Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2015/042

Central and Arctic Region

Proceedings of the regional peer review of the re-evaluation of Ecologically and Biologically Significant Areas (EBSAs) in the Eastern Arctic Biogeographic Region of the Canadian Arctic

January 27-29, 2015
Winnipeg, MB

Chairperson: Kathleen Martin
Editor: Vanessa Grandmaison and Kathleen Martin

Fisheries and Oceans Canada
501 University Crescent
Winnipeg, MB R3T 2N6

December 2015

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1701-1280

Correct citation for this publication:

DFO. 2015. Proceedings of the regional peer review of the re-evaluation of Ecologically and Biologically Significant Areas (EBSAs) in the Eastern Arctic Biogeographic Region of the Canadian Arctic; January 27-29, 2015. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2015/042.

TABLE OF CONTENTS

SUMMARY

In 2011, Fisheries and Oceans Canada (DFO) identified Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic including in the Eastern Arctic Biogeographic Region. Since then, new information from government and academic research has been published and the process that DFO uses to identify EBSAs has evolved. A regional science advisory meeting was held January 27-29, 2015 at the Freshwater Institute in Winnipeg, MB. The purpose of the meeting was to re-evaluate EBSAs in the Eastern Arctic Biogeographic Region, to identify where the key ecological features are located within each EBSA, and review, modify or refine EBSA boundaries as appropriate. This meeting was conducted at the request of the Oceans Program, and is part of Canada's ongoing commitment to building a national network of marine protected areas.

Participants at the meeting included experts from DFO Science, Oceans programs and Fisheries Management, Parks Canada Agency, Geological Survey of Canada, Université Laval, and Canadian Hydrographic Service. These proceedings summarize the meeting discussions. Additional publications from this process will be posted on the DFO Canadian Science Advisory Secretariat website as they become available.

Compte rendu de l'examen régional par des pairs sur le réévaluation des zones d'importance écologique et biologique (ZIEB) dans la région biogéographique de l'est de l'Arctique canadien

SOMMAIRE

En 2011, Pêches et Océans Canada (MPO) a désigné des zones d'importance écologique et biologique (ZIEB) dans l'Arctique canadien, notamment dans la région biogéographique de l'est de l'Arctique. Depuis, de nouvelles données issues de recherches gouvernementales et universitaires ont été publiées et le processus suivi par le MPO pour désigner les ZIEB a évolué. Une réunion de consultation scientifique régionale a été tenue du 27 au 29 janvier 2015 à l'Institut des eaux douces de Winnipeg, au Manitoba. L'objectif de cette réunion était de réévaluer les ZIEB dans la région biogéographique de l'est de l'Arctique afin de déterminer où se situent les principales caractéristiques écologiques au sein de chaque ZIEB, et d'examiner, modifier ou préciser les limites des ZIEB le cas échéant. Cette réunion a été organisée à la demande du Programme des océans. Elle témoigne de l'engagement continu du Canada à la construction d'un réseau national d'aires marines protégées.

Les participants à la réunion comprenaient des experts du Secteur des sciences du MPO, des programmes des océans et de la gestion des pêches, de l'Agence Parcs Canada, de la Commission géologique du Canada, de l'Université Laval et du Service hydrographique du Canada. Le présent compte rendu résume les discussions tenues lors de la réunion. Toute autre publication découlant de cette réunion sera publiée lorsqu'elle sera disponible sur le site Web du Secrétariat canadien de consultation scientifique du MPO.

INTRODUCTION

The identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic is an important step towards a more comprehensive management approach for the marine environment. EBSAs call attention to areas that have particularly high ecological or biological significance. Identification of EBSAs will address a variety of Federal Government commitments (e.g., Arctic Council, Marine Protected Areas Network) and will also provide guidance for a number of regional planning initiatives. EBSAs are management tools used to provide information about important species, habitat and ecosystem components.

In 2011, Fisheries and Oceans Canada (DFO) identified EBSAs in the Canadian Arctic including in the Eastern Arctic Biogeographic Region. Since then, new information from government and academic research has been published and the process that DFO uses to identify EBSAs has evolved. DFO Science was asked by DFO Oceans program to re-evaluate EBSAs in the Eastern Arctic Biogeographic Region to identify where the key ecological features are located within each EBSA, and to review, modify or refine EBSA boundaries as appropriate.

The meeting Chair provided an overview of the Canadian Science Advisory Secretariat (CSAS) process, the expected outputs and document timelines. The Terms of Reference (Appendix 1) were reviewed. The participants were introduced and included experts from DFO Science, Oceans programs and Fisheries Management, Parks Canada Agency, Geological Survey of Canada, Université Laval, and Canadian Hydrographic Service (Appendix 2). The meeting agenda (Appendix 3) was presented.

Presentations were made to provide information on the methods and criteria used to identify EBSAs, and what areas had been identified previously as EBSAs in the eastern Canadian Arctic. Following the presentations, participants discussed the areas already identified as EBSAs to decide whether they meet the current interpretation of criteria for EBSA designation. Boundaries were discussed for each area identified as an EBSA. These proceedings summarise the meeting discussions and present the key conclusions reached at the meeting.

METHODS USED TO IDENTIFY AND EVALUATE ARCTIC EBSAS

Presented by Joclyn Paulic, Oceans

Summary

Canada's *Oceans Act* promotes an understanding of oceans, ocean processes, marine resources and ecosystems. Conservation, based on an ecosystem approach, is of fundamental importance to maintaining biological diversity and productivity in the marine environment. Canada's Ocean Strategy (2002) calls for the use of best available information for decision-making and identifies that there are unique, sensitive and ecologically significant areas of the marine environment that require special protection and remediation. In order to identify significance, DFO Science outlined the criteria to identify both EBSAs (DFO 2004) and Ecologically Significant Species (ESS) and Community Properties (DFO 2006). EBSA and ESSs should be considered tools for managers to call attention to an area or species that has particularly high ecological or biological significance to facilitate a greater-than-usual degree of risk aversion in management of activities.

The three main criteria to identify EBSAs are uniqueness, aggregation and fitness consequences. DFO (2004) summarizes the range in these criteria. There are also two secondary dimensions, resilience and naturalness, both of which are more relevant for prioritizing EBSAs rather than identifying them (DFO 2011). Criteria are evaluated on a scale relative to the subject region.

A challenge to identifying EBSAs in the Arctic is the lack of data. In data-poor situations, prominent physical features (e.g., polynyas[1]) have been used as proxies for significance. Information sources may be clustered in space, and thus provide a biased view of the uniqueness of the well-sampled areas. Areas may be comparatively well studied for logistical reasons such as ease of access, and not because they are necessarily ecologically and biologically significant. Also, scientific study of an area may be dated and there may be little or no current scientific support to validate the significance of that area. During the re-evaluation of the Beaufort Sea EBSAs, a description of the confidence (level of knowledge and source of data) for each of the features evaluated against the EBSA criteria was included to provide context.

Another challenge to define EBSAs in the Arctic is the dramatic seasonal extremes (e.g., presence of ice) and inter-annual variability. Variability may result in large EBSAs relative to the defining feature(s). Significant features used to identify an EBSA may also only be present for part of the year. An understanding of the dynamic seasonal and temporal variability is needed for managers to provide meaningful protection or remediation measures.

During the previous EBSA evaluation processes, it has proven difficult to evaluate widespread, important species (e.g., Arctic Cod (*Boreogadus saida*) Ringed Seal (*Pusa hispida*)) that contribute to ecosystem structure and function using the EBSA criteria. These species would be better evaluated against the ESS criteria (DFO 2006).

Discussion

During the re-evaluation of Beaufort Sea EBSA (DFO 2014a), it was apparent some areas identified as migration corridors were actually being used for foraging. It was decided that a migratory corridor was better defined as an area where directed movement from one place to another occurred. In addition, seasonal refugia was the term that had been used to describe wintering areas but was changed to being used to describe sheltered areas used occasionally as a refuge (e.g., from predators).

Migratory areas are clearly significant to the life history of some species. In the Newfoundland and Labrador (NL) EBSA evaluation (DFO 2013), areas were identified as migratory corridors if they are relatively confined and there were data to support this function for the area. One of their EBSAs was identified primarily because it served as a migratory corridor for Eastern Hudson Bay Beluga (*Delphinapterus leucas)*. That population is Endangered and all telemetry data supported the regular and consistent use of a narrow area along the Labrador coast. A well-defined pathway that a large proportion of the population uses would fit the criteria for EBSA.

