CREE DEVELOPMENT CORPORATION

LA GRANDE ALLIANCE

LA GRANDE ALLIANCE

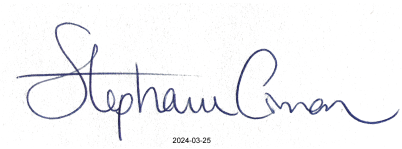
PRE-FEASIBILITY STUDY – PHASES II & III – TRANSPORTATION INFRASTRUCTURE

TECHNICAL NOTE 7
MARINE ENVIRONMENT

FINAL VERSION

DATE: MARCH 25, 2024

PREPARED BY:



Stéphanie Cimon, Biologist, Ph. D.
Aquatic Ecology

Émilie D'Astous, Biologist, M. Sc.

COLLABORATION:

Julie Malouin, Biologist

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EXECUTIVE SUMMARY

Within the framework of La Grande Alliance studies, the development of a small seasonal harbour is considered in the southeastern Hudson Bay near Whapmagoostui/Kuujjuarapik. The study area extends from the northeastern boundary of the *Lac-Burton-Rivière-Rogan-et-la-Pointe-Louis-XIV Land Reserved for Protected Area* to the mouth of Tasiujaq Lake (formerly Guillaume-Delisle Lake and Richmond Gulf before that) while the area under consideration for the infrastructure extends from Black Whale Harbour that is about 30 km southwest of Whapmagoostui/Kuujjuarapik to Boat Opening that is about 60 km northeast of Whapmagoostui/Kuujjuarapik. A review of previous projects, databases and scientific literature was conducted to document water and sediment quality, the species using the area and the sensitive habitats. Special care was given to species at risk and invasive species. To complete these data sources, requests for inputs from local organizations were made. The existence of marine protected areas and land claims in the study area was investigated. A review of the legislation and regulations specifically applicable to harbour development, ship traffic, invasive species and sensitive marine features was also conducted. Data available for the study area is mainly from the hydroelectric project of Complexe Grande-Baleine and is more than 20 years old. Therefore, some of the information could be outdated since changes are happening fast in the Arctic. The Hudson system is still understudied and there is a lack of information regarding many subjects.

Hudson Bay is an oligotrophic inland sea with low nutritive salts. Few data on surface water quality in the Hudson Bay is available. In the study area, water salinity is mainly influenced by The Great Whale River and by James Bay and is generally somewhere between 21 PSU to 24 PSU for surface water and go as low as 0 PSU directly at the mouth of the river and up to 33 PSU in deep waters. In summer, sea surface temperature can reach 12°C in the Hudson Bay while the bottom layer stays around 0-2°C. According to available data, the pH is a little under the recommendation for the protection of aquatic life (chronic effect) of the M*inistère de l'Environnement et de la Lutte contre les changements climatiques* (MELCC 2022) and Canadian Council of ministers of the environment (CCME 1999) and water mercury levels were higher than the MELCC recommendation for the prevention of contamination in aquatic organisms which is based on a daily consumption of 15 g of fish, mollusk and crustacean. In the sediments, arsenic and copper concentrations were higher than recommendations from CCME and Environment Canada and M*inistère du Développement durable, de l'Environnement et des Parcs du Québec* (EC and MDDEP) although all these levels come from local geology and air pollution emanating from further south and depositing in arctic waters.

The east coast of the Hudson Bay is generally exposed to waves, wind and ice, and the substrate is mainly coarse sand. Intertidal habitats for meadows and macroalgae are limited within the study area and mainly present within the Manitounuk Sound. Coastal vegetation is dominated by minerotrophic bogs (50%) while bare sediments (fine or coarse) occupy an important place with about 37% on average in the study area. Salt marshes and eelgrass beds are more frequent and larger in the Manitounuk Sound than anywhere else in the study area. Macroalgae are most probably also more frequent and with higher density in the Manitounuk Sound since it is less exposed than the rest of the study area, although brown algae remain dominant. There is active primary production in summer at the surface particularly along the coast and epontic algae also play an important role in primary production during winter. Zooplankton is dominated by copepods and chaetognaths are dominant in terms of biomass. The assemblages of benthic invertebrates are typical of subarctic environments. Mussel beds are present in the Manitounuk Sound; information regarding their distribution for the rest of the study area is not available.

