RE-EVALUATION OF ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSA) IN THE BEAUFORT SEA

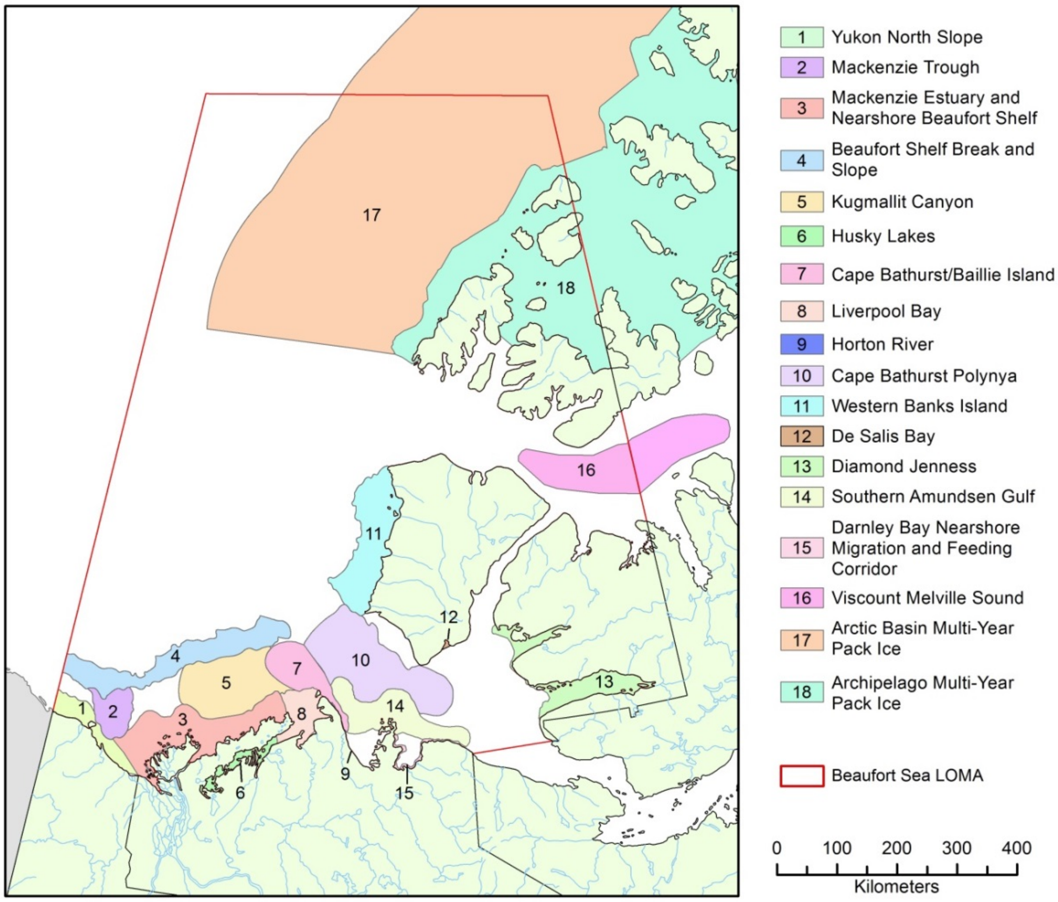

Figure 1. Ecologically and Biologically Significant Areas (EBSA) identified within the Beaufort Sea Large Ocean Management Area (LOMA).

Context

A series of scientific and community workshops were conducted between 2006 and 2007 to identify Ecologically and Biologically Significant Areas (EBSAs) in the Beaufort Sea Large Ocean Management Area (LOMA). At the request of the Beaufort Sea Partnership Ecosystem Working Group, Fisheries and Oceans Canada (DFO) agreed to conduct a regional science peer review to re-evaluate the original EBSAs, their boundaries and Valued Ecosystem Components (VEC) using the National Evaluation Framework for EBSAs.

This Science Advisory Report is from the November 20-22, 2012 re-evaluation of Ecologically and Biologically Significant Areas (EBSAs) in the Beaufort Sea LOMA. Additional publications from this process will be posted on the DFO Science Advisory Schedule as they become available.

SUMMARY

- Within the Beaufort Sea Large Ocean Management Area (LOMA), eighteen Ecologically and Biologically Significant Areas (EBSA) were identified, mapped, and ranked for importance against the three main EBSA criteria.
- Physical drivers (features) and Valued Ecosystem Components (VECs) for each of the identified EBSAs were described and included the level of confidence in the supporting data. Seasonality, when appropriate, was identified.
- Seven EBSAs were identified within the Beaufort Shelf (Yukon North Slope, Mackenzie Trough, Mackenzie Estuary and Nearshore Beaufort Shelf, Beaufort Shelf Break and Slope, Kugmallit Canyon, Husky Lakes, Liverpool Bay), seven within Amundsen Gulf (Cape Bathurst/Baillie Island, Horton River, Cape Bathurst Polynya, De Salis Bay, Diamond Jenness, Southern Amundsen Gulf, Darnley Bay nearshore migration and feeding corridor) and four in the northern portion of the LOMA (Western Banks Island, Viscount Melville Sound, Arctic Basin Multi-year Pack Ice, Archipelago Multi-year Pack Ice).
- A number of sources of information were used for this assessment including scientific data, published and unpublished papers, local ecological knowledge (LEK) and traditional ecological knowledge (TEK) and expert participant knowledge.
- All areas within the Beaufort Sea LOMA hold some ecological and/or biological importance and areas of significance may exist within a number of data/knowledge poor regions of the LOMA. In addition to the limitations imposed on scientific research, local area knowledge is also limited by area accessibility and therefore EBSA evaluations are often constrained to areas that are traditionally visited (i.e., areas of occupation) and accessible with relative ease (e.g., logistically, financially, weather dependent).
- The ability to rank features against the criteria was influenced by the scale of observations and importance making it difficult to evaluate relative to the scale of LOMA.
- The difference between EBSAs that have a wealth of information and those that don't was reflected using a subjective ranking system for the level of confidence in data/information supporting the identification of the EBSA.
- In some cases, the ecological or biological feature of an EBSA extends outside Canadian waters or beyond the LOMA (i.e., Viscount Melville Sound. In these situations, the EBSA boundaries were outlined by the defined political/regional borders.

BACKGROUND

Under Canada's *Oceans Act* (1996), enacted in 1997, Fisheries and Oceans Canada (DFO) is authorized to provide enhanced management to areas of the ocean and coasts that are ecologically and biologically important (DFO 2004). Properly identified, knowledge-based ecologically and biologically significant areas (EBSAs) will address a variety of federal government departmental commitments and will also provide guidance for a number of regional planning initiatives (e.g., Marine Protected Areas) and DFO management decision-making processes. This information will also be of direct use to Canadian provinces and territories, Aboriginal organizations, and co-management bodies that are responsible for the management of activities in the Beaufort Sea Large Ocean Management Area (LOMA) within their mandate.