Participants questioned whether it was precautionary to identify larger EBSAs when data are limited. Based on the size of the EBSAs created in 2011, this might have been the approach taken although in some cases features were grouped rather than being divided into separate EBSAs. During the NL EBSA process the general feeling was that EBSAs should be restricted to areas that could be supported by data. EBSAs are not marine protected areas (MPAs) they identify general areas that are important ecologically. Some participants felt that the onus should be on the managers, when they are using the EBSA information, to figure out why an

[1] Polynyas are areas of open water and thin ice that persist in areas of much thicker surrounding ice during winter (and perhaps year-round in perennial-ice areas). They can be created and driven by wind, currents, tides and ice dynamics.

area was chosen and pick geographically smaller components that they consider important enough, for example, to establish an MPA. Although EBSAs don't, in and of themselves, provide protection, there are cases where they are avoided (e.g., establishment of Alternate Ballast Water Exchange Zones in NL) and by doing so are afforded some level of protection.

2011 EBSA

Presented by Oksana Schimnowski, Science

Summary

The EBSAs identified in this biogeographic region from DFO (2011) were described. Information for each of the EBSAs was tabulated including the criteria that supported the EBSA identification and the physical features that were associated with each EBSA. By presenting the information by EBSA it was possible to compare EBSAs and identify inconsistencies in the documentation supporting the EBSA identification.

Discussion

Participants felt it was important to review and identify physical features within each EBSA but also to compare these features between EBSAs to ensure consistency in terminology. It was also noted that it is important to describe or define the terms used in the report (e.g., shelf break, shelf slope). The description of each EBSA should include why they are considered EBSAs, the important biological features present along with the structural features and ecological functions that create significant habitat for organisms.

EBSA CRITERIA

Ocean areas can be ecologically or biologically "significant" because of the functions that they serve in the ecosystem and/or because of structural properties. Uniqueness, Aggregation, and Fitness Consequences are the three main dimensions along which specific areas can be evaluated with regard to their ecological and biological significance (DFO 2004). Participants were asked to consider the following ranges when evaluating these criteria:

Range in Uniqueness

- Areas whose characteristics are unique, rare, distinct, and for which alternatives do not exist versus areas whose characteristics are widespread with many areas which are similar in most important features.

Range in Aggregation

- Areas where most individuals of a species are aggregated for some part the year versus individuals of a species being widespread and even areas of comparatively high density that do not contain a substantial portion of the total population.

or

- Most individuals use the area for some important life history function versus individuals that may congregate to perform a life-history function, but the area in which they perform the function varies substantially over time.

or

- Some structural feature or ecological process occurs with exceptionally high density versus the structural property or ecological process occurs in many alternative areas.

Range in Fitness Consequences

This dimension generally applies to functional properties of areas, and in most cases reflects contributions to reproduction and/or survival of a species.

- Areas where the life history activity(ies) undertaken make a major contribution to the fitness of the population or species present versus areas where the life history activity(ies) undertaken make only marginal contributions to fitness.

The scope of the evaluation was defined as the Eastern Arctic Biogeographic Region. Where possible, seasonality in use of the EBSAs would be identified and data used to support the identification of EBSAs would be identified.

EBSA IN RELATION TO A POLYNYA

Presented by Charles Hannah

Summary

Not all polynyas are ecologically equivalent. Some are driven by tides making them different from other types of polynyas.

There are two resident populations of Atlantic Walrus (*Odobenus rosmarus rosmarus)* in the eastern Arctic (Foxe Basin and Jones Sound) that stay in these areas year-round.

Both areas have tidally dominated straits with tidal polynyas and strong tidal flows. In Western Jones Sound, Atlantic Walrus inhabit the downstream side of Hell Gate/Cardigan Strait. The area with the polynya is not where walrus live so there is a spatial disconnect and the areas downstream of the polynya are most important.

Mixing in the polynya brings nutrients to the surface (tidal channels) resulting in phytoplankton generation (displaced downstream) and zooplankton generation (further displaced). Should an EBSA be located where the walrus food is found rather than where the polynya occurs?

Discussion

A participant indicated that the supposition that the polynya is more important biologically because there is more benthos there is false. There are more clams in other parts of the Arctic which are completely ice covered than there are in the polynya. The unique part of this system, that allows a resident population of walrus, is the polynya itself. It allows walrus to overwinter there. There may be a downstream effect that should be captured but if an EBSA was to be identified it would need to include the polynya.

PHYSICAL FEATURES

Participants discussed some of the physical features (e.g., polynyas, shelf slope) that were identified within the Eastern Arctic Biogeographic Region EBSAs (DFO 2011). The physical features may create highly productive areas or cause animals to aggregate in certain locations. One of the participants pointed out that the EBSAs in 2011 were identified based on biological or ecological features and the physical features in the areas were simply described with no definitions provided.

Participants reviewed the physical features as some may drive productivity or be used to determine EBSA boundaries during the re-evaluation process. Polynyas and upwelling areas are important in the Eastern Arctic and are relevant to the discussion of EBSAs. Upwelling areas drive the system productivity by increasing nutrients. This leads to increased biodiversity and aggregations of organisms.

Participants discussed some of the bathymetric features from DFO (2011). The Hatton Basin was identified as being a deep basin although it is not particularly deep (700 m) and is actually on a shelf, more like a flat valley or shelf basin. In Baffin Bay there is a shelf, slope and a deep basin. Sills were identified as bathymetric features restricting movement of water masses at depth (e.g., a sill in Barrow Strait restricts Pacific water entering the archipelago and one in Davis Strait restricts Atlantic water).

Several areas included shelf edges. These edge areas may cause upwelling, they link to distribution of sponges/corals, high biodiversity, feeding areas and areas where tagged marine mammals migrate. This feature led to a discussion of bathymetric features; shelf, shelf-break and slope. A participant noted that the benthic community changes in relation to depth. For example, clams are distributed down to about 100 m while the shelf breaks are typically deeper than that along the Baffin coast. The difference between the three areas relates to differing temperature regime that exists on either side of the shelf break. On top of the shelf the water is colder and below, on the slope, the temperature increases. It can be a 4-5°C temperature difference which is the main factor that controls the distribution of animals.

In NL the most diverse marine fish assemblages occurred along the Labrador Shelf slope and there were more corals and sponges there. In the Central and Arctic Region, corals are usually more important at depths > 1000 m and sponges in the Hatton Basin are generally around 400-500 m, although this is variable. Sea Pens (*Pennatulacea)* can be a little shallower (starting at about 300 m but going down to over 1440 m) and occur in soft bottom habitats like those in the troughs off the fiords or off Lancaster Sound where the largest concentration of Sea Pens have been found.

The shelves are typically down to a few hundred meters after which there is a break which begins the slope down to the bottom. The literature indicates species composition and size of fish within a species changes dramatically with change in depth, supporting that the slope is an important habitat feature.

Off Baffin Island, there is a true shelf, shelf-break and slope. The shelf is about 50–60 km wide with the shelf break located in about 300 m water depth. The average slope gradient is about 2 –3º but can vary from ~8º in the upper to mid slope to <1º in the lower slope. There is no true shelf break off eastern Devon Island and Lancaster Sound where there is a gentle slope (~0.4º) to the bottom of Baffin Bay in about 2300 m water depth. In the Eastern Arctic, steep slopes are found very close to the shoreline and are localized along edges of fiords, and transverse troughs (e.g., Scott Inlet). Participants asked if the degree of slope has anything to do with biological significance. Steeper slopes can cause asymmetric eddies (upwellings). A participant noted that on the vertical slopes near Qikiqtarjuaq there are unique species, mostly encrusting organisms, but species density is low.

In DFO (2011), fiords were identified as important features along the Baffin Island Coastline EBSA. They are steep sided and include deep areas. Participants indicated that the fiords can compress tidal effects, they are separated from the main ocean, and they have freshwater inputs. In addition, structural complexity of coastlines is important for upper trophic levels and predator-prey relationships. More diverse coastlines provide more opportunities for refugia and fiords generally have these features.

Transverse (deep sea) troughs were identified in the Baffin Island Coastline EBSA. The troughs are extensions of the fiords that allow the intrusion of warmer water offshore deep water from Baffin Bay or Davis Strait and change the composition of the communities that are there. These are distinct environments differing from the (cool) shelf or nearshore waters. Warmer temperatures result in greater biodiversity. Cumberland Sound and Scott Inlet both have deep troughs or canyons.