At least 47 fish species are documented in the study area, of which most are marine, but also diadromous or typically freshwater species are present. Crees and Inuit mainly fish Greenland cod (*Gadus ogac*), arctic cod (*Boreogadus saida*), sculpins, cisco (*Coregonus artedi*), lake whitefish (*Coregonus clupeaformis*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*), capelin (*Mallotus villosus*) and arctic char (*Salvelinus alpinus*). Marine mammals are present in the study area. Pinnipeds are the most common as well as an important food resource. The ringed seal (*Pusa hispida*) is the most numerous and bearded seal (*Erignathus barbatus*) is second in importance. Beluga whales (*Delphinapterus leucas*) of the eastern Hudson Bay population are present mostly in the northern part of the study area but can be encountered anywhere in the study area. It is uncommon to

sight other whales in the study area. Sightings of polar bears (*Ursus maritimus*) are frequent and denning sites are likely present in the north of the study area. According to the available data, 97 bird species in 25 families are likely to inhabit the marine area and its coastline on an annual basis that represent an important migration route for many bird species. Bird concentrations are highest during the spring migration and particularly during the fall migration when waterfowl are about five times more numerous. Within the study area waterfowl is more frequent in the region of Manitounuk Sound where salt marshes and eelgrass beds are more present. However, their concentration is higher north of the study area near Nastapoka River. Waterfowl is an important food resource for Cree and Inuit communities.

The study area is in Belchers Islands Ecologically and Biologically Significant Area (EBSA) that is also a Priority Area for Conservation by World Wildlife Fund Canada (WWF Canada). Canadian Important Bird Areas (IBA) are at the limit, or near, the study area: Great Whale River, Little Whale River, Tasiujaq Lake and Nastapoka River for Harlequin Duck (*Histrionicus histrionicus*), and Belcher Islands, Salikuit Islands and Sleeper Islands for Common Eider (*Somateria mollissima*). Three small polynyas, which are areas of open water surrounded by sea ice, that can be covered by ice from time to time, are present in the study area: Paint Islands, Schooner Opening and Boat Opening. River estuaries are important for diadromous fish and belugas. In the study area, beluga whales are mainly present from Schooner Opening to Little Whale River estuary but use the entire zone. Manitounuk Sound is used by birds from spring to fall and is believed to be an important habitat in the capelin life cycle. Manitounuk Sound also has the greatest concentration of salt marshes and eelgrass meadows of the study area. The coastal zone around Little Whale River and Tasiujaq Estuary is identified as an important zone for beluga, and for the reproduction of Peregrine Falcon (*Falco peregrinus*) and Golden Eagle (*Aquila chrysaetos*) as well as an important zone for Inuit and Cree subsistence. Beluga hunting is prohibited in Little Whale River Estuary that is identified as a sanctuary for the species. According to Inuit and Cree traditional knowledge, polar bears are sighted from Whapmagoostui/Kuujjuarapik to farther north than Tasiujaq Lake and polar bear denning sites are present from the end of Manitounuk Sound up to Tasiujaq Lake. Kativik Regional Government identified Manitounuk Sound as an area of esthetic interest for its unique landforms and spectacular landscapes and Nunavik communities are requesting that a 10 km-wide coastal zone is recognized and obtains an official protection from governments for its diversity and important productivity notably through Kativik Regional Master Plan. Through community consultation by Eeyou and Nunavik Marine Region Wildlife Boards, Eeyou Istchee Crees and Inuit from Whapmagoostui/Kuujjuarapik voiced some concerns regarding waterfowl, its habitat and how to preserve it, a decrease in the abundance of seals, whales and walruses (*Odobenus rosmarus*), an increase in the eagle and polar bear numbers, changes in the beluga whale distribution, the presence of the rainbow smelt (*Osmerus mordax*), changes to the taste of animals, water levels and quality, caribou populations on the islands of the Eeyou Marine Region, fish (decrease in the populations of capelin, Arctic char, sardines and other fish) and its habitat, and seafood resources including shellfish and shrimp.

Among the different species likely to frequent the eastern Hudson Bay and its coast, 16 species have a protection status. Belugas of the eastern Hudson Bay population are likely to be met in the study area in summer while polar bears are likely to be met on the ice of the Hudson Bay in winter and inland and over the coast during summer. Seven bird species with a status are likely to frequent the coast of the study area from spring to fall. Among them, Harlequin Duck, Golden Eagle, Bank Swallow (*Riparia riparia*) and Rusty Blackbird (*Euphagus carolinus*) are likely to nest near or within the study area.

