (mostly infaunal organisms), megafauna (mostly large epifaunal organisms other than corals and sponges) and for the characteristics of benthic communities (sediment properties, benthic remineralization) were collected from United States Naval Electronic Laboratory boxcorers and Agassiz-trawls during a number of interdisciplinary research programs: North Water Polynya Study (1997 and 1998), Merica (Hudson Bay Complex 2003), Circumpolar Flaw Lead Study and Malina (Beaufort 2008 and 2009) and ArcticNet cruises (Beaufort, Western Arctic, Hudson Bay complex and Eastern Arctic 2008-2010). In addition the literature was also reviewed to identify the location of known polynyas and historical data on benthos and benthic ecosystems. Data sources and results are described in detail in Kenchington et al. (2011).

Marine Mammal Migrations

There is a substantial amount of additional information that is becoming available for the migration of both cetaceans and pinnipeds in the Arctic as a result of the technology associated with satellite-based radio telemetry tags used to track individual animals over extended periods. The information on cetaceans and pinnipeds presented during the meeting comes largely from the Labrador Sea and the Eastern Arctic. The data demonstrate the extensive movements seasonally within Canadian waters from north to south and movements east to west between Greenlandic waters (occasionally even east Greenland) and a number of the eastern biogeographic regions in the Canadian Arctic (e.g., Eastern Arctic, Hudson Bay Complex). The cetacean tagging data were further augmented by additional information on habitat use (e.g., fiords) and some of the focused studies and opportunistic observations of Beluga and Narwhal (*Monodon monoceros*).

Satellite tagging data on various species of seals also documented the extensive migratory patterns. For example, seals from the Labrador Sea (and further south) migrated great distances into the Canadian Arctic, as well as undertaking extensive east-west movements in Arctic waters in summer and fall. Evidence of strong differences among species in their use of on-shelf and off-shelf waters has emerged from these studies. The importance of both the continental shelf break and the position of the ice-edge to seals were again augmented by information from a variety of studies and surveys regarding seal habitat use.

[2] http://www.bio.gc.ca/research-recherche/WebTide-MareeWeb/webtide-eng.htm

Walrus Haul-out Sites

Walrus (*Odobenus rosmarus rosmarus*) tagging data revealed movement of populations between Canadian Arctic waters and Greenlandic waters (e.g., southeast Baffin Island and southwest Greenland). Unpublished and published survey data, traditional knowledge and opportunistic observations have also identified numerous Walrus haul-out site locations (terrestrial and sea ice platforms). Present knowledge suggests that Walrus prefer moving pack ice with access to open water (ice-edge) to haul-out and dive for food. However as ice cover diminishes and with potential of future ice-free periods, suitable terrestrial haul-outs may increase in importance to a number of Walrus stocks. Terrestrial haul-out sites are historically and currently used if the population remains undisturbed and in close proximity to feeding areas.

Seabird Colony Foraging Radius

During the discussions on the foraging radius of seabird colonies, new information was brought forward that changes the original publication sources used extensively in EBSA identification. The original publication by Mallory and Fontaine (2004) defined and produced maps of key marine habitat as 30 km from specific seabird colonies. However, new data and results suggest that this should be extended to 60 km (Elliott et al. 2009) for all the defined Arctic EBSAs that were originally mapped based on the 30 km boundary, and all EBSAs identified in this process as having fitness consequences for seabirds used this 60 km boundary.

ASSESSMENT: EBSA IDENTIFICATION PROCESS

The original working paper proposed 58 candidate EBSAs for review at this meeting (Cobb 2011). In the working paper each candidate EBSA was evaluated using the Convention on Biological Diversity (CBD) criteria defined in Annex 1 of Decision IX/20[3]. These results along with the additional sources of information presented at the meeting and participant knowledge all contributed to a final list of 38 EBSAs identified at this advisory meeting. This is in addition to the previously identified list of 20 EBSAs in the Beaufort Sea LOMA (Paulic et al. 2009) and three EBSAs from northern Foxe Basin (DFO 2010). Each of the 38 EBSAs identified at this meeting, were re-evaluated based on DFO (2004) EBSA criteria, in the context of each marine biogeographic region. Results are presented in Tables 1-4. Altogether, a total of 61 EBSAs have been identified within each of the five marine biogeographic regions in the Canadian Arctic (Figure 1).
For each EBSA a number and name were assigned according to location and the important or defining physical features of the EBSA were listed. The main dimension (uniqueness, aggregation and fitness consequences) and attribute (e.g., spawning, feeding) of a species or species groups were identified. Uniqueness and aggregation was assessed relative to other areas within the same biogeographical region. Fitness consequences were assessed depending upon how the loss of an area would compromise a population or stock. In addition, rare or endanged species that are listed by SARA or COSEWIC were identified as an attribute of the EBSA. This may assist with future EBSA prioritization.

Data confidence and the amount of research, science and LEK/TEK that was collected within an EBSA classified whether the group providing the advice was confident or not in a) the information that was used to support the area as an EBSA and, b) whether there was enough information and/or knowledge and it was recent enough to support the area as an EBSA.

For a number of EBSAs each of the ecological and biological features identified did not occur throughout the entire EBSA. These distinct areas may occur in only a small portion of the EBSA

[3] http://www.cbd.int/decision/cop/?id=11663

and therefore the EBSA was considered heterogeneous. In other cases, such as Lancaster Sound, the features of that EBSA were difficult to distinguish without a more detailed review of available information for the area and therefore, were considered to have no distinct areas.

The boundaries for each EBSA were also discussed at length and finalized based on all available information and are presented throughout this section (Figures 2-6). The decisions of the meeting participants relative to the background information provided by Cobb (2011) are presented in the body of the Science Advisory Report (SAR) for each EBSA.

For each of the five biogeographic regions, meeting participants identified EBSAs with particular significance due to their ecological/biological features:

- Southwestern Hudson Bay estuaries (1.7)
- Belcher Islands (1.9)
- Western Hudson Strait (1.11)
- Eastern Hudson Strait (1.12)
- Ungava Bay (1.13)
- Lancaster Sound (2.6)
- Hatton Basin and Entrance to Hudson Strait (a portion of 2.8)
- North Water Polynya (2.14)
- Lambert Channel (3.1)
- Yukon North Slope (3.7)
- Cape Bathurst Polynya (3.14)
- Arctic Basin Multi-year Pack Ice (4.1)
- Multi-year Pack Ice within Arctic Archipelago Islands (5.3)

Some of these EBSAs also have global and/or national significance. For example, Lancaster Sound and the North Water Polynya were considered globally significant and the Multi-year Pack Ice (Arctic Basin and Arctic Archipelago) should also be considered globally and nationally significant since predictions suggest these areas will be the last remnants of multi-year pack ice remaining in the Arctic. Participants cautioned that the list of prioritized EBSAs may be incomplete and would need to be revisited with other key experts.

During this EBSA identification process there were a number of cases where the ecological or biological feature extended either outside of Canadian waters or into the Newfoundland-Labrador Shelves biogeographic region. In these situations, the EBSA boundaries identified at this advisory meeting were bound by the defined political/regional boundaries.

The following is a detailed list of the outcomes and advice pertaining to newly identified EBSAs and changes to the originally proposed EBSAs from Cobb (2011):

1.0 Hudson Bay Complex

A total of thirteen EBSAs were identified within the Hudson Bay Complex biogeographic region and its three further defined sub-regions: 1) Foxe Basin, 2) Hudson Bay, and 3) Hudson Strait (Figure 2; Table 1). In 2009 an exercise was conducted to aid the Oceans Program in their identification of an Area of Interest (AOI) in the Foxe Basin sub-region. A total of three EBSAs were identified during that process (DFO 2010) and were not re-evaluated during this exercise. If new, published information existed that supported the original rationale it was added.