Strong currents are localized and most are associated with tidally driven polynyas if the currents are sufficiently strong (1 $m \cdot s^{-1}$). However, currents can affect the distribution of organisms if they are too strong. Maximum production is associated with moderate currents. Participants wondered if currents needed to be considered if they were captured by the identification of polynyas. The North Water polynya has a strong current and an ice bridge but doesn't result from tidal mixing. The mixing parameter ($\text{water depth}/\text{current}^3$) is the important driver for upwelling and mixing rather than the current itself. Other factors like stratification of water masses and residence time for phytoplankton and ice algae production are important. Participants agreed that not all polynyas will necessarily be identified as EBSAs.

Tidal amplitude is several metres in places like Hudson Strait. Tides are a component of mixing and productivity and may influence the migration of Arctic Char (*Salvelinus alpinus)*. There were no large tidal flat areas identified in this region.

Estuaries were identified as important for freshwater inputs, nutrient inputs, coloured dissolved organic matter inputs influencing light fields, and mixing zones influencing timing of melt. They are biologically active areas located throughout the region but there are no massive estuary features comparable to the Mackenzie Estuary which dominates the Western Arctic Biogeographic Region. Estuaries are often associated with rivers that have Arctic Char runs. Tidal changes and river extensions through tidal mudflats result in disturbed areas used by fishes. The estuaries differ from coastal environments and if an estuary is sufficiently rich, char may not need to go very far down the coast to feed. Estuaries are also key Beluga aggregation locations. DFO is responsible to the high tide mark.

Ice was discussed briefly. Ice edges are important physical oceanographic features. Although there are some areas in the region that may have broken ice year-round (e.g., Gulf of Boothia), it is not perennial ice cover. Baffin coastal ice shear zones may be important habitat for some species.

Narrow and restricted channels affect flow, and may be migration choke points. Such areas were identified particularly for movement of marine mammals. Participants suggested that coastal complexity is a feature to consider when describing some EBSAs.

Pockmarks, mud volcanoes and seeps were identified as features that may occur in the region. They are hydrocarbon-related features and may be associated with unique bacterial communities. These result from, or are, natural processes. Hydrocarbons at depth make their way to the seabed surface. In an explosive process they leave behind a crater and the sediment is dispersed forming a pockmark. There are lots of pockmarks in the region. Mud volcanoes are also bathymetric features where the mud and fluid movement causes a mound to form. No mud volcanoes have yet been identified. Both features are identified by multi-beam sonar but only a small portion of the Arctic (<1%) has been surveyed this way.

Seeps are not bathymetric features but can be seen in the water column or sometimes in seismic data. Methane can be generated so seeps are important in terms of global carbon but they also are associated with unique micro-organisms and thus unique communities. Seeps have been identified in Scott Inlet. An oil slick has been observed on the sea surface from this seep.

Discussion included the importance of widespread species in the Arctic and that by identifying broad EBSAs some portion of their habitat would be captured. This is analogous to the concept of representativity in the development of MPA networks. A process to identify Arctic ESS would be a better tool to capture the importance of these widespread species than the EBSA process.

During the 2011 EBSA identification process, a bird subject matter expert attended the meeting. This was not the case for the current meeting. Information for birds was taken from DFO (2011)

and Cobb et al. (2011) and other relevant references (e.g., Mallory and Fontaine 2004, Latour et al. 2008, Gaston 2014, Wong et al. 2014). Any EBSA criteria based on bird distribution and habitat use information would be reviewed with a subject matter expert following the meeting before being finalized.

The description of the EBSAs from DFO 2011, and information from Cobb (2011) on proposed EBSAs were used to initiate discussions. For each of the EBSAs being considered the following three questions guided the evaluation:

Why was the area identified as an EBSA?

Is this designation still warranted?

Are the boundaries appropriate?

The re-evaluation would document those criteria that were used to support the identification of EBSA. If additional information about the area was available it was noted.

Participants noted that it would be important to re-evaluate EBSAs as more information became available.

BAFFIN BAY/DAVIS STRAIT REGION

Participants first chose to evaluate the Hatton Basin/Davis Strait/Labrador Sea EBSA, a large and complicated EBSA from DFO (2011). Hatton Basin crosses the regional boundary (61°N) between DFO's Central and Arctic, and NL regions. There were two EBSAs identified by NL (DFO 2013) in the Hatton Basin area (Northern Labrador and Outer Shelf Saglek Bank EBSAs).

DFO (2011) identified a wide variety of physical, biological and ecological features within this EBSA. The rationale for the EBSA boundaries however was not well articulated. Participants were asked to evaluate whether the whole area met the EBSA criteria or whether areas could be separated to focus on specific features and criteria. Some areas are important for a number of species because they are highly productive. Some areas have unique features. Seasonality is also important for EBSAs. It is important to consider that an area may be used by a species for part of the year but what happens there the rest of the time may still be important. From a practical perspective it would be better to identify areas that met specific EBSA criteria rather than combining all such areas into a large nebulous area. If managers were to choose some area within the EBSA we would want to be confident it was representative.

Participants discussed how the criteria would be applied. For uniqueness, the scale was the biogeographic region so the Hooded Seal (*Cystophora cristata*) whelping patch may be considered unique. Aggregation areas generally had to be associated with fitness consequences to be considered EBSAs. Locations of corals are fixed and more easily identified than Hooded Seal whelping areas (slope edge) which depend on sea-ice. Seasonality is a factor as the area is an important summer feeding area for Harp Seal *(Pagophilus groenlandicus)*and an important overwintering area for Beluga, Narwhal (*Monodon monoceros*) and Bowhead Whale (*Balaena mysticetus*).

Figures from Cyr and Larouche (2015) were presented showing an area off Resolution Island and another off the Labrador Shelf with recurring thermal fronts and primary productivity that may help to define productive areas. There are Greenland Halibut (*Reinhardtius hippoglossoides)* (1000–1200 m), and Pandalid Shrimp (300–400 m) commercial fisheries in this area. A participant noted that you don't characterise an EBSA for a certain species unless it is really unique for that species. EBSAs tend to reflect productivity or biodiversity.

Bathymetry may help to delineate borders. As a first step in dividing the area it might be broken into shelf and slope areas. Cumberland Sound and Frobisher Bay could be partitioned off from the rest of the area.

NEWFOUNDLAND AND LABRADOR SHELVES BIOGEOGRAPHIC REGION EBSAs

Presented by Garry Stenson, Science

During the discussions of the Baffin Bay/Davis Strait area it became clear that data were available that had not previously been considered. NL had recently evaluated offshore EBSAs using an approach that had included their fisheries survey data. A participant suggested that this approach may be appropriate for the Baffin Bay/Davis Strait area as well. Garry Stenson had chaired the NL meeting and offered to give an overview of their approach to assist with the current re-evaluation.

Summary

For the identification of EBSAs in the Newfoundland and Labrador (NL Shelves Biogeographic Region) (DFO 2013), 208 biological and oceanographic layers of data were examined. Analyses of onshore data were separated from the offshore because of the types of data available. Ninety-nine offshore layers were resampled using a 20 km x 20 km grid; and 75 coastal layers were reviewed at the scale at which the data were available**.** Taxa were grouped by similar characteristics. Layers were developed for each. Species specialists added knowledge about high aggregation areas. Most EBSAs within the NL study area were identified based on the aggregation of one or, more frequently, several taxa in an area.

Discussion

Participants felt that this approach should be used for the Baffin Bay and Davis Strait areas. The multi-species surveys conducted in the Central and Arctic Region in these areas should be used in this analysis to provide data for marine fishes and invertebrates. The offshore EBSAs within Baffin Bay-Davis Strait (Northern Baffin Bay, Baffin Bay Shelf Break, Southern Baffin Bay, and Hatton Basin-Labrador Sea-Davis Strait EBSAs) would therefore be re-evaluated at a separate peer-review meeting. Information on marine mammal abundance and habitat use should also be included in the re-evaluation of these areas.