At this time, there are no marine invasive species documented in the study area. Eeyou Istchee Crees voiced some concerns regarding increase and introduction of cormorants, green crab (*Carcinus maenas*), algae, jellyfish, Greenland shark (*Somniosus microcephalus*), bald eagles (*Haliaeetus leucocephalus*), and vultures in the Eeyou Marine Region. Rainbow smelt (*Osmerus mordax*) has been confirmed further south in the Eeyou Marine Region, and anecdotal evidence suggests that it may be present near Whapmagoostui. An assessment on the risk of invasions of the Hudson Bay Complex identified 14 species with a risk for invasion. Of those, three are listed on the *100 of the World's Worst Invasive Alien Species*: warty comb jelly (*Mnemiopsis leidyi*), green crab and wakame (*Undaria pinnatifida*).

TECHNICAL NOTE 7 – MARINE ENVIRONMENT

The study area covers three recognized claims: Eeyou Marine Region (Joint Zone), Nunavik Marine Region (Joint Zone) and Nunavut Settlement Area (Area B). These agreements acknowledge ownership and other rights to certain areas in the offshore, allows co-management for wildlife, land management, and development impact issues. As so, wildlife boards and impacts review boards exist for each of those regions.

There are no federal Marine Protected Areas in the study area according to Fisheries and Oceans Canada (DFO). Other marine protected and conserved areas are listed by DFO in the Canadian Protected and Conserved Areas Database (CPCAD), one within the study area, Tursujuq National Park (Québec), and a Land Reserved for Protected Area located outside the zone to the south (*Lac-Burton-Rivière-Roggan-et-la-Pointe-Louis-XIV*). Those two parks are land park that both have small, protected bays in the Hudson Bay and are outside of the terrestrial reach of the study area. There are no proposed marine protected areas in the study area. However, there is one project to protect Belcher Islands: Qikiqtait Protected Area. The study area is located within a Priority Area for Conservation by WWF Canada.

The development of a harbour in the Eeyou Marine Region implies various issues regarding laws and regulations, and environmental components, namely fish habitat, introduction of pollutants and contamination, and introduction of aquatic invasive species. It could also interact with the traditional uses of the area by Cree and Inuit communities. The main laws applicable to the marine environment in the context of La Grande Alliance are the *Fisheries Act*, the *Oceans Act*, the *Canada Wildlife Act*, the *Species at Risk Act*, the *Marine Mammal Regulations*, the *Migratory Birds Convention Act*, the *Aquatic Invasive Species Act*, the *Canada Shipping Act* and the *Ballast Water Regulations*.

The *Oceans Act* requires the Department of Fisheries and Oceans to designate Ecologically and Biologically Significant Areas (EBSA) across Canadian marine waters. There is a large overlap between EBSA and marine transport corridors. To minimize potential effects of shipping on wildlife, respect culturally and ecologically sensitive areas, enhance marine navigation safety, and guide economic development of the North, northern low-impact shipping corridors are under development by the Canadian Coast Guard (CCG), Transport Canada, and Canadian Hydrographic Service, together with Inuit, First Nations and Metis organizations and governments, provincial and territorial governments, and other key stakeholders through the Canadian Arctic region. Ultimately, this initiative should limit the areas available for shipping activity and provide a strong starting point for the integration of the protection of the marine environment and its traditional uses.

Main issues and constraints to the development of a harbour are related to higher maritime traffic that would increase collision risk with marine mammals, increase the risk of water and sediment contamination as well as increase the risk of invasion by non-indigenous species. Such a development also means higher disturbance both under- and above-water, habitat loss, changes in local water dynamics, and possibly a better access to harvested resources. Depending on the location of the harbour, it might also have a localized impact on the landscape appreciation (Manitounuk Sound).

It is recommended to proceed to some photointerpretation of the littoral to identify salt marshes and possibly eelgrass meadows, to perform specific inventories on species at risk, bird colonies and shellfish beds, summering haulout, and fish spawning areas. These studies would allow a better understanding of the use of the study area and would allow to better mitigate impacts on those species. Low Impact Shipping Corridors Initiative and Cree and Inuit community consultations must form an integral part of all future stages of work.