The Beaufort Sea LOMA is located in the extreme northwestern corner of the Canadian Arctic, and encompasses the marine portion of the Inuvialuit Settlement Region (ISR). The LOMA was designed to implement Integrated Oceans Management (IOM) in the Canadian Arctic marine environment (Beaufort Sea Partnership 2009). IOM is described as a process involving comprehensive planning and management of human activities to minimize conflicts among users, while maintaining a healthy marine environment (Beaufort Sea Partnership 2009). The principles guiding IOM include sustainable development, the precautionary approach, conservation, shared responsibility, flexibility, inclusiveness and ecosystem-based management (EBM; Beaufort Sea Partnership 2009). Under the Beaufort Sea IOM plan, a Beaufort Sea Partnership was created so that Aboriginal, Federal and Territorial governments, co-management partners, industry, coastal communities, and other interested parties could work together on the implementation of IOM under an EBM approach (Beaufort Sea Partnership 2009).

As part of the IOM approach and as a first step to achieving EBM, an Ecosystem Overview and Assessment Report (EOAR) was peer reviewed and published for the Beaufort Sea LOMA (Cobb et al. 2008). Based on expert knowledge and a literature review, the report outlines the scientific, local and traditional knowledge, as well as the status and trends for a number of the ecological features in the LOMA. Following this compilation of information, the next step in the EBM process was to identify EBSAs based on the EOAR. The results of a series of workshops to identify EBSAs in the Beaufort Sea and the rational for these EBSAs can be found in Cobb et al. (2008) and Paulic et al. (2009). During this process, a number of the EBSAs were considered data deficient, due to a lack of knowledge for a number of the identified Valued Ecosystem Components (VECs). Presently, new information from government and academic research has been published and the process that DFO uses to identify EBSAs has also evolved based on experience (e.g., DFO 2007; DFO 2011b; DFO 2011c; Paulic et al. 2009) and the resulting lessons learned (DFO 2011a).

DFO Science has been asked by DFO Oceans Programs (under the request of the Beaufort Sea Partnership, Ecosystem Working Group) to re-evaluate EBSAs in the Beaufort Sea LOMA. This request did not include an update of the EOAR, however a working paper was developed to summarize some of the new information and published literature that would contribute to the identification and rational for candidate Beaufort Sea EBSAs (Cobb et al. 2014).

EBM is the management of human activities to ensure that marine ecosystems, their structure (e.g., biological diversity), function (e.g., productivity) and overall environmental quality (e.g., water and habitat quality) are not compromised and are maintained at appropriate temporal and spatial scales. The identification of EBSAs is the assemblage of the best available scientific, local and traditional knowledge in order to identify the most significant areas within a given spatial scale (e.g., LOMA, in this case). EBSAs are thus provided to oceans and resource managers, who, after weighing any socioeconomic concerns, determine if and what level of enhanced regulation and protection should be provided to the area (DFO 2004). It is important to note that EBSAs do not confer any legal protection (DFO 2004), rather they highlight the VECs and/or the features within or utilizing an area. Areas identified as EBSAs should warrant the application of precautionary management to spatial planning and decision-making.

This evaluation builds on the lessons learned from past Arctic EBSA evaluations. Many of the implications, limitations and cautions for the information sources, the use of EBSA results and the key differences between Arctic identifications and other Atlantic and Pacific marine systems apply here as well. For this reason, the limitations and cautions identified in the DFO (2011b) should be reviewed in addition to any identified in this SAR. The following are some of the points that were discussed during this EBSA re-evaluation process:

1. The Beaufort Sea, along with other Arctic regions, will experience an accelerated rate of change due to global warming (e.g., extent and presence of multi-year sea ice) in the

coming years. These changes will impact one of the most unique and important habitat features in Arctic marine ecosystems: sea ice. The degree of change and how this will impact the ecosystem is still widely unknown, but the results could impact the delineation of EBSAs.

2. Some EBSAs rely heavily on data from a small subset of species for which information was readily available and/or prepared in advance of the CSAS meeting. Therefore the location and identification of EBSAs in this process is based heavily on those species and a number of proxy indicators for other identified VECs (e.g., socially, culturally and economically important species).
3. The scope of this exercise is large with a number of remote regions where knowledge is based largely on the area of occupation of local people and scientific camps. It should be cautioned that in some regions of the LOMA no EBSAs could be identified solely based on a complete lack of data and/or knowledge. As new research initiatives continue in the Beaufort LOMA the patchy and incomplete nature of the scientific data will improve our knowledge and likely better define EBSAs.
4. Changes to species status listed under the *Species at Risk Act* (SARA) or designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) will influence the ranking of that VEC for any given EBSA.
5. As with all advisory meetings, participant knowledge and data bias is based on who attends the meeting. In some cases a species group may not be represented by the knowledge holder and the VEC either not identified in an EBSA or adequately identified. In addition, time constraints associated with preparing working materials for the EBSA evaluation process can also be limiting in some cases (e.g., completeness of literature reviews).

In order to avoid some of the limitations listed above and to ensure that management decisions are made with the best possible information, it is important to revisit EBSA delineations as more information becomes available from scientific research and monitoring and local/traditional ecological knowledge (LEK/TEK). Adaptive management and the speed by which the environment is changing suggests a 5 year re-evaluation cycle for EBSAs (DFO 2011b; Beaufort Sea Partnership 2009). The goal for this evaluation process is to continue to move towards a more quantitative approach (similar to other regions) as the data (including spatial data) becomes available and accessible.

Data Confidence

There are a number of remote marine areas in Canada that are rarely visited and/or explored. This is the case for many of the northern areas in the Beaufort Sea LOMA. For this reason, it should be noted that EBSAs may exist in areas that have not been identified as an EBSA due to a lack of data and/or knowledge of the physical systems/drivers or other VECs. For the Arctic, in cases such as this, often there is a reliance on LEK/TEK. Local area knowledge can be limited by area accessibility and therefore constrained to areas that are traditionally visited (i.e., areas of occupation). This limitation would also restrict the ability to rank against the criteria because of the difficulty comparing information and relative importance at a LOMA scale rather than local importance. In any case, this information should not be overlooked unless there is a valid, documented reason to do so (DFO 2011a).