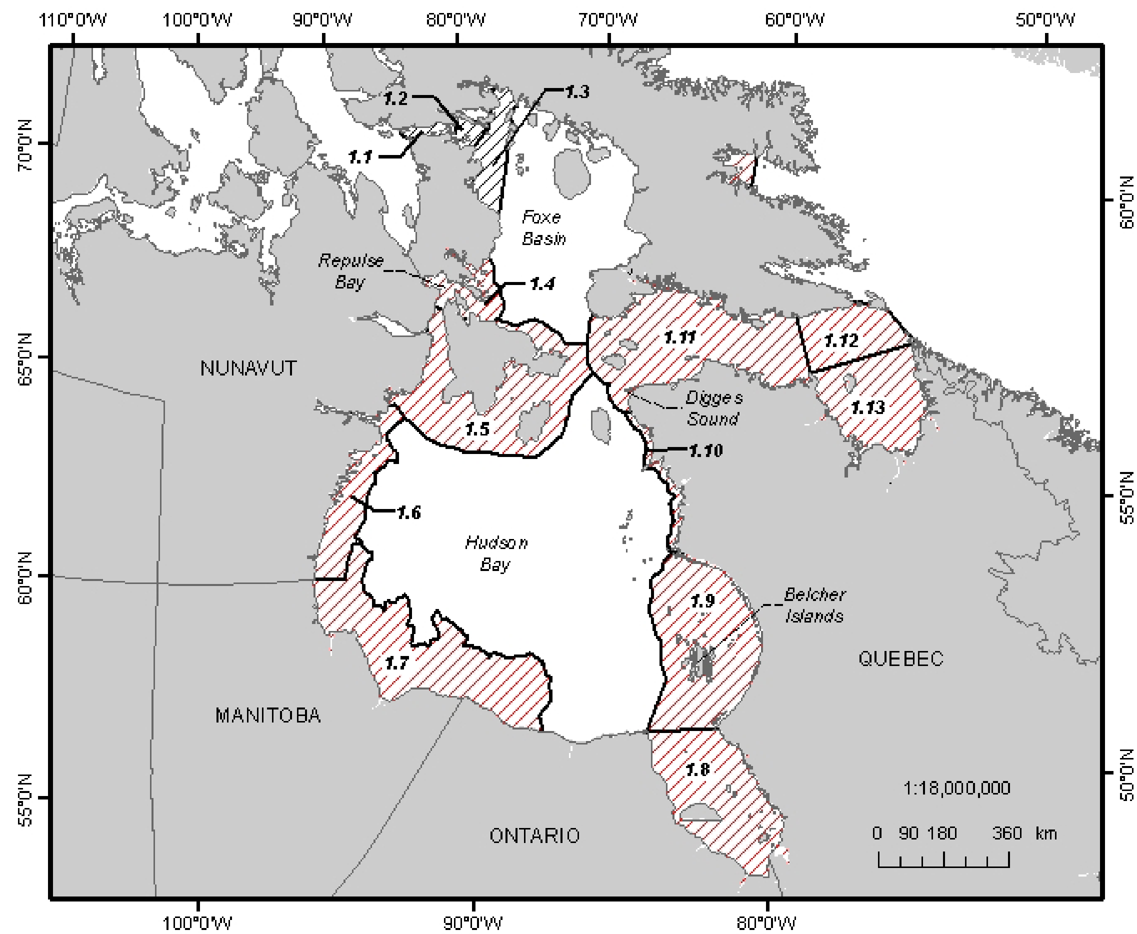

Figure 2. EBSAs identified within the Hudson Bay Complex biogeographic region, including those identified from the northern Foxe Basin exercise (black hatch marks, DFO 2010) and those identified during this advisory meeting (red hatch marks).

The boundaries and rationales for seven of the EBSAs were unchanged from the background paper. The boundaries and rationale for six EBSAs were adjusted based on additional information presented during the advisory meeting. The adjustments were:

1.5 Southampton Island

- The rationale of the EBSA was accepted; however minor adjustments were made to the south-western (reduction) and north-eastern (extension) boundaries. These boundary changes were based on the migratory routes of Narwhal and Bowhead.

1.6 Western Hudson Bay coastline

- The rationale of the EBSA was accepted. However, the offshore boundary was extended eastward to include the shore lead which is one of the defining physical features of this EBSA. LEK/TEK also supports the extension of this boundary for marine mammal migration (DFO 2001a). During fall freeze-up this area is used by migrating Polar Bears from the western Hudson Bay Polar Bear population. The offshore boundary coincides with a persistent sea-surface temperature front in the summer time (Galbraith and Larouche 2011).

1.7 Southwestern Hudson Bay estuaries

- The rationale of the EBSA was accepted. However the offshore boundary was extended eastward to include the 100 m water depth contour and a portion of the 3/10th ice cover. This area is also seasonally important for the western Hudson Bay and southern Hudson Bay Polar Bear populations during the spring break-up as it represents the last are where consolidated sea-ice occurs prior to the summer open water period. The sea ice feature is critical for the fitness of Polar Bears from each of these subpopulations and represents critical habitat for the rearing and survival of Polar Bear cubs. The area is often where sea-ice melts last in Hudson Bay (Galbraith and Larouche 2011). Moreover, data indicating high benthic diversity and high benthic production in the extended part were presented (Kenchington et al. 2011).

1.9 Belcher Islands

- The rationale of the EBSA was accepted, however the southern boundary was extended to ensure the overwintering habitat of Beluga and Walrus was incorporated based on local knowledge. This is critical habitat for the overwintering Beluga for their fitness consequences and as an aggregation (feeding). It is a seasonally important feeding area for the southern Hudson Bay Polar Bear population. This region has the coldest summer sea-surface temperatures of Hudson Bay south of Southampton Island, suggesting strong vertical mixing likely to sustain high primary productivity (Galbraith and Larouche 2011). Data on benthic diversity and production proxies supported this extension (Kenchington et al. 2011).

1.10 Eastern Hudson Bay coastline

- This is a new EBSA. It is based on data suggesting that the eastern coastline from the Belcher Islands to Digges Sound is an important migratory corridor for the Endangered Eastern Hudson Bay Beluga population.

Table 1. Evaluation Matrix for each of the identified EBSAs in the Hudson Bay Complex biogeographic region based on DFO (2004) criteria.

EBSA[4]		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species[5]	Level of Confidence	Heterogeneity of the EBSA
1.1	Fury and Hecla Strait	• Strong currents	• Migration Corridor	• Migration corridor[6] for marine mammals	• Polar Bear denning • Bowhead nursery	• Eastern Canada-West Greenland Bowhead (ECWG Bowhead)	HIGH	No distinct areas
1.2	Igloolik Island	• Polynya		• Walrus haul-out sites[7] • Migration corridor for marine mammals • Migration corridor for Arctic Char	• Walrus feeding • Bowhead nursery • Arctic Char feeding	• ECWG Bowhead	HIGH	No distinct areas
1.3	Rowley Island	• Sea ice-edge and Islands	• Preferred Walrus Habitat	• Migration pathway[8] • Walrus haul-out sites	• Walrus feeding	• ECWG Bowhead	HIGH	No distinct areas
1.4	Repulse Bay/Frozen Strait[1.4]	• Strong currents • Polynya	• Marine mammal summering area	• Summer marine mammal and seabird feeding • Iceland Gull	• Marine mammal and seabird feeding	• Northern Hudson Bay Narwhal • ECWG Bowhead • Northern Hudson Bay-Davis Strait Atlantic Walrus	HIGH	No distinct areas

[4] Original EBSA reference number in Cobb (2011)
[5] This refers to species that are identified by the COSEWIC and/or SARA as Endangered, Threatened, Special Concern or Extirpated.
[6] This refers to an area that no other option for migration would occur.
[7] Walrus haul-outs are referred to as either areas of land (e.g., fjords, mainland) or ice habitat (e.g., pack ice, sea-ice edge) that is required by the animals for fitness consequences.
[8] This refers to an area where the migration pathway may be either very large or other options for migration routes are available.

Table 1. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
1.5	Southampton Island[1.5]	• Islands	• Largest single colony of Common Eiders in Nunavut	• Migration pathway for marine mammals • Polar Bear denning area and summer refugia • Walrus haul-out sites • Seabird colonies	• Seabird nesting and foraging • Polar Bear denning and feeding • Walrus feeding	• ECWG Bowhead	HIGH	Some distinct areas
1.6	Western Hudson Bay Coastline[1.6]	• Consistent frontal zone • Winter shore lead	• Macrophytes	• Arctic Char migration corridor • Beluga aggregation • Fall migration area for Polar Bears	• Arctic Char feeding		HIGH	No distinct areas
1.7	Southwestern Hudson Bay Estuaries[1.7]	• Three estuaries (Churchill, Nelson and Seal rivers)	• World's largest summering Beluga aggregation • Harbour seals	• Beluga aggregation • Polar Bear denning, feeding and rearing • High benthic diversity and production	• Polar Bear denning and feeding • Beluga aggregation • High food supply for benthos	• Western Hudson Bay Beluga • Ross's Gull • Western Hudson Bay Polar Bear (Threatened under Province of Manitoba)	HIGH	No distinct areas

Table 1. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
1.8	James Bay[1.8]	• Shallow waters • Lower salinities • Large estuary	• Supports variety of warm water species that are relicts and rare or absent in other Eastern Arctic waters • Summer and wintering Beluga • Most southerly location used by Polar Bears in the world • Eelgrass beds (ESSCP) • International importance for Hudsonian Godwit and Red Knot (staging)	• Walrus haul-out sites and feeding • Polar Bear denning • Beluga aggregation • Cisco and Broad Whitefish migration and feeding • Shorebird and waterfowl staging and feeding • Seaduck feeding and moulting (Black Scoter)	• Walrus haul-out sites and feeding • Polar bear denning and feeding • Shorebird, seaduck and waterfowl staging and foraging area • Seaduck moulting • Cisco and Broad Whitefish feeding	• Northern Hudson Bay-Davis Strait Atlantic Walrus • Eastern Hudson Bay Beluga • Red Knot (*rufa* subspecies)	HIGH	No distinct areas