FROBISHER BAY

Frobisher Bay is a productive area and serves as habitat for a number of marine mammal and bird species. There is also a polynya that forms near the mouth of the bay. Participants agreed that although the outer section of Frobisher Bay was identified as part of the Hatton Basin-Labrador Sea-Davis Strait EBSA, this area ranks low for Uniqueness and Fitness Consequences. For example, although Bowhead Whale can be found in Frobisher Bay, this area is not as important as other areas in the biogeographic region, such as Cumberland Sound and Admiralty Inlet. Participants agreed there was insufficient information to include Frobisher Bay as an EBSA. This may be revisited once more data become available for the area. Frontal frequency and chlorophyll-*a* data (Cyr and Larouche 2015) indicate the area around the east entrance of the bay, and the Resolution Island area may be ecologically important. The entrance to Frobisher Bay may be evaluated with the offshore EBSAs if there are supporting data from the multi-species survey for this area.

CUMBERLAND SOUND

Cumberland Sound was identified as an important habitat for marine mammals and bird species. The Cumberland Sound Beluga (*Delphinapterus leucas*) population, genetically distinct

from other Beluga populations, is believed to spend its entire life within the sound. A long-line fishery in Cumberland Sound and research activities associated with the fishery, have provided data for marine fishes including Greenland Shark, *Somniosus microcephalus*, and Greenland Halibut. Cumberland Sound also has many rivers that support anadromous Arctic Char stocks which may be fished for subsistence and commercial purposes. This area is comparatively data-rich relative to other areas in the Eastern Arctic Biogeographic Region in large part due to ease of access and interest in local fisheries.

Cumberland Sound has a deep trough running into it and a polynya regularly forms near the mouth of the sound. It is likely that the trough contributes to the polynya formation. There was a lengthy discussion whether all of Cumberland Sound should be identified as one large EBSA, or whether the Western portion of Cumberland Sound (i.e., Clearwater Fiord) should be considered a separate EBSA from Eastern Cumberland Sound. There was also discussion about Kingnait Fiord being a separate EBSA but there were insufficient data to support this. After much debate, participants decided to identify two distinct EBSAs, one in Clearwater Fiord and another in Eastern Cumberland Sound.

CLEARWATER FIORD EBSA

Participants discussed the Clearwater Fiord area of Cumberland Sound. Participants agreed that Clearwater Fiord met the EBSA criteria. Clearwater Fiord is a unique summering habitat for the Cumberland Sound Beluga population, and participants felt it was important to create a distinct EBSA focussed solely on these Beluga. The population, numbering somewhere between 700 and 2000 individuals, aggregate in the Clearwater Fiord area during the summer from late July to late September. In August, typically about 80% of the animals are found in Clearwater Fiord and the remainder in Kangilo Fiord, meeting the Aggregation criteria for an EBSA. The area is used by the population to feed and to rear their young meeting the Fitness Consequence criteria and the area may also provide refuge from predators.

The eastern boundary for this EBSA was based on the summer distribution data for Cumberland Sound Beluga including Clearwater and Kangilo fiords.

Arctic Char from several river systems use the area during the summer open-water period for feeding. The area is also important for seabirds and seaducks.

EASTERN CUMBERLAND SOUND EBSA

The polynya that forms near the eastern end of Cumberland Sound is an important area for overwintering Beluga and Bowhead Whale. The polynya's open water allows whales to survive during the winter, thereby enabling them to remain in Cumberland Sound year-round. Cumberland Sound Beluga move from coastal areas into deeper water for feeding in late fall. The area also has had some of the highest densities of Bowhead Whale and one instrumented whale was found to stay in the eastern portion of Cumberland Sound for a full year. Bowhead Whale use the area for feeding. Bowhead Whale and Cumberland Sound Beluga overwintering in this area meet the EBSA criteria for Aggregation and Fitness Consequences. The area is also important for bird species as the polynya allows early spring access to feed and nest, thereby increasing reproductive success. Frontal frequency and chlorophyll-*a* data (Cyr and Larouche 2015) provide support for the ecological importance of the area at the north east entrance to the sound.

Participants agreed that the boundaries of the EBSA should be based on distribution data for Beluga (Richard and Stewart 2009; 75% kernel density) and extending out to capture the key Bowhead Whale summer feeding area within the outer part of Kingnait Fiord. It should also

follow the deep trough leading into the sound and should be based on bottom topography rather than the shoreline.

Other marine mammals use this EBSA including Harp Seal, Narwhal and Atlantic Walrus. This is also a productive area for fishes. Greenland Halibut are present year-round along with some skates and Greenland Shark move through this area. Spotted Wolffish (*Anarhichas minor*) have been found in the area. Cyr et al. (2014) identified a recurring oceanic thermal front within the EBSA which may be associated with enhanced biological activity. Important bird feeding and staging habitat and Polar Bear (*Ursus maritimus*) habitat would also be captured by this EBSA.

BAFFIN BAY NEARSHORE

Participants discussed the information that had been used to identify this area as an EBSA. Participants agreed that three areas met the criteria for EBSAs within this area; including Cape Searle, Isabella Bay, and Scott Inlet. Although the entire coastline is biologically interesting, these three areas stood out. The Cape Searle, Isabella Bay, and Scott Inlet EBSAs were identified based on significant aggregations of marine birds, large bowhead aggregations, and a unique hydrocarbon seep area, respectively. These areas are representative of the eastern Baffin Island coastal zone.

A participant noted that Nunavummiut have indicated that Narwhal in the Home Bay area may be a separate stock from other Eastern Baffin Island Narwhal, however, there are currently insufficient data to support this hypothesis.

CAPE SEARLE EBSA

Cape Searle, including Reid Bay (Akpait Fiord), was identified as an EBSA based on the presence of the largest nesting colony of Northern Fulmar (*Fulmarus glacialis*) in Canada (22% of the Canadian population) and one of the largest nesting colonies of Thick-billed Murre (*Uria lomvia*) in Canada (10% of the Canadian population). This area meets the aggregation and fitness consequences criteria for an EBSA. The area is used for nesting and foraging.

The boundaries of the Cape Searle EBSA are based on the area identified as Key Marine Habitat (Mallory and Fontaine 2004).

The area is considered important for a number of species of seabirds and marine mammals (e.g., Ringed Seal, Atlantic Walrus). It is not particularly important for whales. The area may be used by Polar Bear.

ISABELLA BAY EBSA

Isabella Bay was identified as an EBSA based on summer Bowhead Whale aggregations. These whales feed within the shallow waters of the bay.

The boundaries of the Isabella Bay EBSA are based on the boundaries of the Ninginganiq National Wildlife Area established by Environment Canada in 2010. The National Wildlife Area includes the shoreline and islands of Isabella Bay and adjacent ocean out to 12 nautical miles from shore.

The area is frequented by Ringed Seal, Narwhal and Polar Bear and it provides habitat for seabirds (e.g., King Eider (*Somateria spectabilis)*; Long-tailed Duck (*Clangula hyemalis)*; Dovekie (*Alle alle)*; Northern Fulmar).

SCOTT INLET EBSA

Scott Inlet was identified as an EBSA based on the presence of a naturally occurring and unique hydrocarbon seep. Participants discussed whether this area should be considered unique as there may be other areas in the Arctic with hydrocarbon seeps that have not yet been discovered. The seep in Scott Inlet was identified by multi-beam technology, and thus far, only 1% of the Arctic has been surveyed in this manner. Participants agreed that we need to use the current information, and thus far, Scott Inlet is the only known location of a seep in this region. Due to high hydrocarbon concentrations, it supports a unique chemolithic biological community. Several participants agreed to provide supporting information for this area to be included in the research document and science advisory report.

An important transverse trough is also located in Scott Inlet and participants noted that it should be included within the EBSA boundaries. The boundaries of the Scott Inlet EBSA include the inlet and extend seaward along the trough edge to the shelf break.

Although not being the key reason for its selection as an EBSA, Scott Inlet has been identified as a Narwhal nursery area and habitat for Greenland Sharks. The extension of the EBSA to the Baffin Bay Shelf Break would capture part of the Baffin Bay Narwhal population spring and fall migration corridor. It was originally noted as one of the areas that marine birds aggregate during migrations.

NORTHERN BAFFIN ISLAND AREA

Two EBSAs were identified in 2011 at the north end of Baffin Island, Eclipse Sound/Navy Board Inlet and Admiralty Inlet EBSAs.