In the past, some EBSAs in the Beaufort Sea were identified as data deficient (Paulic et al. 2009). Often the term data deficiency implies there is not enough information to make a decision. To data all EBSAs in the LOMA have been evaluated against the criteria and conclusions were drawn from the evaluation process. For this reason the term will no longer be used to describe a lack of data/knowledge for Arctic EBSAs. The difference between EBSAs that have a wealth of information and those that don't may mean that the criteria ranking against other areas cannot be conducted due to low data quality/quantity. In an attempt to reflect these data restrictions, a subjective ranking system for the level of confidence in data/information supporting the identification of an EBSA (modified from Chan et al. 2011) was included in the current Beaufort Sea EBSA evaluation as follows:

- Very Low–Little or no scientific information; no supporting data
- Low–Limited scientific information; circumstantial evidence
- Moderate–Moderate level of scientific information; first hand, unsystematic observations
- High–Substantial scientific information; expert opinion
- Very High–Extensive scientific/systematic information; peer-reviewed data sources/information

Seasonality

Many Arctic VECs are recognized to be seasonally variable. For example, ice cover is extremely variable on an annual and inter-annual basis, greatly affecting biodiversity at any given point in time (Carmack and Macdonald 2002). It is often because of this variability that it is difficult to delineate concrete EBSA boundaries as well as efficiently identify management decisions for the VECs within an EBSA. Arctic EBSA boundary delineation has typically covered large spatial areas as a precautionary measure, however this approach can be somewhat intimidating and may render the EBSA process less useful for management since the process becomes additive and inclusive rather than selective. In an attempt to provide all available information to decision-makers, seasonal use by VEC has also been provided in this evaluation. This should influence subsequent decision making and improve the ability of a manager to identify and/or mitigate activities and impacts in accordance with the temporal changes occurring within an EBSA.

ASSESSMENT

All proposed EBSAs identified in Cobb et al. (2014) were reviewed and evaluated by participants using the evaluation results and information contained in the working paper (Cobb et al. 2014), as well as additional sources of information presented at the meeting and participant knowledge. Each candidate EBSA was evaluated and ranked (when possible) using the 3 main criteria (uniqueness, aggregation and fitness consequences) from DFO (2004) to contribute to a final list of 18 EBSAs (Tables 1-18). The secondary criteria of naturalness and resilience were not evaluated in this process.

For each EBSA, a number and name was assigned based on location. The three dimensions of the EBSA evaluation framework and the attributes of the species or species groups (e.g., spawning, feeding, etc.) were identified. Uniqueness and aggregation were assessed relative to other areas within the Beaufort Sea LOMA, similar to the Canadian Arctic EBSA evaluation process (DFO 2011b). Fitness consequences were assessed depending upon how the disturbance of an area would compromise a population or stock. In addition, extirpated, threatened, endangered and species of special concern listed by SARA (with year of listing) and/or designated by COSEWIC were also identified:

1. Bowhead Whale (*Balaena mysticetus*) Bering-Chukchi-Beaufort population – Special Concern (2007)
2. Polar Bear (*Ursus maritimus*) – Special Concern (2011)

3. Ivory Gull (*Pagophila eburnea*) – Endangered (2009)
4. Barren-ground Caribou (*Rangifer tarandus groenlandicus*) Dolphin and Union population – Special Concern (2011)
5. Peary Caribou (*Rangifer tarandus pearyi*) – Endangered (2011).
6. Grey Whale (*Eschrichtius robustus*) Eastern North Pacific population – Special Concern (2011)
7. Dolly Varden (*Salvelinus malma malma*) Western Arctic population – Special Concern
8. Grizzly Bear (*Ursus arctos*) Western population – Special Concern
9. Wolverine (*Gulo gulo*) Western population – Special Concern

The identification of SARA listed and/or COSEWIC designated species may assist in future EBSA prioritization exercises.

In order to provide a clear understanding of the basis for which an EBSA is identified participants identified the physical feature(s) that were important to the structure and function of the EBSA, and where, possible identified a uniqueness ranking (Tables 1-18). Often the basis for which an aggregation(s) of a species is likely due to the existence of the physical features that drive productivity in that region (e.g., land-fast ice, upwelling). In some cases, an EBSA was identified based mainly on the existence of the physical driver as a proxy for ecological and/or biological productivity and/or VECs.

The level of confidence for each feature/VEC attribute was ranked as either very low, low, moderate, high, or very high, based on a modified system proposed by Chan et al. (2011). This classification system qualitatively reflects data quality and uncertainty. There are a number of instances where a proxy is used to identify a VEC or the associated attribute (e.g., spawning) and therefore the confidence ranking is very low or low. In these cases, the level of uncertainty associated with the feature/VEC limited the ability of participants to rank features/VEC attributes against the EBSA evaluation framework (i.e., 3 main criteria), and in many cases no evaluation ranking is provided in these cases.

For a number of the VECs, the attribute (e.g., feeding, spawning) does not exist throughout the year within each identified EBSA. Under these circumstances the season (e.g., spring) for which it takes place is identified (Tables 1-18). In cases where there is high to very high confidence in the seasonal component of the feature the month(s) of the year for which the feature exists are identified. It should be noted that seasonality may not be identified in the evaluation matrices (Tables 1-18) either because the feature is static (e.g., deep trough) and/or exists year-round or participants were uncertain due to a difficulty in placing seasonal bounds.

In some cases, the ecological or biological feature of an EBSA extends outside Canadian waters. In these situations, the EBSA boundaries were outlined by the defined political/regional borders, similar to what was done in the Canadian Arctic EBSA evaluation (DFO 2011b). Political/regional borders were also used to define boundaries when an EBSA extends beyond the LOMA (i.e., Viscount Melville Sound).

There were a number of areas within the LOMA where no additional work or no new knowledge was brought to the evaluation process. In many cases, these were EBSAs that were identified by local community members. Participants felt there was no justification to remove them as EBSAs at this time (i.e., Horton River, De Salis Bay, Walker Bay, Minto Inlet, Kagaloryuak River, Prince Albert Sound). As our experience with the EBSA evaluation process continues to evolve and more research and community monitoring are enhanced in some of these less visited areas, the evaluation of these EBSAs may change.

Relative to the number of EBSAs first identified in Cobb et al. (2008) and those proposed by Cobb et al. (2014), a number of EBSAs were either modified, added or deleted during this review. The Kugmallit Corridor EBSA was added during the advisory meeting as there where a number of features identified as significant by participants (Table 4). Finding similar features and areas that could be commonly defined to create single agglomerative EBSAs across larger spatial scales were also highlighted in a number of discussions (e.g., Southern Amundsen Gulf, Diamond Jenness).

The information and evaluation that was completed in the working paper (Cobb et al. 2014) lists all possible VECs and features present in the area, while this SAR identifies the most significant. In many cases, it was due to a lack of confidence or knowledge of the feature and/or relative to the scale of the LOMA the feature was not deemed significant. As new information becomes available to assess these other features and VECs, they may be identified in future EBSA evaluations.

The following tables describe the VECs (rankings, seasonality and confidence) used to define each of the 18 EBSAs within their corresponding evaluation matrix.