Table 1. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
1.9	Belcher Islands[1.9]	• Polynyas • Several small estuaries • Landfast ice around the islands • Currents around islands • Cooler water temperatures than surrounding Hudson Bay waters.	• Possible overwintering Beluga • Eelgrass • World population of resident Hudson Bay Common Eider subspecies	• Walrus haul-out sites • Summer Beluga aggregations at estuaries • High benthic diversity and productivity • Bearded Seals • Entire world population of the Hudson Bay subspecies of Common Eiders summers and winters here (100,000 – 200,000 birds) • Polar Bear feeding	• Walrus Feeding • Seaduck nesting and foraging • High food supply for benthos • Polar Bear feeding	• Northern Hudson Bay-Davis Strait Atlantic Walrus • Eastern Hudson Bay Beluga • Polar Bear feeding	HIGH	Some distinct areas
1.10	Eastern Hudson Bay Coastline[NEW]			• Migration pathway for Eastern Hudson Bay Beluga		• Eastern Hudson Bay Beluga	HIGH	No distinct areas

Table 1. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
1.11	Western Hudson Strait[1.10]	• Conduit for Arctic waters and periodic intrusions of Atlantic waters • Strong currents • Sponge Beds	• Migration corridor	• Migration corridor for marine mammals • Seabird colonies (murres) and seaduck nesting (eiders) and foraging sites • Walrus haul-out sites • Killer Whale • Overwintering Bowhead and Beluga • Sponge Beds	• Migration corridor to summer feeding and nursery grounds for marine mammals • Seabird and seaduck nesting and foraging • Walrus feeding • Epibenthic habitat	• Western & Eastern Hudson Bay Beluga • ECWG Bowhead • Northern Hudson Bay-Davis Strait Atlantic Walrus	HIGH	No distinct areas
1.12	Eastern Hudson Strait[1.11]	• Conduit for Arctic waters and periodic intrusions of Atlantic waters	• Migration corridor	• Migration corridor for marine mammals • Sponges and Corals • Shrimp • Overwintering Beluga and Bowhead • Walrus haul-out sites	• Migration corridor to summer feeding and nursery grounds for marine mammals • Seabird nesting and foraging • Beluga and Bowhead overwintering • Epibenthic habitat	• Western & Eastern Hudson Bay Beluga • ECWG Bowhead • Northern Hudson Bay-Davis Strait Atlantic Walrus • Ivory Gull	HIGH	No distinct areas

Table 1. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
1.13	Ungava Bay[1.12]		• Largest number of breeding Thick-billed Murres in Canada	• Corals • Depleted stock of Beluga • Polar Bear seasonal refugium • Seabird colonies • Seaduck nesting (eiders)	• Seabird and seaduck nesting and foraging • Polar Bear breeding, rearing and feeding • Epibenthic habitat	• Ungava Bay Beluga	HIGH	Some distinct areas

2.0 Eastern Arctic

A total of sixteen EBSAs were identified within the Eastern Arctic biogeographic region and its two further defined sub-regions: 1) Lancaster Sound/Barrow Strait and 2) Davis Strait/Baffin Bay (Figure 3; Table 2).

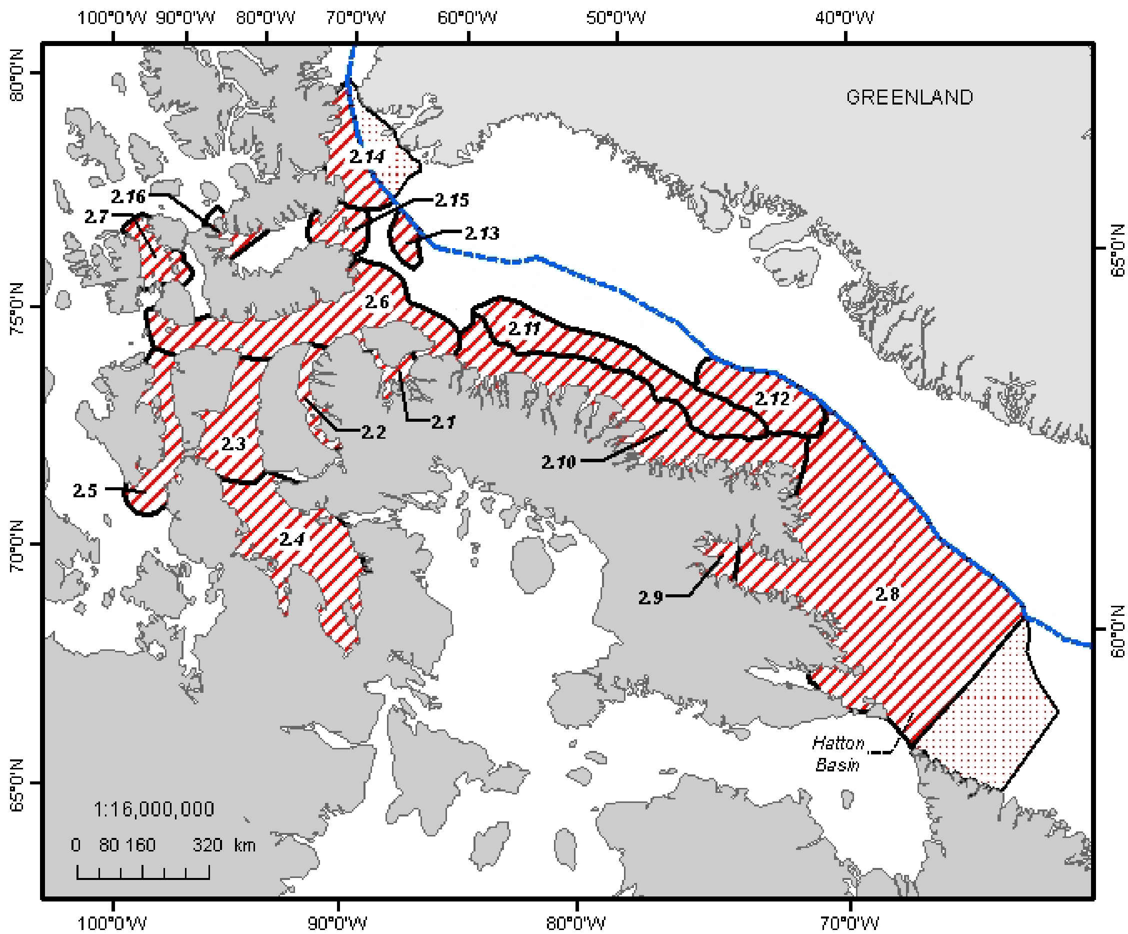

Figure 3. EBSAs identified within the Eastern Arctic biogeographic region. The Davis Strait EBSA (2.8) is defined by the biogeographic region boundary however, the ecological and biological feature(s) extend beyond into the Labrador-Shelf biogeographic region (identified by the red stippled area adjacent). This was also the case for the North Water polynya EBSA (2.14), where the ecological and biological features extend into Greenlandic waters to the east. The blue dashed line represents Canada's international boundary.

Several adjustments were made to the Davis Strait EBSAs. There was one additional area identified based on new information provided at this meeting (Kenchington et al. 2011). The following are the changes/adjustments to the rationale and boundaries of five Eastern Arctic EBSAs:

2.4 Gulf of Boothia

- This EBSA was also considered an important Bowhead migration and nursery area, the boundaries of this area were adjusted to reflect new satellite tagging data. This area also supports one of the highest reported concentrations of Polar Bears in the Canadian Arctic (10.4 bears/1000 km^2; Taylor et al. 1995).

2.7 Wellington Channel

- Nesting populations of Ross's Gull (*Rhodostethia rosea*) are present within this EBSA. Extended boundaries to the waters surrounding Queen Charlotte, Dundas and Baillie-Hamilton islands to include areas of Walrus aggregations and Ross's Gull nesting locations. Contains important summer sea-ice refuge and hunting habitat for Polar Bears in the central Canadian Arctic.

2.8 Hatton Basin-Labrador Sea-Davis Strait

- There was heterogeneity amongst the original four EBSAs (2.8, 2.9, 2.11, 2.12; Cobb 2011), however, it was noted that there was homogeneity as well, particularly concerning marine mammal migration and habitat. Further, both Frobisher Bay and Cumberland Sound have polynyas and as a result participants felt it appropriate to combine these areas into a single EBSA. Kenchington et al. (2011) report benthic diversity in this new area, including soft and hard bottom invertebrate communities. Significant aggregations of corals and sponges are found in particularly high abundances in Hatton Basin at the outflow of Hudson Strait and to the northern border of this EBSA. The ecological and biological feature extends into the Labrador Sea outside of the defined political boundary. Important spring and fall feeding area for the Davis Strait Polar Bear population. Satellite movement data indicate that the seasonal sea-ice in this area may provide bears access to migrating Harp Seals (*Pagophilus groenlandicus*). The ecological and biological feature extends south down the Labrador coast outside of the Eastern Arctic biogeographic region. Further research may lead to future refinement of this large EBSA.