ECLIPSE SOUND EBSA

Participants agreed that the Eclipse Sound/Navy Board Inlet region should remain an EBSA as this area is an important Narwhal summer aggregation area and a spring/fall migration area. It meets the EBSA criteria for Aggregation and Fitness Consequences as a summer rearing site for the Eclipse Sound summering stock of Baffin Bay Narwhal.

Within Eclipse Sound, a number of small fiords provide refuge for Narwhal and Beluga from Killer Whale (*Orcinus orca)*. There was some discussion about focussing on Tremblay Sound however participants felt that is was important to include migration routes into and out of Eclipse Sound.

DFO (2008) estimated about 20,000 Narwhal used the area in the summer, although abundance estimates from the 2013 survey are reported to be considerably lower. There is some speculation that a portion of the Eclipse Sound Narwhal stock moved into Admiralty Inlet. Until the degree of mixing between the two summering areas is confirmed, the group agreed to still treat the Eclipse Sound Narwhal as a summering aggregation separate from Admiralty Inlet.

Although this EBSA was identified as a Narwhal feeding area (DFO 2011), summer isn't generally considered an important Narwhal feeding period and is much more important for rearing.

DFO (2011) listed Beluga in the Aggregation and Fitness Consequences criteria for the Eclipse Sound EBSA, participants decided to remove them. Beluga is not typically hunted around Eclipse Sound, and not a lot of research on Beluga has been conducted in this area. Killer Whale feed in Eclipse Sound, though it is not clear what proportion of the overall population uses this area. Participants agreed to remove Killer Whale, Ringed Seal, Harp

Seal and seabirds from the aggregation and fitness consequences criteria, as they don't meet these EBSA criteria. Killer Whale, Beluga and seals are quite abundant throughout the Arctic and those found in Eclipse Sound are not unique or in significant aggregations compared to other areas within the region. A significant portion of the seabird habitat (i.e., southeastern portion of Bylot Island) is located outside this EBSA.

A consensus was reached to extend the boundaries of the Eclipse Sound EBSA identified in 2011 to include all of Pond Inlet and Navy Board Inlet. The mouths of each of these inlets are considered to be choke points, connecting to Lancaster Sound and Davis Strait, respectively. The inlets serve as important migration corridors for the Eclipse Sound Narwhal summering stock from and to the wintering areas in Davis Strait. Participants agreed that Tremblay Sound and Milne Inlet are the key aggregation areas for Narwhal. Inlets to the east along the south coast of Eclipse Sound (e.g., Oliver Sound, Tay Sound, Paquet Bay) would be removed from the EBSA as they were much less important habitat. At the request of participants following the meeting, the distribution data from DFO surveys in 2002, 2004 (Richard et al. 2010) and 2013 (DFO 2015) and Baffinland surveys[2] in 2007 and 2008 were reviewed. They indicate Narwhal are generally aggregated in Eclipse Sound, Milne Inlet, Navy Board Inlet and Tremblay Sound. Narwhal were found, on occasion and to a much lesser extent, in Eskimo Inlet, White Bay and Tay Sound, supporting removal of these areas from the EBSA.

ADMIRALTY INLET EBSA

Participants reviewed the information from DFO (2011). The features of Admiralty Inlet that meet the EBSA criteria are its use as a rearing site for Narwhal and a nesting and foraging site for 13% of the Canadian population of Northern Fulmar from April to October. This meets the EBSA criteria for Aggregation and Fitness Consequences. Bowhead Whale also aggregate in the Inlet although other locations in the biogeographic region seem to be more important for them. Admiralty Inlet was identified as a marine mammal migration corridor in 2011, but participants agreed that it is better described as an aggregation area. The coastal areas in the inlet are used as refuge from Killer Whale predation.

A consensus was reached to remove marine fishes from the Aggregation criteria for this EBSA (DFO 2011), as their presence is inferred from marine mammal habitat use and little is actually known about marine fish abundance in Admiralty Inlet. There was some discussion whether to incorporate Bearded Seal as a key ecological feature supporting this EBSA but little information is available on Bearded Seal abundance in the area.

The boundaries of the Admiralty Inlet EBSA were not changed from those delineated in 2011. Based on the survey work from 2010 (Asselin and Richard 2011), Narwhal vary widely in their use of the inlet, so no part of it could be considered more important. Some inlets and coastal areas were used by Narwhal (Asselin and Richard 2011), possibly as refuge areas from Killer Whale. Polar Bears also use this area as a summer retreat.

2 From the Baffinland Iron Mines Corporation. 2013. Early revenue phase – addendum to final environmental impact statement. Mary River Project final environmental impact statement. Vol. 8 Marine Environment. Unpubl. rep. submitted to the Nunavut Impact Review Board. (archived on the NIRB website)

WEST OF BAFFIN ISLAND

DFO (2011) identified all of Prince Regent Inlet, Gulf of Boothia and Peel Sound as EBSAs. Strong currents in Prince Regent Inlet and recurring polynyas in both Prince Regent Inlet and Peel Sound were noted (DFO 2011). In addition to relatively predictable ice cover, the region has a large scale current that feeds ice and nutrients into the area which may increase prey availability and accessibility (Dueck and Ferguson 2009).

Participants discussed the use of the area in the summer by Bowhead Whale, Beluga, and Narwhal. There was general agreement that the area could be further divided to focus on areas with ecological significance based on available data.

PRINCE REGENT INLET EBSA

Eastern Canada-West Greenland Bowhead Whale, the Somerset Island summering stock of the Baffin Bay population of Narwhal and Eastern High Arctic–Baffin Bay Beluga use this area in the summer. DFO (2009) identified the Gulf of Boothia and Prince Regent Inlet as important habitat associated with nursing female Bowhead Whale accompanied by calves from about late July to October. Dueck and Ferguson (2009) provide details about habitat use in this area.

The revised Prince Regent Inlet EBSA was identified based on Bowhead Whale and Narwhal aggregations. Bowhead Whale aggregate in the inlet to feed and rear their young. Narwhal use the inlet to rear their young and both species use the area to avoid predators. Although not key criteria for identifying this area as an EBSA, participants acknowledged that Prince Regent Inlet is also used by Beluga as a nursery area, by Killer Whale to feed and by Polar Bear. Participants thought this EBSA was better described as an aggregation area rather than a migration pathway.

The boundaries for this EBSA were reduced to focus on the Bowhead Whale distribution data. It included the area east from the slope break on the west side of the inlet across to the east side of the inlet.

CRESWELL BAY EBSA

Originally included as part of the 2011 Prince Regent Inlet EBSA, participants discussed Creswell Bay the area and selected it as an EBSA based on Eastern High Arctic–Baffin Bay Beluga population use of this area. Belugas aggregate in the shallow waters of Creswell Bay using it as a nursery area to rear their young. They also use the area to take refuge from Killer Whale predation. The area meets the EBSA criteria for Aggregation and Fitness Consequences.

The boundary for the EBSA crosses the mouth of the bay.

Creswell Bay is also used by several species of marine birds including Common Eider (*Somateria mollissima*), King Eider, Black-legged Kittiwake (*Rissa tridactyla*), and Northern Fulmar. It is also important for moulting seaducks. Narwhal are present in the area most years. Anadromous Arctic Char from Stanwell Fletcher Lake migrate down the Creswell River annually to feed in Creswell Bay and along the Somerset Island coastal waters. Ringed Seal and Polar Bear are found in this area.

BELLOT STRAIT EBSA

Bellot Strait is a migration corridor for Narwhal and Beluga from Prince Regent Inlet to Peel Sound. This area is considered a choke point forcing the whales through a relatively narrow body of water. This meets the EBSA criteria for Uniqueness and Fitness Consequences.

The EBSA boundaries would cross the eastern and western ends of the strait.

GULF OF BOOTHIA EBSA

Participants reiterated the important features of the Gulf of Boothia EBSA (identified in 2011), which serves as a Bowhead Whale rearing and feeding area and a Narwhal rearing area, meeting the EBSA criteria for Aggregation and Fitness Consequences.

There is a recurrent polynya within Committee Bay. Fury and Hecla Strait was identified as an EBSA (DFO 2014b) but is part of the Hudson Bay Complex Biogeographic Region.

The Gulf of Boothia EBSA was previously identified in 2011 as a marine mammal migration corridor, but it was agreed that this area is more accurately identified as a Bowhead Whale and Narwhal summer refugia. Fury and Hecla Strait is considered a migration corridor. Ice in the Gulf of Boothia area can provide refuge from Killer Whale. Participants agreed to remove Narwhal feeding as a key ecological feature for identifying this EBSA, as there is no current literature to support this. In addition, a consensus was reached not to include Arctic Char as key criteria for identifying this EBSA, as Arctic Char can be found in nearly all Arctic rivers in this area and there is no current way to identify significant aggregations to be used in this assessment.