Table 1. Attributes of the Yukon North Slope EBSAs. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Topographically enhanced upwelling (spring – summer) (*high* – west; *moderate* – south) • Coarse substrate *(high)* • Freshwater corridor (spring – fall) *(very high)* • Freshwater mixing zone and plume (estuary) (spring – fall) *(high)* • Freshwater under-ice lake (winter) *(high)* • Increased fast flowing currents at steep slopes between Herschel Island and the Mackenzie Trough *(moderate)*	• **HIGH:** Black Guillemot foraging and rearing (summer) *(high)* • Kelp Beds *(low)* • **HIGH:** Dolly Varden population present (juvenile and adult life stages) (spring – fall) *(very high)* • **HIGH:** Arctic Cisco feeding and migration (spring – fall) *(very high)* • Marine fishes and benthic invertebrates (based on the course substrate habitat feature) *(very low)*	• **HIGH:** Key prey species (e.g., zooplankton, Arctic Cod, Pacific Herring) for higher trophic level foraging (when retention and/or upwelling occurs) *(high)* • **HIGH:** Anadromous fishes (e.g., Arctic Cisco, Whitefish, Inconnu) foraging (spring – fall) *(high)* • **MED:** Migratory corridor for Beluga, Bowhead Whale and Juvenile Ringed Seal (fall) *(high)* • **MED:** Bowhead Whale foraging (summer – fall) *(high)* • **MED:** Polar Bear denning, rearing and foraging (October – May) *(high)* • **MED:** Seabird, shorebird, and sea duck foraging and staging (spring – fall) *(high)*	• **HIGH:** Anadromous fishes (e.g., Arctic Cisco, whitefish, Inconnu) foraging (spring – fall) *(high)* • **MED:** Ringed Seal breeding and feeding (March – late summer) *(high)* • **MED:** Beluga foraging (late August) (*moderate*) • **HIGH:** Bowhead Whale foraging (summer – fall) *(low)* • **MED:** Polar Bear denning, rearing and foraging (October – May) *(moderate)* • **LOW:** Seabird, shorebird, and sea duck foraging and staging (spring - fall) *(high)*

Table 2. Attributes of the Mackenzie Trough EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **MED:** Upwelling *(high)* • Deep water canyon *(very high)* • Freshwater mixing zone and plume (estuary) (spring – fall) *(high)*		• **HIGH:** Key prey species (e.g., zooplankton, larval fish, Arctic Cod, Pacific Herring) for higher trophic level foraging (when retention and/ or upwelling occurs) *(high)* • **MED:** Macrofaunal density *(moderate)* • **HIGH:** Macrobenthic taxa richness *(moderate)* • **HIGH:** Migratory corridor for Beluga, Bowhead Whale and Juvenile Ringed Seal (fall) *(high)* • **MED:** Ringed Seal foraging (late summer) *(moderate)* • **MED:** Beluga foraging (spring) *(high)* • **MED:** Bowhead Whale foraging (summer – fall) *(high)* • **HIGH:** Polar Bear rearing and foraging (October – May) *(high)* • **MED:** Seabird, shorebird, and sea duck foraging (spring – summer) and staging (fall) *(high)*	• **HIGH:** Benthic ecosystem functions *(high)* • Key prey species (e.g., Arctic Cod) *(very low)* • **MED:** Ringed Seal foraging *(high)* • Beluga foraging (summer – fall) *(moderate)* • Bowhead Whale foraging (summer – fall) *(low)* • **HIGH:** Polar Bear rearing and foraging (October – May) *(moderate)* • **MED:** Seabird, shorebird, and sea duck foraging (spring – summer) and staging (fall) *(high)*

Table 3. Attributes of the Mackenzie Estuary and Nearshore Beaufort Shelf EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Freshwater corridor (spring – fall) *(very high)* • Freshwater under-ice lake (winter) *(high)* • Freshwater mixing zone and plume (estuary) (spring – fall) *(high)* • Gravel substrate *(very high)* • Underwater Pingos *(low)* • Stamukhi Zone (winter) *(moderate)* • Grounded ice may or may not be touching the sea floor (winter – summer) *(high)* • Landfast ice attached to the shore (winter – summer) *(high)* • Fast-ice edge and shore lead (spring – summer) *(high)* • Ice scouring *(high)*	• **HIGH:** Beluga refugia, calving, and foraging (July - August) *(moderate)* • Blackline Prickleback distribution range *(low)* • Kelp Beds *(low)*	• **HIGH:** Key prey species (e.g., zooplankton, Pacific Herring) for higher trophic level foraging (when retention and/ or upwelling occurs) *(high)* • **HIGH:** Primary and bacterial productivity at plume front (spring – summer) *(moderate)* • **HIGH:** Macrobenthic density *(moderate)* • **MED:** Macrobenthic taxa richness *(moderate)* • **HIGH:** Anadromous fishes (e.g., Arctic Cisco, Whitefish, Inconnu) foraging (spring – fall) *(high)* • **HIGH:** Marine larval fishes nursery *(moderate)* • **LOW:** Marine fishes (e.g., Pacific Herring) foraging *(moderate)* • **MED:** Ringed Seal foraging (late summer) *(moderate)* • **HIGH:** Beluga seasonal refugia, calving and foraging (spring – summer) *(moderate)*	• **HIGH:** Anadromous fishes (e.g., Arctic Cisco, Whitefish, Inconnu) foraging (spring - fall) *(high)* • Ringed Seal breeding and foraging (March – late summer) *(high)* • Beluga seasonal refugia, calving and foraging (spring - summer) *(moderate)* • Bowhead Whale foraging (summer – fall) *(low)* • Polar Bear denning, rearing and foraging (October – May) *(moderate)* • **HIGH:** Seabird, shorebird, and sea duck foraging (spring – summer) and staging (fall) *(high)*

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
		• **LOW:** Bowhead Whale foraging (summer – fall) *(high)* • Polar Bear denning, rearing and foraging (October – May) *(high)* • **HIGH:** Seabird, shorebird, and sea duck foraging (spring – summer) and staging (fall) *(high)*	

Table 4. Attributes of the Beaufort Shelf Break and Slope EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Shelf break • Strong along-shelf flow with the possibility of re-suspension of sediments *(moderate)* • Upwelling and downwelling Pacific winter water. This water mass is nutrient-rich and corrosive to aragonite due to re-mineralization of organic matter *(high)* • Potential formation of eddies *(very low)*	• Demersal marine fish assemblages *(low)*	• Primary productivity within the photic zone (spring) *(moderate)* • Key prey species (e.g., zooplankton) for higher trophic level foraging (when upwelling occurs) *(moderate)* • Macrobenthic taxa richness *(moderate)* • Arctic Cod (200-400m) *(moderate)* • Marine mammal migratory corridor (fall) *(moderate)* • Beluga foraging (spring/fall) *(moderate)* • Polar Bear seasonal habitat and foraging (December – September) *(moderate)*	• Key prey species (e.g., zooplankton and Arctic Cod) *(low)* • Polar Bear foraging (December – September) *(moderate)*