2.10 Baffin Island Coastline

- This EBSA should be considered unique habitat because of the complex fjord system that extends the entire length of Baffin Island. This habitat feature extends offshore to the approximate location of the floe-edge (physical feature).

2.11 Baffin Bay Shelf Break

- This EBSA is an important migratory pathway for a number of marine mammals that were identified during the meeting and by LEK/TEK (G. Stenson, DFO, St. John's, NL, DFO 2011a).

2.13 Northern Baffin Bay

- This area is a new EBSA based on information in Kenchington et al. (2011) which delineates significant concentrations of Sea Pens (*Ombellula* sp.) at the outflow of Lancaster Sound in Baffin Bay.

2.16 Cardigan Strait/Hell Gate

- The resident Walrus population of western Jones Sound has been recently identified as a distinct stock separate from the Walrus populations of Baffin Bay, Lancaster Sound and Penny Strait (Stewart 2008).

Table 2. Evaluation Matrix for each of the identified EBSAs in the Eastern Arctic biogeographic region based on DFO (2004) criteria.

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
2.1	Eclipse Sound/Navy Board Inlet[2.1]			• Narwhal and Beluga migration pathway • Narwhal feeding • Ringed and Harp seals • Seabird staging	• Narwhal and Beluga feeding • Seabird nesting and foraging • Killer Whale feeding	• Baffin Bay Narwhal • Eastern High Arctic/Baffin Bay Beluga	HIGH	No distinct areas
2.2	Admiralty Inlet[2.2]			• Marine fishes – inferred from marine mammal habitat use • Marine mammal migration pathway • Narwhal feeding • Seabird colony (fulmars)	• Narwhal and Bowhead feeding • Seabird nesting and foraging	• Baffin Bay Narwhal	HIGH	No distinct areas
2.3	Prince Regent Inlet[2.3]	• Strong currents • Polynyas		• Bowhead nursery area • Marine mammal migration pathway • Narwhal feeding • Arctic Char migration corridor • Seaduck molting	• Marine mammal feeding • Arctic Char feeding • Seabird feeding	• Eastern High Arctic/Baffin Bay Beluga • ECWG Bowhead • Baffin Bay Narwhal	HIGH	Some distinct areas

Table 2. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
2.4	Gulf of Boothia[2.4]			• Bowhead migration corridor and nursery area • Narwhal migration pathway • Arctic Char migration corridor • Polar Bear denning, feeding and rearing	• Bowhead and Narwhal feeding • Arctic Char feeding corridor	• ECWG Bowhead • Baffin Bay Narwhal	HIGH	No distinct areas
2.5	Peel Sound[2.5]	• Polynya	• Largest Canadian Arctic population of Narwhal	• Marine fish – inferred from marine mammal habitat use • High benthic diversity and production	• Narwhal and Beluga feeding	• Eastern High Arctic/Baffin Bay Beluga • Baffin Bay Narwhal	HIGH	No distinct areas
2.6	Lancaster Sound[2.6]	• Polynya and associated sea ice-edges	• Major migration corridor • High productivity • High export of sea-ice aglae	• Marine mammal migration corridor • High benthic diversity and production • Highest density of Polar Bears • Over 1,000,000 seabirds and seaducks use this as a nesting and feeding area • Walrus haul-out sites	• Polar Bear feeding • Key foraging area for breeding Arctic seabirds and seaducks • High benthic re-mineralization • High quality food supply for benthos	• Eastern High Arctic/Baffin Bay Beluga • ECWG Bowhead • Baffin Bay Narwhal • Ivory Gull	HIGH	No distinct areas

Table 2. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
2.7	Wellington Channel[2.7]	• Strong currents • Polynya	• Ross's Gull nesting population	• Walrus haul-out sites • Seabird breeding • Seaduck breeding (eiders) • Summer feeding area for Polar Bear	• Walrus feeding • Seabird and seaduck nesting and foraging	• Ross's Gull	HIGH	No distinct areas
2.8	Hatton Basin-Labrador Sea-Davis Strait[2.8,2.9,2.11,2.12]	• Continental Shelf • Mixing waters • Polynyas in Cumberland Sound and Frobisher Bay • Deep Basin	• Diversity of deep water corals • Recurring mammal overwintering site	• High biological productivity • Corals and sponges • Hooded and Harp seals feeding • Hooded Seal breeding • Shrimp • Bowhead migration corridor • Seabird colonies • Marine fish • Walrus haul-out sites, ice-edge winter habitat, migration corridor to Greenland • Polar Bear feeding	• Overwintering Ivory Gull • Hooded Seal whelping • Marine mammal overwintering and feeding • Seabird and seaduck nesting and foraging • Epibenthic habitat • Polar Bear feeding	• Ivory Gull • Harlequin Duck • Wolfish • Western and Eastern High Arctic/Baffin Bay Beluga • ECWG Bowhead • Baffin Bay Narwhal	HIGH	Some distinct areas

Table 2. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
2.9	Cumberland Sound[2.10]			• Beluga summer habitat • Seabird feeding	• Seabird nesting and foraging • Beluga feeding and rearing	• Cumberland Sound Beluga	HIGH	Some distinct areas
2.10	Baffin Island Coastline[2.15]	• Floe-edge • Deep-sea troughs	• Bowhead nursery grounds	• Marine mammal migration pathway • Corals • Seabird colonies • Walrus haul-out sites • Polar Bear denning, feeding and rearing • Arctic Char migration corridor	• Walrus feeding • Seabird nesting and foraging • Marine fish • Polar Bear denning, rearing and feeding • Epibenthic habitat	• Ivory Gull	HIGH	Distinct areas
2.11	Baffin Bay Shelf Break[2.13]	• Continental Shelf		• Marine fish – inferred from shelf habitat • Marine mammal migration pathway • Corals and sponges	• Epibenthic habitat	• Baffin Bay Narwhal • ECWG Bowhead	HIGH	Distinct areas
2.12	Southern Baffin Bay[2.14]		• Black Corals	• Overwintering Narwhal and Bowhead • Corals	• Narwhal feeding • Epibenthic habitat	• Baffin Bay Narwhal • ECWG Bowhead	HIGH	No distinct areas

Table 2. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
2.13	Northern Baffin Bay[NEW]		• Sea pen aggregation	• Large sea pens	• Epibenthic habitat		HIGH	No distinct areas
2.14	North Water Polynya[2.16]	• Polynya and ice-edge	• Most of Canadian population of Ivory Gull • Largest and most productive polynya in the Arctic	• Marine mammal feeding • Polar Bear feeding • Seabird nesting and feeding • High biological productivity • High benthic diversity and production • Walrus winter and summer haul-out sites and migration corridor	• Seabird nesting and foraging • Marine mammal feeding • High quality food supply for benthos • Benthic re-mineralization • Polar Bear feeding	• Ivory Gull	HIGH	No distinct areas
2.15	Eastern Jones Sound[2.17]	• Polynya	• Largest colony of Black-legged Kittiwakes in Nunavut • Atlantic Puffin breeding site	• Walrus haul-out sites • Marine mammal and Polar Bear feeding • Seabird staging • Seaduck molting • Seabird colonies	• Seabird feeding and breeding • Walrus feeding	• Ivory Gull	HIGH	No distinct areas
2.16	Cardigan Strait/Hell Gate[2.18]	• Polynya • Fjords	• Distinct western Jones Sound Walrus population	• Walrus haul-out sites • Seabird nesting	• Walrus feeding • Seabird breeding and foraging		HIGH	No distinct areas

3.0 Western Arctic

A total of 26 EBSAs are identified within this biogeographic region (Figure 4; Table 3).