The area north of Committee Bay encompasses key Polar Bear habitat although this was not used as the basis for identifying the EBSA. There was some question about Beluga use of the Gulf of Boothia. They occur there but there are not believed to be any significant aggregations in this area comparable to those at Creswell Bay.

A consensus was reached to change the boundaries of the Gulf of Boothia EBSA identified in 2011 (DFO 2011), to exclude a majority of Pelly Sound and Committee Bay. Ice tends to be thickest in Committee Bay (south of Gulf of Boothia) which may limit Narwhal and Bowhead Whale access to this area. They use the remainder of the area. Bowhead Whales nurse their young for up to about a year (7–11 months) and the Gulf of Boothia is a key nursing area. Participants were unsure how to define the exact boundaries of this EBSA, as bathymetry for the area is limited. It was finally decided that Bowhead Whale satellite telemetry data (Dueck and Ferguson 2009) and 2013 multi-species marine mammal survey data would be the focus for identifying the EBSA boundaries.

PEEL SOUND EBSA

Peel Sound is a summering habitat from the last week of July through August, for a large portion of the Somerset Island summering stock of Baffin Bay Narwhals. Narwhals aggregate in Peel Sound to rear their young. It may also be important for feeding although more research needs to be conducted to verify this. Recent survey data provide further support for this being an important aggregation area. The area meets the EBSA criteria for Aggregation and Fitness Consequences.

Although Belugas are present in Peel Sound, they are not found in large aggregations and the area is not used by a large proportion of the population. Participants agreed not to include marine fishes as key criteria for identifying this EBSA, since the presence of marine fishes is only inferred by the abundance of marine mammals in the area and there is

currently no research to support this. In 2011, high benthic diversity and production was identified under the aggregation criteria for Peel Sound. Tidal current gauges and modelling at King William Island, coupled with some benthic sampling, had suggested the presence of a highly diverse macrobenthic community. However this discussion and the inclusion of these data would be more relevant for the refinement of EBSAs in the Western Arctic Biogeographic Region, which includes James Ross Strait and Rae Strait. There are no data to support this criterion within Peel Sound itself.

The boundaries of the Peel Sound EBSA were reduced to focus on the portion of the EBSA identified in 2011 where Narwhal and Beluga activity was centred. The southern end of the EBSA extends into the Western Arctic biogeographic region.

The northern end of the EBSA is delineated by a line from Prince of Wales Island to Somerset Island (between Prescot and Pandora islands on the west and the Bear Islands on the east). The southern boundary was delineated by a line from Cape Hobson on Boothia Peninsula to the point on Prince of Wales Island in line with the southern end of Dixon Island.

BARROW STRAIT-LANCASTER SOUND

There was a lengthy discussion on how to re-evaluate the Lancaster Sound EBSA (identified in 2011). This is a large EBSA with many important and distinct physical and ecological features. Parks Canada Agency is examining the possibility of establishing Lancaster Sound as a national marine conservation area. Some participants felt that all of Lancaster Sound should be identified as a one, large EBSA, to encompass the large migration corridor that is used by marine species. Other participants wanted to split the area into multiple EBSAs, as they felt that different areas within Lancaster Sound have distinct defining features and should be treated separately. A consensus was finally reached to divide up the Lancaster Sound EBSA identified in 2011 into four distinct areas: Lancaster Sound, Resolute Channel, Cunningham Inlet, and Prince Leopold Island. This generally removes the Barrow Strait area from the 2011 EBSA.

LANCASTER SOUND EBSA

The Lancaster Sound EBSA was identified by participants as a major migration corridor for marine mammals. Eastern High Arctic–Baffin Bay Beluga migrate through the area. Baffin Bay Narwhal overwinter in Baffin Bay-Davis Strait. Similar to Beluga, they follow the retreating ice and leads as they move west through Lancaster Sound to summering sites. Bowhead Whale circumnavigates Baffin Island and access Admiralty Inlet and Prince Regent Inlet through Lancaster Sound, or travel through Lancaster Sound to Baffin Bay. In the fall, marine mammals follow the shorelines eastward.

About 25% of Canada's Polar Bear, 80% of Narwhal and most of the Eastern Arctic/Baffin Bay Beluga Whale populations pass through Lancaster Sound (Yurick and Mercier 2013). Walrus overwinter along the floe edges and in the recurrent polynya in eastern Lancaster Sound. Ringed Seal and Bearded Seal use the Lancaster Sound area year-round. Harp Seal migrate into the area for the open-water season.

The sound connects Atlantic waters with the waters of the Arctic Archipelago. There is limited information on benthic communities. Kenchington et al. (2011) indicates that based on historical and recent data, this region supports a high macro- and megafaunal abundance, biomass and diversity (both infauna and epifauna). Lancaster Sound has high productivity. An ice bridge often forms near Prince Leopold Island and high levels of benthic remineralization occur to the east of it. Frontal frequency and chlorophyll-*a* data (Cyr and Larouche 2015) supports the ecological importance of the area around the east entrance to the sound.

Large colonies of seabirds are found on Bylot Island, Baffin Island, Devon Island and Somerset Island. Outside the breeding season several million birds spend all or part of the summer in this area or on migration further north (Yurick and Mercier 2013).

Participants discussed, at length, where to delineate boundaries for the Lancaster Sound EBSA. Some participants felt that all of Lancaster Sound as far west as Prince Leopold Island should be considered an EBSA. Others felt that only the coastlines of Lancaster Sound should be included, as this is the area used by migratory species. However, as the ice edge forms across the sound, shore leads and polynyas are also important aggregation areas for staging marine mammals and seabirds, participants agreed to include the full width of the sound in the EBSA. The eastern boundary of this EBSA was not changed.

Participants discussed the western boundary for the EBSA and agreed that Prince Leopold Island warranted a separate EBSA. Maxwell Bay on Devon Island has been identified as an important area in the summer for schooling Arctic Cod, Beluga and Polar Bear. Participants agreed it should be included in the Lancaster Sound EBSA and was likely similar to other inlets along the Devon Island southern coastline. So the western boundary would extend to the Prince Leopold Island EBSA boundary and include Maxwell Bay.

RESOLUTE PASSAGE EBSA

Participants discussed this area and whether it met the EBSA criteria. Research has been focused on this area because of accessibility. Natural Resources Canada's Polar Continental Shelf Program operates a facility at Resolute supporting Arctic research and DFO operated a field camp for a number of years near the community providing access to this area.

The area was identified because of high ice algal biomass and this continues to persist based on recent DFO ice surveys (i.e., 2010-2013) in the EBSA (A. Niemi, DFO, pers. comm.). The highest biomass of ice algae comes from Resolute Passage (Welch and Bergmann 1989, Smith et al. 1988) from studies conducted in the 1980s. Ice algal biomass based on chlorophyll-*a* concentrations were 250 mg m^2 (or 60 mg L^{-1}). There is variability in the algal blooms annually which may have to do with physical oceanographic dynamics. Although sampling has occurred widely, the ice algae biomass reported here has not been seen elsewhere. Export of sea-ice algae from this area would feed the ecosystem downstream leading to high benthic productivity.

There was general agreement that there was confidence in the data for this area, but there was less confidence in how this area compared to other areas in the Arctic. Resolute Channel was identified as an EBSA, separate from the rest of Lancaster Sound, due to high ice algal biomass recorded for the area which is likely associated with high benthic productivity meeting the EBSA criteria for Fitness Consequences.

Ice scouring was noted to occur in this area. Kelp beds occur here but they also occur elsewhere in the region. A participant speculated that Resolute Channel could potentially be an area of high genetic exchange, as the channel acts as a meeting point for Atlantic and Pacific populations.

The boundary for this area should encompass the area where high ice algal biomass has been reported.

CUNNINGHAM INLET EBSA

Cunningham Inlet was proposed as a separate EBSA because of the aggregations of Baffin Bay High Arctic Beluga that use the shallow estuary during July and August. Beluga may use

estuaries as refuge from predators (i.e., Killer Whale). The aggregations in estuaries indicate that they serve important life history functions.