Table 5. Attributes of the Kugmallit Canyon EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Upwelling *(moderate)* • Freshwater mixing zone and plume (estuary) (spring – fall) *(high)* • Underwater pingos *(low)* • Fast-ice edge and shore lead (spring – summer) *(high)*		• **HIGH:** Key prey species (e.g., zooplankton, larval fishes, Pacific Herring) for higher trophic level foraging (when retention and/ or upwelling occurs) *(high)* • **HIGH:** Primary and bacterial productivity at plume front (spring – summer) *(moderate)* • **HIGH:** Macrobenthic density and taxa richness *(moderate)* • **HIGH:** Megabenthic density and taxa richness *(moderate)* • **HIGH:** Marine larval fishes nursery *(moderate)* • **LOW:** Marine fishes (e.g., Pacific Herring) foraging *(moderate)* • **MED:** Ringed Seal foraging and juvenile migration (late summer) *(moderate)* • **MED:** Bowhead Whale foraging and migration (summer – fall) *(high)*	• **MED:** Ringed Seal foraging (spring – fall) *(high)* • **HIGH:** Bowhead Whale foraging (summer – fall) *(moderate)*

Table 6. Attributes of the Husky Lakes EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Tidal currents (northern boundary) causing upwelling (spring – summer) *(high)* • Small arctic estuary with strong tidal flow and fairly stable annual salinity gradients *(high)* • Unique depth profile for an estuary environment in this region (with maximum depths of 100 m) *(high)*	• Rarely observed physiological plasticity in species (e.g., Lake Trout and Arctic Grayling) *(high)* • Unique species assemblage of freshwater and estuarine fishes *(high)* • Blackline Prickleback distribution range *(low)* • Lake Trout spawning (fall) *(high)*	• Anadromous Coregonids (e.g., Arctic Cisco, Broad Whitefish, Inconnu) (spring – fall) *(high)* • Estuarine and Marine fishes (e.g., Pacific Herring) *(high)* • Pacific Herring spawning (June – mid-July) *(moderate)* • Seabird, sea duck, shorebird, and waterfowl foraging, moulting, and staging (summer – fall) *(high)*	• Lake Trout spawning (fall) *(high)* • Pacific Herring spawning (June – mid-July) *(high)* • Seabird, sea duck, shorebird, and waterfowl foraging, moulting, and staging (summer – fall) *(high)*

Table 7. Attributes of the Cape Bathurst/Baillie Island EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **HIGH:** Topographically enhanced upwelling (spring – summer) *(high)*		• **MED:** Enhanced primary productivity (spring) *(moderate)* • **HIGH:** Key prey species (e.g., zooplankton, larval fishes) for higher trophic level foraging (when retention and/or upwelling occurs) (spring – summer) *(high)* • **HIGH:** Macrofaunal density and taxa richness *(high)* • **HIGH:** Macro- Megabenthic density and taxa richness *(high)* • **MED:** Ringed Seal foraging and juvenile migration (late summer) *(moderate)* • **HIGH:** Bowhead Whale foraging and migration (summer – fall) *(high)* • **HIGH:** Seabird, shorebird, and sea duck foraging (spring – summer) and staging (fall) *(high)*	• **HIGH:** Benthic ecosystem functions (remineralization) *(moderate)* • **MED:** Ringed Seal foraging (late summer) *(moderate)* • **HIGH:** Bowhead Whale foraging (summer – fall) *(high)* • **HIGH:** Polar Bear foraging (summer – spring) *(high)* • **HIGH:** Seabird, shorebird, and sea duck foraging (spring – summer) and staging (fall) *(high)*

Table 8. Attributes of the Liverpool Bay EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **HIGH:** Tidal currents (northern boundary) causing upwelling (spring – summer) *(high)*	• Kelp Beds *(low)* • Blackline Prickleback distribution range *(low)*	• Enhanced primary productivity (spring) *(moderate)* • Benthic diversity *(moderate)* • Anadromous Coregonids (e.g., Arctic Cisco, Broad Whitefish, Inconnu) (spring – fall) *(high)* • Saffron Cod spawning (winter) *(moderate)* • Pacific Herring spawning (June – mid – July) *(moderate)* • Polar Bear habitat (October – May) *(moderate)* • Seabird, sea duck, shorebird, and waterfowl foraging, moulting, and staging (summer – fall) *(high)*	• Anadromous Coregonids (e.g., Arctic Cisco, Broad Whitefish, and Inconnu) (spring – fall) *(high)* • Polar Bear habitat (October – May) *(moderate)* • Seabird, sea duck, shorebird, and waterfowl foraging, moulting, and staging (summer – fall) *(high)*

Table 9. Attributes of the Horton River EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Freshwater corridor (spring – fall) • **HIGH:** Land-fast ice (winter) *(high)*		• **HIGH:** Enhanced primary productivity (spring) *(moderate)* • **LOW:** Arctic Char feeding and migration (spring – fall) *(low)*	• **HIGH:** Arctic Char foraging (spring – fall) *(high)*

Table 10. Attributes of the Cape Bathurst Polynya EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **HIGH:** Large polynya (winter – summer) *(high)* • **HIGH:** Fast-ice edge (associated with the polynya and flaw lead system) (winter – summer) *(moderate)*		• **HIGH:** Enhanced primary production (spring) *(high)* • **HIGH:** Key prey species (e.g., Arctic Cod and zooplankton) for higher trophic level foraging (when conditions apply) *(high)* • **MED:** Megabenthic taxa richness and density *(high)* • **HIGH:** Arctic Cod (i.e., adult and nursery) (spring – summer) *(moderate)* • **MED:** Ringed seal foraging (late summer) *(moderate)* • **LOW:** Beluga foraging (summer) *(high)* • **MED:** Bowhead Whale foraging (spring – fall) *(high)* • **HIGH:** Polar Bear rearing and foraging (October – May) *(moderate)* • **HIGH:** Seabird and sea duck forgaing and staging (spring – fall) *(moderate)*	• **HIGH:** Benthic ecosystem functions *(moderate)* • **MED:** Arctic Cod nursery (spring – summer) *(moderate)* • **LOW:** Ringed seal foraging (late summer) *(moderate)* • **LOW:** Beluga foraging (summer) *(high)* • **MED:** Bowhead Whale foraging (spring – fall) *(high)* • **HIGH:** Polar Bear rearing and foraging (October – May) *(moderate)* • **HIGH:** Seabird and sea duck foraging and staging (spring – fall) *(moderate)*

Table 11. Attributes of the Western Banks Island EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Fast-ice edge (associated with the polynya and flaw lead system) (winter – summer) *(moderate)* • Land-fast ice (winter) *(moderate)*	• Bearded Seal habitat *(very low)*	• **MED:** Enhanced primary production (spring) *(low)* • **MED:** Key prey species (e.g., Arctic Cod and zooplankton) for higher trophic level foraging (when upwelling occurs) *(high)* • **MED:** Marine Mammal travel corridor (spring – fall) *(low)* • **LOW:** Beluga foraging (spring) *(moderate)* • **LOW:** Bowhead Whale foraging (summer – fall) *(moderate)* • **HIGH:** Polar Bear habitat, rearing, and foraging (October – May and sometimes annually) *(moderate)* • **HIGH:** Seabird and sea duck foraging (May – August) *(high)*	• **HIGH:** Polar Bear habitat, rearing, and foraging (October – May and sometimes annually) *(moderate)* • **HIGH:** Seabird and sea duck foraging (May – August) *(high)*