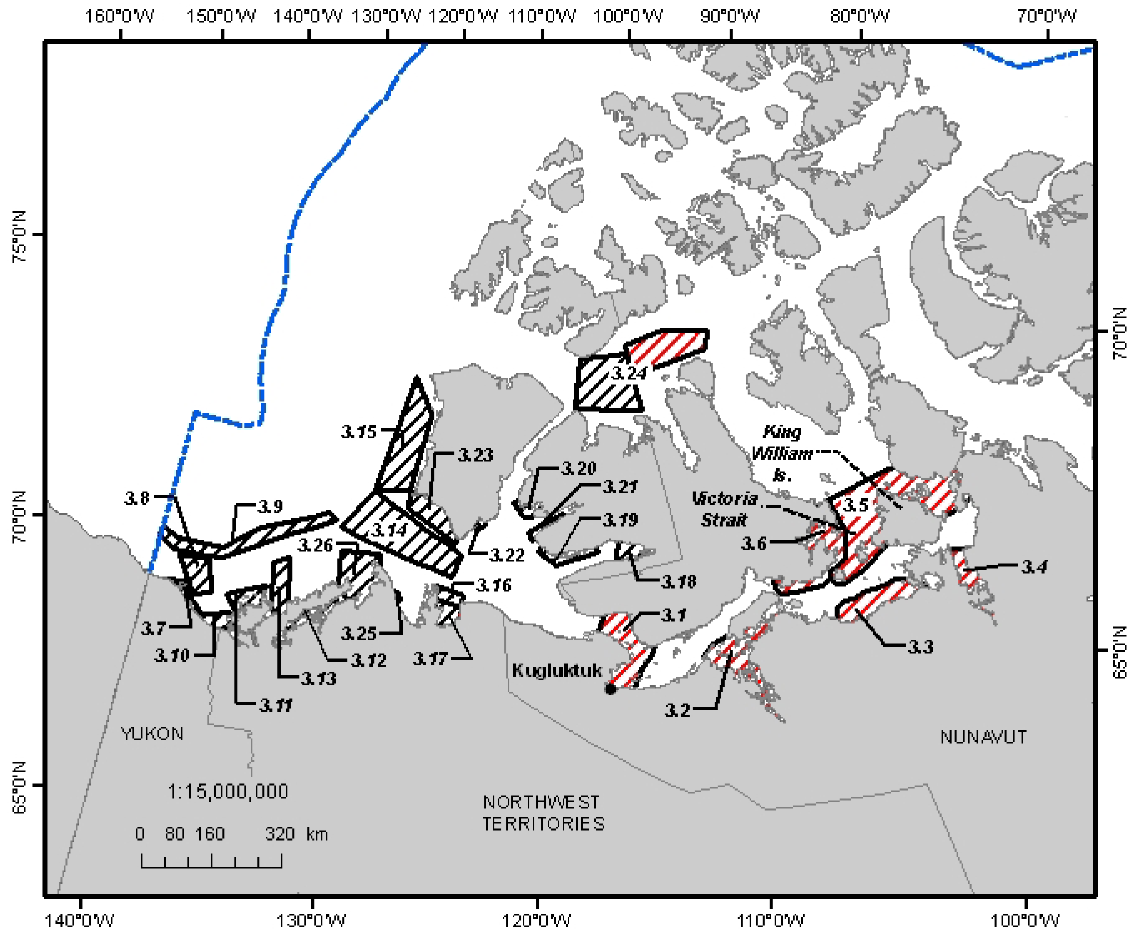

Figure 4. EBSAs identified within the Western Arctic biogeographic region, including those identified from the Beaufort Sea LOMA exercise (black hatch marks, Paulic et al. 2009) and those identified during this advisory meeting (red hatch marks).

There was no evaluation provided for the Beaufort Sea LOMA and this process did not consider revisions to the current 20 EBSAs identified in Paulic et al. (2009). Some additional information was presented in Kenchington et al. (2011) and will be considered in a future revision. Information for the eastern portion of this region (east of the Inuvialuit Settlement Region (ISR)) was scarce and relied heavily on data from the Canadian Wildlife Service, DFO Stock Assessments and LEK/TEK (Government of Nunavut 2010). The M'Clintock Channel EBSA, as defined by Cobb (2011) was removed based on new information brought forward at this advisory meeting. The area no longer met the criteria to be defined as an EBSA. Four EBSAs had adjustments made to their boundaries and the rationale for EBSA identification and two new EBSAs were identified:

3.1 Lambert Channel

- This area was a newly defined EBSA based on the existence of a polynya at the mouth of Lambert Channel and the wealth of LEK/TEK published in the Government of Nunavut

(2010) coastal community report (Kugluktuk) and a recent community consultation tour (DFO 2011a). The area is important to seaducks (Mallory and Fontaine 2004) and as an Arctic Char migration and feeding corridor. There is enhanced biological productivity at and/or surrounding the recurrent polynya.

3.5 King William Island

- The boundaries for this area were extended based on information from Hannah et al. (2009) which indicated there are enhanced tidal mixing zones on both the western and eastern sides of the island. In addition, Victoria Strait shows high bottom food supply and high epifaunal diversity (Kenchington et al. 2011). This area is also habitat for a depleted Polar Bear population.

3.6 Southern Victoria Island Coastline

- It was agreed that the Arctic Char nearshore migratory and feeding corridor should be a separate EBSA from the King William Island area (3.5) since the ecological feature/properties were different than those of the King William Island area. This EBSA was considered as a new EBSA for Arctic Char, extending to the 50 m depth contour.

3.24 Viscount Melville Sound

- The feature on which this EBSA was originally identified (Paulic et al. 2009) was defined by the presence of Beluga aggregations in a deep offshore basin. The eastern boundary of the original EBSA was defined by the political boundary of the ISR (Figure 4, black hatch marks), although the feature does extend farther east (Figure 4, red hatch marks). This EBSA was extended east into Nunavut based on the physical feature. This EBSA includes important feeding and rearing habitat for the Viscount Melville Polar Bear population.

Table 3. Evaluation Matrix for each of the identified EBSAs in the Western Arctic biogeographic region based on DFO (2004) criteria.

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
3.1	Lambert Channel[NEW]	• Polynya • Estuary		• Seabird feeding and staging	• Seabird migration, staging and foraging		HIGH	Some distinct areas
3.2	Bathurst Inlet[3.2]	• Strong currents		• Seabird feeding • Marine fish communities • Ringed Seal • Possible productive benthic epifauna communities	• Seabird feeding • Ringed Seal feeding		LOW	No distinct areas
3.3	Queen Maud Gulf Coastline[3.3]	• Several estuaries		• Arctic Char migration corridor	• Arctic Char feeding		LOW	No distinct areas
3.4	Chantrey Inlet[3.4]	• Estuary • Low salinities		• Arctic Char migration corridor • Ringed Seal feeding •	• Arctic Char feeding • Ringed Seal feeding		LOW	No distinct areas
3.5	King William Island[3.5]	• Tidal mixing zones		• Possible enhanced productivity based on mixing • Ringed Seal and Polar Bear feeding • High benthic diversity and production	• High food supply for benthos		HIGH	Some distinct areas
3.6	Southern Victoria Island Coastline[NEW]	• Estuaries		• Arctic Char migration corridor	• Arctic Char feeding		HIGH	No distinct areas

Table 3. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
3.7	Yukon North Slope	• Steep bathymetry • Potential upwelling • Freshwater corridor	• One of two Black Guillemot colonies in Inuvialuit Settlement Region (ISR) • Possible kelp beds	• Arctic Cisco and Dolly Varden Char migration corridor • Marine mammal migration pathway and feeding	• Arctic Cisco and Dolly Varden Char feeding • Marine mammal feeding	• Depleted populations of Dolly Varden Char	HIGH	Some distinct areas
3.8	Mackenzie Trough	• Deep trough • Upwelling • Mackenzie plume waters		• Bowhead, Beluga and Ringed Seal migration and feeding • Polar Bear feeding • High benthic diversity and production	• Polar Bear breeding • High food supply for benthos • High benthic re-mineralization		LOW	No distinct areas
3.9	Beaufort Shelf	• Steep bathymetry – continental shelf • Upwelling		• Polar Bear feeding and migration • Marine fish • Bowhead feeding • Beluga migration pathway • High benthic diversity and production	• Polar Bear feeding • High food supply for benthos • High benthic re-mineralization		LOW	No distinct areas
3.10	Shallow Bay	• Shallow waters • Large estuary • Gravel shoals		• Beluga • Ringed Seal	• Beluga		HIGH	No distinct areas

Table 3. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
3.11	Beluga Bay	• Shallow waters • Large estuary • Gravel shoals		• Beluga • Seabirds • Ringed Seal	• Beluga		HIGH	No distinct areas
3.12	Husky Lakes	• Estuary • Strong tidal flows	• Unique “finger-lakes” • Complex coastline	• Lake Trout spawning, nursery and feeding • Ringed Seal breeding, rearing and feeding • Seabird and seaduck migration and feeding • Beluga	• Lake Trout spawning, nursery and feeding • Ringed Seal breeding, rearing and feeding • Seabird and seaduck migration and feeding		HIGH	No distinct areas
3.13	Kugmallit Corridor	• Deep trough • Upwelling • Mackenzie plume waters	• Artificial islands • Gas vents • Underwater pingos	• Ringed Seal migration and feeding	• High food supply for benthos • High benthic re-mineralization	• Pigheaded Prickleback	HIGH	Some distinct areas
3.14	Cape Bathurst Polynya	• Polynya and associated ice-edge • Upwelling		• Seaduck staging and feeding • Marine mammal feeding and migration • Seal feeding and migration • High benthic diversity and production	• Seaduck feeding • Marine mammal feeding and migration • Seal feeding • High food supply for benthos • High benthic re-mineralization		HIGH	No distinct areas