The boundary of the Cunningham Inlet EBSA crossed the inlet mouth and was based on Beluga distribution.

PRINCE LEOPOLD ISLAND EBSA

Prince Leopold Island is the largest multi-species aggregation of breeding seabirds in the Canadian Arctic (Gaston 2014) including Common Eider, Northern Fulmar, Black-legged Kittiwake, Glaucous Gull *(Larus hyperboreus*), Thick-billed Murre and Black Guillemot (*Cepphus grille)*. Many bird species make use of the open water leads that form near the island. The island and surrounding waters (including a 5 km marine buffer) were declared a Migratory Bird Sanctuary in 1992 (EC 2013). Participants agreed that this area met the criteria as an EBSA with respect to seabird aggregations and it differed from other areas within the 2011 Lancaster Sound EBSA.

The boundaries of the Prince Leopold Island EBSA include the island and a 30 km buffer zone around it to accommodate Black-legged Kittiwake and Thick-billed Murre foraging activity. This is based on the foraging area for Black-legged Kittiwake (Mallory and Fontaine 2004).

NORTHERN REGION

PENNY STRAIT EBSA

In 2011, an EBSA was identified in the Penny Strait/Wellington Channel area. The Dundas (Island) polynya and two other smaller polynyas occur in this area and support the largest known nesting colony of Ross's Gull (*Rhodostethia rosea)*, in the Canadian Arctic. In 1978, the Cheyne Islands colony peaked at 20 individuals (COSEWIC 2007). Ross's Gull is listed as Threatened under the *Species at Risk Act*.

The Dundas polynya is tidally driven and as such is important for mixing nutrients and making them available downstream. Some Atlantic Walrus may overwinter in the Dundas polynya area and there are a number of walrus haulout sites in the area.

A participant noted that this whole area is extremely dynamic. Based on the available information participants agreed the aggregation of Ross's Gull met the EBSA criteria. The area should focus around the colony. Foraging area around the colony would be checked following the meeting to see if the 30 km radius was sufficient. In addition the Dundas polynya would be captured within this EBSA. So participants agreed that the EBSA would include Penny Strait and the area around the Dundas Island and up to Ballie-Hamilton Island. It would not include Wellington Channel or Queens Channel. This would focus the EBSA on the more productive habitat in this area although not all known Atlantic Walrus haulout sites would be captured.

Based on these changes participants recognized that Wellington Channel is no longer an appropriate name for this EBSA so it has been changed to Penny Strait.

NORTH WATER POLYNYA EBSA

The North Water Polynya represents an area of high biological productivity and diversity. It is the largest and most productive polynya in the Canadian Arctic, making this area unique. The area is extremely important for marine mammals and seabirds.

Mallory and Fontaine (2004) described the development of the polynya as follows: Formation of the polynya is initiated by the development of an ice bridge between Greenland and Ellesmere Island in Nares Strait usually in January. New ice forming below the bridge is moved south by the currents and winds. There is a counter clock-wise gyre that maintains the open water and results in higher productivity on the east side of the polynya. The polynya extends southward in early May joining the shore leads and connecting to other polynyas in June. The polynya merges with water in Davis Strait in July and the ice bridge breaks up in late July or early August.

Blooms of diatoms begin in May in the polynya creating a high quality food supply for benthos and benthic remineralisation. The influence of Atlantic water flowing north along the Greenland coast extends primary production in the North Water Polynya for much longer than other places in the Arctic. Frontal frequency and chlorophyll-a data (Cyr and Larouche 2015) supports the ecological importance of the area.

Kenchington et al. (2011) indicated that benthic fluxes measured in the North Water Polynya are the highest so far reported from the Canadian Arctic. In addition, sediment pigment and organic carbon contents are reasonably high throughout the polynya and may actually support highly productive and rich benthic communities.

Heide-Jørgensen et al. (2012) reported the results of recent surveys and reiterated the significance of the polynya for Beluga, Narwhal, Bowhead Whale, Ringed Seal and Bearded Sea. Harp Seal use the area during the open water season. Polar Bear rely on Ringed Seal in the fast ice adjacent to the polynya over the winter and spring.

Millions of seabirds breed in the vicinity of the North Water Polynya. The North Water Polynya may be extremely important as a feeding ground for Ivory Gull (*Pagophila eburnean).* A large portion of the Canadian population of Ivory Gull feed and nests in this area.

Although there was some discussion about extending the boundaries northward, the current boundary follows the biogeographic region boundary. High productivity may warrant extending the area northward and should be considered when EBSAs in the Arctic Archipelago Biogeographic Region are re-evaluated. Participants agreed the boundaries should remain unchanged from 2011.

EASTERN JONES SOUND EBSA

Participants discussed the original justification for identifying this area as an EBSA. Although Atlantic Walrus haul out sites occur in this area and Polar Bear feed in the area, all discussions focused on use of this area by marine birds as marine mammals use of the area was not considered to meet the EBSA criteria. Several significant breeding colonies of marine birds are located in this area. Most of the seabird activity occurs from March to October although some birds may overwinter in this area. The area is used for marine bird staging, feeding, breeding and molting. A participant asked whether Atlantic Puffin (*Fratercula arctica)* nest here, and if so whether this was the only such area in Nunavut.

Large breeding aggregations of Black-legged Kittiwake and Thick-billed Murre colonies were located in this area and were thought to meet the EBSA criteria for Aggregation and Fitness Consequences. Ivory Gull may use this area although nesting colonies are located on Ellesmere Island. Prior to finalizing the SAR, details about seabird colonies would be confirmed to ensure that they met the EBSA criteria. In 2011, a 60 km radius was used to establish the boundaries around Coburg Island. CWS has identified specific foraging

distances for marine bird species so the boundaries would be adjusted to the appropriate foraging area for the seabirds that met the EBSA criteria to delineate the EBSA boundaries.

CARDIGAN STRAIT-HELL GATE EBSA

This area has a tidally driven polynya in Cardigan Strait and Hell Gate. The area has high productivity. It is of particular importance for Atlantic Walrus which have haulout sites along in the fiords around the western end of Jones Sound. Atlantic Walrus aggregations meet the EBSA criteria. These walrus are able to stay in this area year-round because of the polynya. The benthic community in the area should be particularly productive given the currents running through the area. Given Atlantic Walrus generally feed in water less than 100 m and clams densities are highest at these depths, bathymetry may be useful for delineating this EBSA. Following the meeting, Canadian Hydrographic Service bathymetric data would be requested to help identify the boundaries.

There was some debate as to whether the northern fiords should be included in this EBSA (as was done in 2011). As Atlantic Walrus frequent haulout sites in these northern fiords a participants agreed to include these northern fiords in the EBSA. Participants then discussed whether to separate the Cardigan Strait-Hell Gate EBSA, into a northern EBSA and a southern EBSA. The rationale was that while walrus use the northern fiords, birds are more abundant in the southern portion of this EBSA. Presumably the high tidal currents carry plankton and nutrients southward. The boundary would focus on walrus but might extend around the southern portion to capture use of the area by birds if they met the EBSA criteria. This area is used by marine birds. It may support a larger density of diving birds given the benthic productivity. Participants thought Black Guillemot aggregations might meet the EBSA criteria. They occur in the area year-round. This would be checked following the meeting.

Although Baffin Bay Narwhal use the area and move through Hell Gate, this doesn't meet the EBSA criteria. Participants asked if they were a distinct population but further research is needed to provide evidence for stock structuring.

Norwegian Bay to the north of Cardigan Strait and Hell Gate is in the Arctic Archipelago Biogeographic Region. Given this, the EBSA boundary did not extend into Norwegian Bay. The Norwegian Bay area would be considered when EBSAs in the Arctic Archipelago biogeographic regions are re-evaluated. The biogeographical regional boundary bisects the channels but participants agreed that the EBSA should include the full Cardigan Strait and Hell Gate.

NEXT STEPS

Participants discussed the level of detail that should be incorporated into the science advisory report and agreed that it should only include concise summary information. Detailed scientific supporting information should be included in the research document.

A bird subject-matter expert was not present at this peer-review. For the EBSAs that were defined based on birds (e.g., Eastern Jones Sound, Cape Searle) the information used would be verified prior to publishing the reports.

Although the EBSAs in the Eastern Arctic biogeographic region were re-evaluated with the best available information, they should be reviewed as new information becomes available.

Participants were thanked for their input into this review and the meeting was adjourned.