Table 12. Attributes of the De Salis Bay EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **LOW:** Freshwater corridor (spring – fall) • **LOW:** Upwelling (spring – summer) *(low)*		• **LOW:** Arctic Char feeding and migration (spring – fall) *(low)* • **LOW:** Beluga foraging (summer) *(low)* • **LOW:** Bowhead Whale foraging (August – September) *(low)* • **MED:** Polar Bear rearing and foraging (spring) *(low)*	• **HIGH:** Arctic Char foraging (spring – fall) *(high)* • **LOW:** Polar Bear rearing and foraging (spring) *(low)*

Table 13. Attributes of the Diamond Jenness EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Freshwater corridor (spring – fall) • **HIGH:** Land-fast ice (winter – spring) *(high)*	• Macro-invertebrate diversity *(very low)* • Overwintering habitat in Kuujjua Delta for Arctic Char (winter) *(very low)*	• **HIGH:** Arctic Char feeding and migration (spring – fall) *(high)* • **MED:** Marine fishes (e.g., Capelin, Arctic Cod) *(low)* • **HIGH:** Ringed Seal moulting (late June), breeding (winter – spring), rearing (spring) and foraging *(very high)* • Bearded Seal breeding and foraging (summer) *(low)* • **LOW:** Beluga and Bowhead Whale foraging (summer) *(low)* • **LOW:** Polar Bear rearing and foraging (spring) *(moderate)* • **HIGH:** Seabird, sea duck and shorebird breeding, rearing and foraging (spring – summer) *(high)*	• **HIGH:** Ringed Seal breeding (winter – spring), rearing (spring) *(very high)* • **HIGH:** Arctic Char foraging (spring – fall) *(high)* • **LOW:** Polar Bear rearing and foraging (spring) *(moderate)* • **HIGH:** Seabird, sea duck, and shorebird rearing and foraging (spring – summer) *(high)*

Table 14. Attributes of the Southern Amundsen Gulf EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Features	Uniqueness	Aggregation	Fitness Consequences
• Coarse substrate *(low)* • Upwelling (due to orientation of ice-edge or bathymetry and winds) (spring – fall) *(low)* • **HIGH:** Fast-ice edge (late winter – summer) *(high)*	• Marine fishes and benthic invertebrates (based on the course substrate habitat feature) *(very low)* • **HIGH:** Thick-billed Murre breeding and rearing (spring – summer) *(high)*	• Enhanced primary production (spring) *(low)* • **MED:** Key prey species (e.g., zooplankton, Arctic Cod) for higher trophic level foraging (when retention and/or upwelling occurs) *(high)* • **HIGH:** Macrobenthic taxa richness and density *(moderate)* • **LOW:** Marine mammal travel corridor (Juvenile Ringed Seal, Beluga, Bowhead Whale) (fall) *(high)* • **MED:** Ringed Seal breeding and rearing (March – June) *(low)* • **MED:** Beluga foraging (spring) *(moderate)* • **MED:** Bowhead Whale foraging (summer – fall) *(moderate)* • **HIGH:** Polar Bear rearing and foraging (late winter – early spring) *(moderate)* • **HIGH:** Seabird breeding, rearing and foraging (spring – summer) *(high)*	• **HIGH:** Benthic ecosystem functions *(moderate)* • **MED:** Ringed Seal breeding and feeding (March – late summer) *(high)* • **LOW:** Beluga foraging (spring – fall) *(moderate)* • **LOW:** Bowhead Whale foraging (spring – fall) *(moderate)* • **MED:** Polar Bear rearing and foraging (fall – spring) *(moderate)* • **HIGH:** Thick-billed Murre and Black Guillemot breeding, rearing and foraging (spring – fall) *(moderate)*

Table 15. Attributes of the Darnley Bay Nearshore Migration and Feeding Corridor EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Freshwater corridor (spring – fall) • **HIGH:** Land-fast ice (winter – spring)	• Kelp Beds *(low)* • Deep holes in the channels of the Hornaday River for Arctic Char overwintering habitat *(low)*	• **MED:** Arctic Char feeding and migration (spring – fall) *(high)* • **MED:** Ringed Seal breeding, seasonal refugia and rearing (winter – spring) *(high)* • **MED:** Polar Bear rearing and foraging (spring) *(moderate)*	• **HIGH:** Arctic Char feeding and migration (spring – fall) *(high)* • **HIGH:** Polar Bear rearing and foraging (spring) *(moderate)*

Table 16. Attributes of the Viscount Melville Sound EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• Deep water basin		• Key prey species (e.g., Arctic Cod) for higher trophic level foraging *(very low)* • **HIGH:** Beluga foraging (late August) *(moderate)* • **HIGH:** Polar Bear summer refugia *(moderate)*	• Beluga foraging (late August) *(low)* • **HIGH:** Polar Bear denning, rearing and foraging *(moderate)*

Table 17. Attributes of the Arctic Basin Multi-year Pack Ice EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **HIGH:** Multi-year ice *(very high)* • **HIGH:** Freshwater storage; Beaufort Gyre *(high)* • Shore lead polynya (spring – summer) *(very high)*	• Under-ice communities (e.g., autochthonous ice fauna) *(very low)*	• **HIGH:** Polar Bear summer refugia *(moderate)*	• **HIGH:** Polar Bear foraging and rearing *(moderate)* • Mat-forming centric diatoms *(low)*

Table 18. Attributes of the Archipelago Multi-year Pack Ice EBSA. Uniqueness, aggregation and fitness consequences of the attributes are ranked relative to other EBSAs in the Beaufort LOMA (rankings are identified in capitals and bold font). Seasonality of attributes is identified if known. Level of confidence in data/information supporting the attributes is identified in italics.

Physical Feature	Uniqueness	Aggregation	Fitness Consequences
• **HIGH:** Last remaining pack ice habitat; stationary multi-year pack ice • **HIGH:** Largest Arctic archipelago in the world	• **HIGH:** Ivory gull nesting (spring – fall) *(high)*	• Under-ice communities (e.g., autochthonous ice fauna) *(very low)* • **HIGH:** Polar Bear summer refugia *(moderate)* • **MED:** Seabird nesting and foraging (spring – fall) *(high)*	• **HIGH:** Polar Bear foraging, rearing and denning *(moderate)* • **MED:** Seabird nesting and foraging (spring – fall) *(high)*

Sources of Uncertainty

All EBSAs identified in this process were based on scientific literature, LEK/TEK and expert knowledge and opinion. It should be noted that although best attempts were made to include the full range of expertise needed to evaluate EBSAs in the Beaufort, this process might have benefitted from the attendance of other knowledge holders and the conclusions reached might have differed with their participation.