Table 3. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
3.15	Banks Island Shorelead	• Flaw lead and associated ice-edge		• Seaduck staging and foraging • Bearded Seal feeding	• Seaduck foraging		LOW	No distinct areas
3.16	Pearce Point	• Upwelling	• One of two western Arctic Black Guillemot colonies • Only colony of Thick-billed Murres in western Canadian Arctic and only colony of this subspecies in Canada	• Ringed Seal rearing • Polar Bear rearing and feeding • Seabird breeding and foraging • Marine mammal migration pathway	• Seabird breeding, rearing and feeding • Bowhead and Beluga migration pathway		LOW	Some distinct areas
3.17	Hornaday River	• Estuary	• Possible kelp beds	• Ringed Seal rearing • Arctic Char migration corridor • Pacific Herring • Bowhead and Beluga migration pathway	• Ringed Seal rearing and feeding • Bowhead feeding • Arctic Char feeding corridor		HIGH	Some distinct areas
3.18	Kagloryuak River	• Estuary		• Arctic Char migration corridor • Ringed Seal breeding, rearing and feeding • Seabird feeding • Polar Bear feeding	• Arctic Char feeding corridor • Ringed Seal breeding, rearing and feeding • Seabird feeding • Polar Bear feeding		LOW	No distinct areas

Table 3. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
3.19	Prince Albert Sound	• Flaw lead • Estuary influences		• Arctic Char migration corridor • Seabird and seaduck feeding and migration • Ringed Seal breeding, rearing and feeding	• Arctic Char feeding corridor • Seabird and seaduck feeding • Ringed Seal breeding, rearing and feeding	• Northern Wolfish	HIGH	No distinct areas
3.20	Walker Bay	• Coastal estuary		• Arctic Char migration corridor • Ringed and Bearded Seals feeding • Seabird and seaduck feeding	• Arctic Char feeding corridor • Ringed and Bearded Seals feeding • Seabird and seaduck feeding		LOW	No distinct areas
3.21	Minto Inlet	• Coastal estuary		• Arctic Char migration corridor • Seabird migration and feeding • Ringed Seal rearing and feeding	• Arctic Char feeding corridor • Ringed Seal rearing and feeding		LOW	No distinct areas
3.22	De Salis Bay	• Upwelling		• Arctic Char migration corridor • Seabird and seaduck nesting and feeding • Marine mammal rearing, feeding and migrations	• Arctic Char feeding corridor • Seabird and seaduck feeding • Marine mammal feeding and migration		HIGH	Some distinct areas.

Table 3. Continued…

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
3.23	Thesiger Bay	• Flaw lead polynya • Estuary • Gravel shoals • Saline lakes/depres sions	• Possible Kelp beds	• Benthic communities • Capelin migration • Seals and Polar Bear feeding • Beluga • Arctic Char migration corridor	• Arctic Char feeding corridor • Seals, Polar Bear and Beluga feeding	• Walrus • Peregrine Falcon	HIGH	Distinct areas
3.24	Viscount Melville Sound	• Deep basin		• Beluga feeding • Polar Bear feeding and rearing habitat	• Beluga feeding • Polar Bear feeding and rearing		LOW	No distinct areas
3.25	Horton River	• Steep bathymetry • Upwelling • Estuary	• Diverse meiofauna communities	• Marine mammal migration pathway and feeding • Arctic Char migration corridor • Polar Bear breeding	• Marine mammal feeding • Arctic Char feeding corridor • Polar Bear breeding		LOW	Some distinct areas
3.26	Liverpool Bay	• Upwelling • Tides	• Possible Kelp beds	• Seabird and seaduck nesting, feeding, staging and/or molting • Polar Bear feeding and rearing • Zooplankton communities • Marine mammal migration and feeding	• Seabird and seaduck feeding, nesting and staging • Polar Bear feeding and rearing • Marine mammal feeding		LOW	Some distinct areas

4.0 Arctic Basin

The distinctive feature of the Arctic Basin is the relatively constant cover of ice sheets and multi-year pack ice (Figure 5; Table 4). The multi-year ice floats on the Arctic Ocean and currently covers more than 90 percent of this Canadian biogeographic region and was the only area defined as an EBSA. There was general agreement that this physical habitat was unique both globally, nationally and regionally. The feature itself extends outside of Canadian waters, well into the Arctic Basin. The boundaries of one EBSA was modified and a number of biological and ecological features within were identified:

4.1 Multi-year Pack Ice

The region of the Canadian Arctic Ocean between M'Clure Strait and Nares Strait is the source region for the thickest multi-year ice in the Arctic Ocean. The spatial and temporal patterns of the dramatic declines in Arctic summer ice coverage over the last few decades demonstrate that this region is the area where the thick multi-year ice will persist the longest.

This multi-year ice is a unique habitat whose community structure is not well known. It is thought to be particularly important for long-lived (6+ years) autochthonous amphipods, such as *Gammarus wilkitzkii* and the mat-forming centric diatom *Melosira arctica* that is generally associated with Arctic under-ice communities. There is a likelihood that this region is core habitat for a variety of ice adapted heterotrophic microbes (e.g., bacteria, archaea, protists) and zooplankton. The portion of this region near M'Clure Strait is now the summer habitat for a significant portion of the southern Beaufort and northern Beaufort Polar Bear populations (Durner et al. 2009). The edge of the multi-year pack ice has become an important summer refuge for these bears and is expected to remain so into the future (Durner et al. 2009).

In addition to the multi-year pack ice, the Beaufort Gyre was also identified as an important and unique physical feature within this biogeographic region (Figure 5). The Beaufort Gyre is a large anticyclonic gyre in the southern Canada Basin of the Arctic Ocean that contains a globally significant accumulation of freshwater from the North American and Eurasian arctic rivers. It is unique in this respect; and the release of freshwater from the gyre through the Canadian Arctic Archipelago and Fram Strait is of international interest via its impact on the oceanography of the Canadian Arctic Archipelago and Greenland and Labrador seas. The Beaufort Gyre is defined by the strong stratification and low surface nutrient concentrations that are created by the accumulated freshwater. This ecosystem is relatively poorly understood and requires further study to define and assess its ecological properties, and, if appropriate, delineate boundaries for an EBSA.

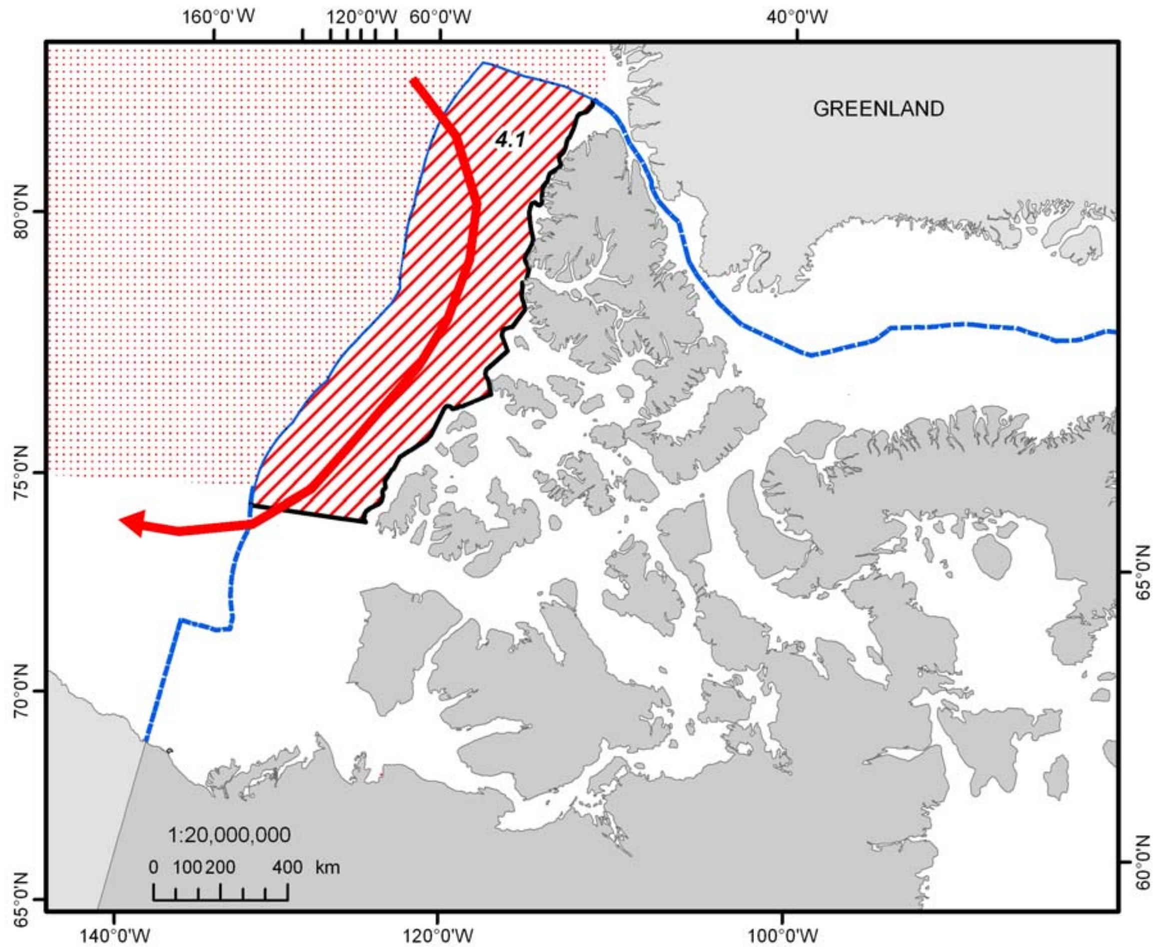

Figure 5. Multi-year Pack ice EBSA identified for the Arctic Basin biogeographic region. The Beaufort Gyre (red arrow) is an important oceanographic feature which contributes to ecosystem structure and functioning in the Arctic Basin and the Western Arctic biogeographic regions. The Arctic Basin multi-year ice EBSA is defined by Canada's international boundary (blue dashed line). The ecological and biological features of this EBSA extend beyond Canadian waters and are identified (approximately) by the red stippled area adjacent.