REFERENCES CITED

Asselin, N.C., and Richard, P.R. 2011. Results of Narwhal (*Monodon monoceros*) aerial surveys in Admiralty Inlet, August 2010. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/065. iv + 26 p.

Cobb, D.G. 2011. Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/070. vi + 38 p.

COSEWIC. 2007. COSEWIC assessment and update status report on the Ross's Gull *Thodostethia rosea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 13 p.

Cyr, F., and Larouche, P. 2014. Thermal Fronts Atlas of Canadian Coastal Waters. Atmosphere-Ocean DOI: 10.1080/07055900.2014.986710.

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

DFO. 2006. Identification of Ecologically Significant Species and Community Properties. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/041.

DFO. 2008. Total allowable harvest recommendations for Nunavut Narwhal and Beluga populations. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/035.

DFO. 2009. Advice relevant to identification of Eastern Canadian Arctic Bowhead (*Balaena mysticetus*) critical habitat. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/060.

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

DFO. 2013. Identification of Additional Ecologically and Biologically Significant Areas (EBSAs) within the Newfoundland and Labrador Shelves Bioregion. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/048.

DFO. 2014a. Re-evaluation of Ecologically and Biologically Significant Areas (EBSAs) in the Beaufort Sea. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/052.

DFO. 2014b. Ecologically and Biologically Significant Areas (EBSA) in northern Foxe Basin, Nunavut. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/024.

DFO. 2015. Abundance estimates of narwhal stocks in the Canadian High Arctic in 2013. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/046.

Dueck, L., and Ferguson, S.H. 2009. Habitat Use by Bowhead Whales (*Balaena mysticetus*) of the Eastern Canadian Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2008/082. iv + 24 p.

EC (Environment Canada). 2013. Important areas for birds in Nunavut: Qikiqtaaluk region, (73) Prince Leopold Island.

Gaston, A.J. 2014. Birds and Mammals of Prince Leopold Island, Nunavut, 1975-2012. Arctic 67(1): 10-19.

Heide-Jørgensen, Burt, M., Hansen, R. G., Nielsen, N. H., Rasmussen, M., Fossette, S., and Stern, H. 2012. The significance of the North Water Polynya to Arctic top predators. Ambio. 42: 596-610.

Kenchington, E., Link, H., Roy, V., Archambault, P., Siferd, T., Treble, M., and Wareham, V. 2011. Identification of Mega- and Macrobenthic Ecologically and Biologically Significant Areas (EBSAs) in the Hudson Bay Complex, the Western and Eastern Canadian Arctic. DFO Can. Sci. Advis. Sec. Res. Doc. 2011/071. vi + 52 p.

Latour, P.B., Leger, J., Hines, J.E., Mallory, M.L., Mulders, D.L., Gilchrist, H.G., Smith, P.A., and Dickson, D.L. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut. 3rd ed. Canadian Wildlife Service, Occasional Paper Number 114. 120 p.

Mallory, M.L., and Fontaine, A.J. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper No.109. Canadian Wildlife Service, Environment Canada, Ottawa, ON.

Richard , P., and Stewart, D.B. 2009. Information Relevant to the Identification of Critical Habitat for Cumberland Sound Belugas (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Res. 2008/085. iv + 24 p.

Richard, P.R., Laake, J.L., Hobbs, R.C., Heide-Jørgensen, M.P., Asselin, N.C., and Cleator, H. 2010. Baffin Bay Narwhal population distribution and numbers: Aerial surveys in the Canadian High Arctic, 2002-04. Arctic 63: 85-99.

Smith, R.E.H., Harrison, W.G., Harris, L.R., and Herman, A.W. 1988. Abundance and production of ice algae in Resolute Passage, Canadian Arctic. Mar. Ecol. Prog. Ser. 48: 251-263.

Welch, H.E., and Bergmann, M.A. 1989. Seasonal development of ice algae and its prediction from environmental factors near Resolute, N.W.T., Canada. Can. J. Fish. Aquat. Sci. 46: 1793-1804.

Wong, S.N.P., Gjerdrum, C., Morgan, K.H., and Mallory, M.L. 2014. Hotspots in cold seas: The composition, distribution, and abundance of marine birds in the North American Arctic. J. Geophys. Res. Oceans 119, doi:10.1002/2013JC009198.

Yurick, D., and Mercier, F. 2013. An updated assessment of the ecological values of Lancaster Sound in the eastern Canadian Arctic. Parks Canada Agency.

APPENDIX 1. TERMS OF REFERENCE

RE-EVALUATION OF ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSAS) IN THE EASTERN ARCTIC BIOGEOGRAPHIC REGION OF THE CANADIAN ARCTIC

Regional Peer Review – Central and Arctic Region

January 27-29, 2015
Winnipeg, MB

Chairperson: Kathleen Martin

Context

The identification of Ecologically and Biologically Significant Areas (EBSAs) in the Canadian Arctic is an important step towards a more comprehensive management approach for the marine environment. EBSAs call attention to areas that have particularly high ecological or biological significance. Identification of EBSAs will address a variety of Federal Government commitments (e.g., Arctic Council, Marine Protected Areas Network) and will also provide guidance for a number of regional planning initiatives. EBSAs are management tools used to provide information about important species, habitat and ecosystem components.

In 2011, Fisheries and Oceans Canada (DFO) identified EBSAs in the Canadian Arctic including in the Eastern Arctic Biogeographic Region. Since then, new information from government and academic research has been published and the process that DFO uses to identify EBSAs has evolved. DFO Science has been asked by DFO Oceans program to re-evaluate EBSAs in the Eastern Arctic Biogeographic Region to identify where the key ecological features are located within each EBSA.

Objectives

The objectives of this meeting are to re-evaluate EBSAs in the Eastern Arctic biogeographic region (DFO 2011) based on new information and revise as necessary, review EBSA boundaries and modify if necessary, identify and map ecological layers within the EBSAs.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

- Fisheries and Oceans Canada (DFO) (Ecosystems and Oceans Science, and Ecosystems and Fisheries Management sectors)
- Environment Canada, Parks Canada Agency, Natural Resources Canada
- Government of Nunavut
- Nunavut Wildlife Management Board, Nunavut Tunngavik Inc.
- Academia
- Other invited experts

References

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

APPENDIX 2. PARTICIPANTS

Robbie Bennett	Geological Survey of Canada
Steve Ferguson	DFO, Science
Vanessa Grandmaison (Rapporteur)	DFO, Science
Charles Hannah	DFO, Science
Kevin Hedges	DFO, Science
Yamin Mohammad Janjua	Contractor
Chris Lewis	DFO, Fisheries Management
Lisa Loseto	DFO, Science
Connie Lovejoy	Université Laval
Kathleen Martin (Chair)	DFO, Science
Francine Mercier	Parks Canada Agency
Steve Newton	DFO, Oceans Program
Andrea Niemi	DFO Science
Joclyn Paulic	DFO, Oceans Program
Oksana Schimnowski	DFO, Science
George Schlagintweit	DFO, Canadian Hydrographic Service
Tim Siferd	DFO, Science
Garry Stenson	DFO, Science
Ross Tallman	DFO, Science

APPENDIX 3. AGENDA

27 January 2015

9 a.m. – 4:30 p.m.

- Welcome and Introductions (Martin)
- Review Meeting Terms of Reference, Agenda, Background (Martin)
- Methods used to Identify EBSAs – (Paulic)

10:30 – 10:45 Health Break

- EBSAs identified in 2011 – (Schimnowski)

12:00 Lunch (not provided)

- Physical Environment – considerations for uniqueness, aggregations, fitness consequence

2:45 – 3:00 Health Break

- Continued Discussion
- Day 1 Adjourns

28 January 2015

9 a.m. – 4:30 p.m.

- Recap of Day 1 (Martin)
- Biological Environment – considerations for uniqueness, aggregations, fitness consequence

10:30 – 10:45 Health Break

- Continued Discussion

12:00 Lunch (not provided)

- Continued Discussion

2:45 – 3:00 Health Break

- Continued Discussion
- Day 2 Adjourns

29 January 2015

9 a.m. – 12:00 p.m.

- Recap of Day 2 (Martin)
- Review of Draft Science Advisory Report

10:30 – 10:45 Health Break

- Finish Discussions on Draft SAR
- 11:45 Closing Remarks (Martin)

12:00 Meeting Adjourns