For some taxa there are clear definitions on how to define a species aggregation. In the case of the birds, Environment Canada often refers to >1% of the Canadian population. A method for the number of whales that was considered an aggregation was proposed and used for this evaluation, however a question as to how it can be applied to schooling fish or spawning areas (e.g., char, herring) is still an ongoing discussion.

For Arctic Char (*Salvelinus alpinus)* feeding and migration corridors that were used to justify an EBSA, the 20 m depth contour defined the outer boundary of that EBSA. There was concern that without any established criteria to decide which rivers containing Arctic Char are significant from an ecological and biological perspective made it difficult to provide rational as to why the entire coastline to 20 m was not an EBSA for anadromous fishes. This discussion included the identification of distinct management zones based on precise conservation objectives, however there were no conclusions made on this topic and it will be an important consideration for future EBSA evaluations.

During this evaluation process it was identified that Arctic Cod (*Boreogadus saida*) was a widespread species throughout the Beaufort Sea LOMA and important to ecosystem structure and function, however it was difficult to incorporate this VEC into the EBSA evaluation process. Arctic Cod are now known to aggregate in the 200-400 m depth strata across the LOMA, specifically identified along the Beaufort Shelf and in Franklin Bay. This is a 3-dimensional feature and difficult to map. For the Franklin Bay EBSA that was proposed in Cobb et al. (2014) participants concluded that the Arctic Cod VEC was not a unique feature to create a new EBSA rather, it was a ubiquitous species that we are continually learning more about its habitat preferences, one area being Franklin Bay. There was some discussion as to how to deal with species that we know very little about but are considered to be keystone in the Arctic food web and therefore qualify as an ecologically significant species (ESSs). The incorporation of ESSs into future EBSA evaluations will be important to explore further.

The Multi-Year Pack Ice is also an important feature among the Arctic Basin and Archipelago Multi-Year Pack Ice EBSAs. It is difficult to delineate concrete EBSA boundaries based on Multi-Year Pack Ice due to its inter-annual and seasonal variability. Participants suggested defining EBSA boundaries based on flexible definitions such as confidence limits (e.g., the 30 year mean) rather than inflexible boundaries such as geographic areas or bathymetric lines. An informed decision on this subject should be made once more experts assess this information. There was also some concern that the name and feature of this EBSA should be thick-ice as opposed to multi-year. This would suggest the feature is more related to the use and importance of the habitat for the species and processes that use it rather than the difference in the terminologies and definitions used by the Canadian Ice Service.

Additional knowledge of certain accepted EBSA VECs is needed in order to better assess/manage these areas:

- Knowledge of the importance of underwater pingos in the Mackenzie Estuary and Nearshore Beaufort Shelf EBSA;
- Knowledge on the importance of kelp beds;

- More information from the Canadian Ice Service to better map the boundaries of the Southern Amundsen Gulf and Multi-Year Pack Ice EBSAs;
- Knowledge regarding upwelling events in the De Salis Bay EBSA;
- Further knowledge on the physical oceanographic properties of the Prince of Wales Strait and the corresponding biological consequences are needed before it can be considered an EBSA.

For more detailed information regarding these sources of uncertainty, see DFO (2014b).

CONCLUSIONS AND ADVICE

A total of 18 EBSAs were identified within the Beaufort Sea LOMA based on new scientific information and publications, TEK, and the advice formulated from DFO (2011a). There were no significant changes in the number of EBSAs identified from this SAR relative to previous evaluations (see Cobb et al. 2014). The current EBSAs reflect new information and data presented in the literature and expert opinion present at the meeting. In order to effectively present to management current knowledge, each VECs was not only ranked, in most cases, against the main criteria (based on a subjective score of High, Medium and Low) but participants were also able to present their level of confidence associated with that VEC. Furthermore it was noted that seasonal variability can affect both EBSA boundaries and any resulting management decisions and thus a seasonal component was also added to each VEC for clarification.

Unlike past Arctic EBSA evaluations the identification and ranking (for uniqueness) of the physical drivers was considered an important starting point for each EBSA discussion. Often, the VECs were associated with the timing and/or presence of that physical forcing (e.g., upwelling) or habitat feature (e.g., fast-ice edge).

Similar to the DFO (2011c), policy and management should take into account the heterogeneity and underlying ecological properties within the larger identified EBSA boundaries. For this reason a separate technical report will be produced to reflect these details and further inform any future decisions in an EBSA.

A number of ecological and/or biological features which were used as the basis for delineating EBSAs extend outside both the scope of this process and Canadian waters. For example, many of the features that define the Yukon North Slope, Beaufort Shelf Break and Slope and the Arctic Basin Multi-year Pack Ice EBSAs extend beyond Canadian waters into Alaska (e.g., Speer and Laughlin 2011). For these EBSAs the western-most boundaries are defined by the political boundary. For EBSAs that cross the boundaries of the LOMA, the EBSA boundary continues into the adjacent bioregion (EBSAs 16, 17 and 18; Figure 1). Finally, the connectivity between EBSAs (i.e., physical features, VECs) within the LOMA, Alaskan Beaufort Sea, Chukchi and Bering seas are important for future management decision-making processes and should be discussed in the future.

As new scientific data becomes available and on-going research strengthens the knowledge within the LOMA, revisions may need to be made to the EBSAs (i.e., VECs and precision in boundaries) in order to ensure the best available information is incorporated which would influence future decision-making processes. It should also be noted that this CSAS was the result of a scientific and technical process using available science and previously documented traditional knowledge. The DFO Oceans Program should consider presenting the results in this SAR to the community members within the Inuvialuit Settlement Region in future consultations. Information brought forward out of these meetings may provide further important and relevant information for consideration by the users of this EBSA evaluation.

OTHER CONSIDERATIONS

The information collected and evaluated in this SAR will be important for other spatial planning and decision-making. For example, the Inuvialuit will be updating the maps and information in each of the community conservation plans and it would be valuable to unite the results of this SAR with their planning exercise.

Although naturalness and resilience are two key dimensions of an EBSA evaluation framework (DFO 2004), they were not considered in this evaluation based on the advice from the DFO (2011a) advisory process. Naturalness refers to how much a system has already been changed, directly or indirectly by human activities (DFO 2004). Its continuum varies from regions that are undisturbed and defined by native species to regions that are highly disturbed by human activities and/or characterized by an abnormal abundance of non-native species (DFO 2004).

Resilience refers to how likely a system is to change if exposed to a pressure, and its ability to recover following disturbance (DFO 2004). Its continuum ranges from regions where species or habitat components are extremely sensitive, easily disturbed, and slow to recover to regions where species or habitat components are hardy, resistant to disturbances, or easily return to the pre-disturbed state (DFO 2004). Despite being a key dimension of an EBSA evaluation framework, resilience is extremely difficult to measure. Detailed knowledge on ecosystem structure, function and connectivity is needed in order to evaluate EBSAs based on these criteria, and unfortunately to date there is limited knowledge on this topic.