Table 4. Evaluation Matrix for each of the identified EBSAs in the Arctic Basin and Arctic Archipelago biogeographic regions based on DFO (2004) criteria.

EBSA		Physical Feature	Uniqueness	Aggregation	Fitness Consequences	Rare or Endangered Species	Level of Confidence	Heterogeneity of the EBSA
4.1	Arctic Basin Multi-year Pack Ice[4.1]	• Pack ice and associated ice edges • Shorelead polynya • Deep basin • Shelf break • Anti-cyclonic Beaufort Gyre	• Unique structural and physical habitats • Under-ice communities • Globally significant accumulation of freshwater (Beaufort Gyre)	• Polar Bear denning, feeding and summer refugia	• Polar Bear feeding, rearing and summer refugia habitat • Long-lived arthropods • Mat-forming centric diatom		HIGH	Some distinct areas
5.1	Ellesmere Island Ice Shelves[5.2]	• Ice shelves • Landfast ice	• Under-ice communities				HIGH	No distinct areas
5.2	Nansen-Eureka-Greely Fjord[5.1]	• Fjord complex	• Unique fish communities	• Polar Bear • Ringed Seal			HIGH	No distinct areas
5.3	Archipelago Multi-year Pack Ice[NEW]	• Pack ice and associated ice-edges • Island archipelago	• Largest Arctic archipelago in the world • Last remaining island pack ice refugium • Ivory Gull nesting (Seymour Island)	• Under-ice communities • Seabird nesting and foraging • Polar Bear denning, feeding and rearing	• Polar Bear summer refugia habitat	• Ivory Gull	HIGH	No distinct areas
5.4	Norwegian Bay[NEW]		• Most genetically differentiated population of Polar Bears	• Marine mammal feeding • Polar Bear feeding and rearing	• Polar Bear summer refugia habitat			No distinct areas
5.5	Princess Maria Bay[NEW]	• Fjords		• Walrus haul-out sites • High productivity	• Walrus feeding • Seal and Narwhal feeding	• Baffin Bay Narwhal	HIGH	No distinct areas

5.0 Arctic Archipelago

This biogeographic region was another area where information was particularly incomplete. Consequently both boundaries and rationales for EBSAs are uncertain, although still based on the best available information in this region. Three new EBSAs were identified for a total of five EBSAs within this biogeographic region (Figure 6; Table 4).

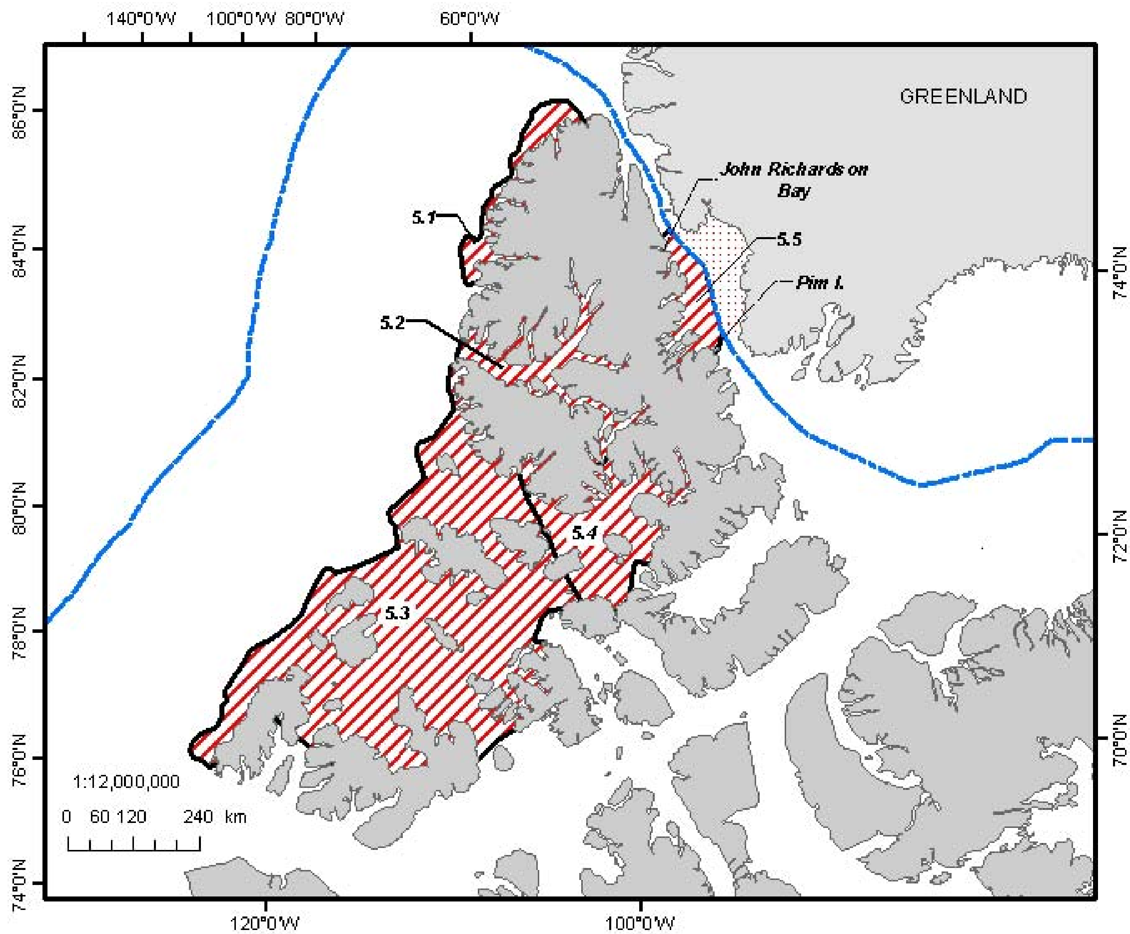

Figure 6. EBSAs identified for the Arctic Archipelago biogeographic region (red hatched areas). The Princess Maria Bay EBSA (5.5) boundary is defined by the political boundary between Canada and Greenland however, the ecological and biological features extend past these boundaries and are identified by the red stippled area adjacent. The dashed blue line represents Canada's international boundary.

Two EBSAs were identified based on the EBSAs proposed and documented in Cobb (2011). An additional three were identified based on expert knowledge (including LEK/TEK) and additional scientific data/publications contributed at the meeting:

5.3 Archipelago Multi-year Pack Ice

- There was general agreement that the multi-year pack ice within the archipelago supports different communities than those within the Arctic Basin. In addition the EBSA includes thousands of islands with jagged coastlines, making it one of the largest/most expansive Arctic archipelagos in the world, a unique feature of the Canadian Arctic.

Important feeding and rearing area for the Norwegian Bay and Viscount Melville Polar Bear populations.

5.4 Norwegian Bay

- Although marine mammal aggregations and current concentrations/densities appear to be low in comparison to the entire Arctic this area is considered to be important regionally for a number of marine mammal aggregations that occur within the Arctic Archipelago biogeographic region. Important feeding and rearing area for the Norwegian Bay Polar Bear population which is the most genetically differentiated Polar Bear population in the world (Paetkau et al. 1999).

5.5 Princess Maria Bay

- A number of important Walrus haul-out sites were identified during a Walrus aerial survey along the coast and on the ice floes from Pim Island north to John Richardson Bay. As sea-ice continues to diminish the use of terrestrial sites for hauling out will likely increase in this area. The area was also highlighted as highly productive based on SeaWiFS satellite data analysis (primary productivity; WWF 2011) and LEK/TEK (DFO 2011a).

CONCLUSIONS AND ADVICE

The identification of EBSAs in Canadian waters according to the guidance provided by the DFO EBSA criteria have proved valuable for both DFO Science and management sectors in all three of Canada's coastal ocean areas (DFO 2011b). The rationale for each of the identified Arctic EBSAs (Tables 1-5) will serve as key components in the knowledge base for making sound management decisions in Canadian Arctic marine waters.