Although both naturalness and resilience were not considered to be necessary for the identification of EBSAs, they will be imperative for the future prioritization of EBSAs and the application of the Ecosystem Approach[1] to management within them. Industry, such as tourism and oil and gas continue to show an interest in the Arctic, and climate warming appears to have increased the possibilities and opportunities for future development. Naturalness and resilience will become of greater value to management and thus the EBSA evaluation process in the future. These criteria, however, depend greatly on a comparison of past and current development within the region of interest.

[1] The Ecosystem Approach is a policy for the integrated management of water, land and living resources that supports sustainable use and conservation.

SOURCES OF INFORMATION

This Science Advisory Report is from the November 20-22, 2012 re-evaluation of the Beaufort Sea Ecologically and Biologically Significant Areas (EBSAs). Additional publications from this meeting will be posted on the DFO Science Advisory Schedule as they become available. A DFO Technical Report will be prepared, at a later date, to support the EBSA identification with geo-referenced data layers.

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APPENDIX 1: GLOSSARY

Aggregation - the accumulation of a certain ecosystem component(s) so that a given area is attributed with a high density of that component. Aggregation can vary depending on the timing of life history events such as mating, foraging, hibernating, etc.

Dispersal - the scattering of a certain ecosystem component(s) so that a given area is attributed with a low density of that component. Dispersal can vary depending on the timing of life history events such as mating, foraging, hibernating, etc.

Fast Ice-Edge - the area where the edge of the fast ice meets open water. These boundaries are dynamic and subject to continuous change.

Flaw Leads - a waterway opening between fast ice and pack ice.

Foraging - the act of seeking out and exploiting food reserves. The loss of a foraging ground may have less severe consequences for life history traits than the loss of a historical migratory route. Migratory routes are often not replaceable whereas multiple foraging grounds typically exist.

Grounded Ice - buoyant ice that is aground in shallow water. It may or may not be land-fast ice.

Land-fast Ice - ice formations that remain fastened along the coast by attachment to an ice wall, the shore, an ice front or between grounded icebergs or shoals. Land-fast ice can range from a couple meters to several hundred kilometers from the coastline. Depending on the age of land-fast ice, it can be prefixed with the term first year, second year, multi-year or old. There are physical differences in land-fast ice depending on its ability to retain freshwater, its degree of rubble and ridges, and its thickness. The different features of landfast ice may also have unique ecological features based on the characteristics (e.g., ice thickness, degree of rubble, ridges)

Migration Route - involves the directed movement for a relatively long duration from a summer range to a winter range. It is also often associated with an important shift in life history characteristics of a given species. Migratory routes are much more linear than foraging routes and may result in greater consequence to a given species if impacted by multiple stressors.

Mobile Pack-Ice - a broad term describing any region of ice, aside from fast ice, regardless of its form or how it is disposed of

Polynya - *a* geographically fixed region of open water (or low average sea-ice thickness) that is isolated within thicker pack ice.

Travel Corridor - a travel path that is often used as part of a foraging route as well.

APPENDIX 2: MAP OF EBSAS WITHIN THE SOUTHERN AMUNDSEN GULF REGION

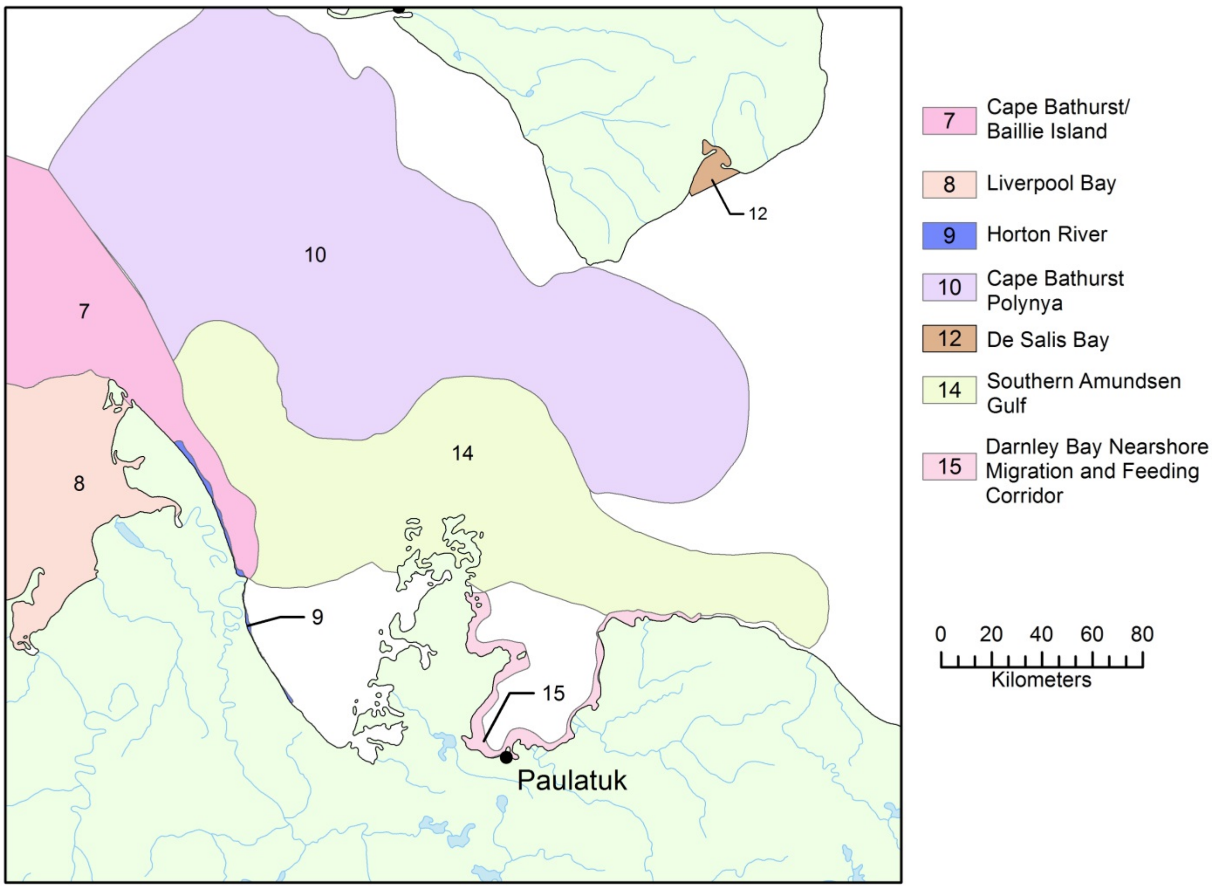

Figure 2. Ecologically and Biologically Significant Areas identified within the western Amundsen Gulf region.

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MPO. 2014. Réévaluation des zones d'importance écologique et biologique (ZIEB) de la mer de Beaufort. Secr. can. de consult. sci. du MPO, Avis sci. 2014/052.