This is the first attempt to identify EBSAs in five of the Canadian Arctic marine biogeographic regions: the Hudson Bay Complex, Eastern Arctic, Western Arctic, Arctic Basin and Arctic Archipelago. This was a daunting task due to the immense size and scope of these biogeographic regions, the patchiness of data and the availability of expert knowledge-holders that could contribute to the process. For this reason, the 38 EBSAs identified during this advisory meeting were broadly defined and future work is needed to better refine boundaries and potentially identify more specific areas of significance within each of the EBSAs. Despite the patchiness and relative incompleteness of data, for most EBSAs there was a relatively high degree of confidence that the areas contained ecologically and/or biologically significant features, likely due to the size of each of the identified EBSAs. As new scientific information and local knowledge comes available, revisions may be made to the current EBSAs and/or more may be added or removed from the current list.

Earlier EBSA identification processes did not benefit from some of the considerations that emerged as important in the application of EBSA criteria at this meeting and the previous Lessons Learned meeting (DFO 2011b). For example features such as the Beaufort Gyre emerged as ecologically important on a larger scale than was considered in the earlier process. It would be timely to review the earlier conclusions about EBSAs in the Beaufort Sea LOMA and Foxe Basin in light of these further developments and new knowledge.

A number of ecological and/or biological features which were used as the basis for delineating EBSAs extended outside of both the scope of this exercise and Canadian waters. For example, some of the ecological features which define the Davis Strait EBSA extend south out of the area being considered at this meeting. Hence, the southern boundary of this EBSA is based on the defining boundary of the biogeographic region. There is a need for a focused effort to complete the EBSA delineations with an appropriate EBSA identification process for the Labrador Shelf in order to fully identify the ecological and/or biological feature(s).

It is stressed again that the information in this SAR is the result of a scientific and technical CSAS process using available science and previously documented traditional knowledge. Many further important insights are expected from the holders of traditional knowledge of the Arctic. Users of the results of the EBSA identification process reported in this SAR should also give full consideration to additional science and traditional knowledge as it comes available, and the results of this scientific and technical process should be discussed fully with the Aboriginal peoples.

Policy and management should take into account the heterogeneity and underlying ecological properties within the larger identified EBSAs. This could affect policy and management measures in at least two ways. Firstly, some management actions may apply to the entire large EBSA, especially in cases where the management actions address activities that create permanent structures or impacts that potentially pose threats to the ecological function or structure of the EBSA. However, if the activities themselves are mobile or their impacts otherwise temporary, the measures may focus on a given year or season for a subset of the larger EBSA (e.g., ice-edges). Second, heterogeneity within an EBSA would imply that flexible tools for conservation and management should be preferred when they are available, and there may be a need for more frequent reassessments of both EBSA delineation and management effectiveness than is the case in other regions. Reassessments will be of particular importance in the Arctic region where climate effects are predicted to result in rapid changes in the structure and functioning of Arctic marine ecosystems. Also, those areas that were not identified as EBSAs have roles to play in the overall function of the Arctic marine ecosystems and thus should be provided the appropriate management and protection.

SOURCES OF INFORMATION

Cobb, D.G. 2011. Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic: A working paper for the Arctic EBSA workshop, June, 2011. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/070.

DFO. 2004. Identification of Ecologically and Biologically Significant Areas. DFO Can. Sci. Advis. Sec. Ecosystem Status Rep. 2004/006.

DFO. 2009*a*. Development of a Framework and Principles for the Biogeographic Classification of Canadian Marine Areas. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/056.

DFO. 2009*b*. Does Eelgrass (*Zostera marina*) meet the criteria as an ecologically significant species? DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/018.

DFO. 2010. Proceedings of the workshop to select Ecologically and Biologically Significant Areas (EBSA) in northern Foxe Basin, Nunavut; 29 June 2009, 10 September 2009, 19 November 2009. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2010/037.

DFO. 2011*a*. Conversations with Nunavut Communities on Areas of Ecological Importance. Oceans Program Division, Winnipeg, MB. 137 p.

DFO. 2011*b*. Ecologically and Biologically Significant Areas – Lessons Learned. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/049.

Durner, G.M., D.C. Douglas, R.M. Nielson, S.C. Amstrup, T.L. McDonald, I. Stirling, M. Mauritzen, E.W. Born, Ø. Wiig, E. DeWeaver, M.C. Serreze, S. Belikov, M. Holland, J.A.

Maslanik, J. Aars, D.A. Bailey and A.E. Derocher. 2009. Predicting 21st-century Polar Bear Habitat distribution from global climate models. Ecological Monographs. 79: 25-58.

Elliott, K.H., K.J. Woo, A.J. Gaston, S. Benvenuti, L. Dall'Antonia, and G.K. Davoren. 2009. Central-place foraging in an Arctic seabird provides evidence for Storer-Ashmole's halo. Auk 126: 613- 625.

Galbraith, P.S., P. Larouche. 2011. Sea-surface temperature in Hudson Bay and Hudson Strait in relation to air temperature and ice cover breakup, 1985-2009. Journal of Marine Systems. 87: 66-78.

Government of Nunavut (GN). 2008. Nunavut Coastal Resource Inventory: Iglulik Pilot Project. Department of Economic Development and Transportation, Fisheries and Sealing Division. Government of Nunavut. Iqaluit, Nunavut. 200 p.

Government of Nunavut (GN). 2010. Nunavut Coastal Resource Inventory: Kugluktuk. Department of Economic Development and Transportation, Fisheries and Sealing Division. Government of Nunavut. Iqaluit, Nunavut. 200 p.

Hannah, C.G., F. Dupont, K. Collins, M. Dunphy and D. Greenberg. 2008. Update on the Validation of a Tidal Model for the Canadian Arctic Archipelago. Can. Tech. Rep. Hydrogr. Ocean Sci. 259: vi + 62 p.

Hannah, C.G., F. Dupont and M. Dunphy. 2009. Polynyas and Tidal Currents in the Canadian Arctic Archipelago. Arctic 62:83-95.

Kenchington, E., H. Link, V. Roy, P. Archambault, T. Siferd, M. Treble and V. Wareham . 2011. Identification of Mega- and Macrobenthic Ecologically and Biologically Significant Areas (EBSAs) in the Hudson Bay Complex and the Western and Eastern Canadian Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/071.

Latour, P.B., J. Leger, J.E. Hines, M.L. Mallory, D.L. Mulders, H.G. Gilchrist, P.A. Smith and D.L. Dickson. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories. 3rd ed. Canadian Wildlife Service Occasional Paper No. 114, Ottawa.

Mallory, M.L. and Fontaine, A.J. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Environment Canada, Canadian Wildlife Service, Occasional Paper Number 109: 92 p.

Paetkau, D., S.C. Amstrup, E.W. Born, W. Calvert, A.E. Derocher, G.W. Garner, F. Messier, I. Stirling, M.K. Taylor, Ø. Wiig and C. Strobeck. 1999. Genetic structure of the world's Polar Bear populations. Molecular Ecology. 8: 1571-1584.

Paulic, J.E., M.H. Papst and D.G. Cobb. 2009. Proceedings for the Identification of Ecologically and Biologically Significant Areas in the Beaufort Sea Large Ocean Management Area. Can. Manuscr. Rep. Fish. Aquat. Sci. 2865: ii+ 46 p.

Stewart, R.E.A. 2008. Redefining Walrus Stocks in Canada. Arctic. 61: 292-308.

Taylor, M. and J. Lee. 1995. Distribution and Abundance of Canadian Polar Bear Populations: A Management Perspective. Arctic. 48(2): 147-154.

World Wildlife Fund (WWF). 2011. RACER: Rapid Assessment of Circum-Arctic Ecosystem Resilience: A Tool for Identifying and Mapping Land and Sea Features that Support Ecosystem Functioning in a Climate-Changed Arctic. WWF Global Arctic Programme, Ottawa. [http://wwf.panda.org/arctic]

FOR MORE INFORMATION

Contact: Dr. Jake Rice
National Science Advisor
200 Kent Street, 12th Floor (12S014)
Ottawa, ON K1A 0E6
Tel: 613-990-0228
Fax: 613-998-3329
E-Mail: Jake.Rice@dfo-mpo.gc.ca

Contact: Joclyn Paulic
Central & Arctic Region
Freshwater Institute
501 University Cr., Winnipeg, MB, R3T 2N6
Tel: 204-983-5232
Fax: 204-984-2403
E-Mail: Joclyn.Paulic@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
National Capital Region
Fisheries and Oceans Canada
200 Kent Street
Ottawa, ON K1A 0E6

Telephone: (613) 990-0293
Fax: (613) 990-2471
E-Mail: CSAS@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs

ISSN 1919-5079 (Print)
ISSN 1919-5087 (Online)

La version française est disponible à l'adresse ci-dessus.

CORRECT CITATION FOR THIS PUBLICATION

DFO. 2011. Identification of Ecologically and Biologically Significant Areas (EBSA) in the Canadian Arctic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/055.