LIST OF ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS/ ACRONYMS	DEFINITION
AOI	Areas of Interest
BWM	Ballast Water and Sediments Convention
CCG	Canadian Coast Guard
CCME	Canadian Council of ministers of the environment
CEN	Centre d'études Nordiques
CIOOS	Canadian Integrated Ocean Observing System
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMIST	Canadian Marine Invasive Screening Tool
CPCAD	Canadian Protected and Conserved Areas Database
CRRNTBJ	Commission régionale sur les ressources naturelles et le territoire de la Baie-James
DFO	Fisheries and Oceans Canada
EBSA	Ecologically and Biologically Significant Area
EC	Environment Canada
EIJBRG	Eeyou Istchee James Bay Regional Government
EMR	Eeyou Marine Region
EMRLCA	Eeyou Marine Region Land Claims Agreement
EMRWB	Eeyou Marine Region Wildlife Board
GBIF	Global Biodiversity Information Facility
IBA	Important Bird Areas
IOM	Integrated Oceans Management
JBNQA	James Bay and Northern Quebec Agreement
KRG	Kativik Regional Government
LOMA	Large Ocean Management Areas
MARPOL	International Convention for the Prevention of Pollution from Ships
MDDEP	Ministère du Développement durable, de l'Environnement et des Parcs du Québec
MELCC	Ministère de l'Environnement et de la Lutte contre les changements climatiques
MFFP	Ministère des Forêts, de la Faune et des Parcs
MPAs	Marine Protected Areas

ABBREVIATIONS/ ACRONYMS	DEFINITION
NILCA	Nunavik Inuit Land Claims Agreement
NLCA	Nunavut Land Claims Agreement
NMR	Nunavik Marine Region
NMRWB	Nunavik Marine Region Wildlife Board
NSA	Nunavut Settlement Area
NWAs	National Wildlife Areas
NWMB	Nunavut Wildlife Management Board
OBIS	Ocean Biodiversity Information System
PAC	Priority Areas for Conservation
TAT	Total Allowable Take
WoRMS	World Register of Marine Species
WWF Canada	World Wildlife Fund Canada

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1 METHODOLOGY AND PREVIOUS STUDIES

The description of the marine biological environment, its management, important issues and sensitive elements were investigated from a review of available literature and specific information requests concerning the study of a potential harbour in the Whapmagoostui/Kuujjuarapik region.

Based on conclusions outlined in Technical Notes 13A and 13B, the small craft harbour is the recommended option to be developed. Nevertheless, this note assumes all potential harbour variants so as to provide an exhaustive analysis of all possible requirements and constraints.

Hudson Bay is a large inland sea largely understudied due to its size and remoteness, but also due to a long ice cover period typically extending in some parts from December to July (Stewart and Lockhart 2005). Studies in this area are generally localised and linked to development projects, covering very specific subjects that tend to be limited due to insufficient funding. Documented information remains limited and often insufficient. In this context, Traditional Ecological Knowledge from Inuit and Crees communities, specifically active hunters and elders, becomes paramount.

1.1 LITERATURE AND PUBLIC DATA REVIEW

Information was gathered mainly from pre-project and monitoring inventories carried out as part of development projects whose footprint is in or near the areas under study. Most of the information originates from pre-project studies for the Grande-Baleine hydroelectric complex, in the 1980s and early 1990s, which was never built. While much of the information gathered at the time remains useful today, rapid environmental change in the arctic region makes a good proportion of it outdated. Impact studies of similar harbour projects in the North were also consulted, but these tend to be limited in scope and outside the study area.

To complete the marine wildlife report, scientific data from Whapmagoostui/Kuujjuarapik region was collected using the Federal Science Libraries Network. Online databases such as the Global Biodiversity Information Facility (GBIF), Ocean Biodiversity Information System (OBIS), Canadian Integrated Ocean Observing System (CIOOS), *Atlas des oiseaux nicheurs du Québec*, eBird, Canadian Wildlife Service, and Important Bird Areas (IBA) were consulted. Scientific names were verified to update current taxonomy using WoRMS (World Register of Marine Species).

Official federal and provincial Species at Risk lists were verified, as well as available distribution maps.

The Canadian Marine Invasive Screening Tool (CMIST) database was searched for recordings of invasive species in the study area.

1.2 INFORMATION REQUESTS

Information requests were made to gather available information on wildlife inventory, sensitive areas, elements of interest and preoccupation of local communities.

Information requests were sent in October and November 2021 to:

- *Centre d'études Nordiques* (CEN);
- Eeyou Istchee James Bay Regional Government (EIJBRG);
- Eeyou Marine Region Wildlife Board (EMRWB);
- Kativik Regional Government (KRG).

Information request to the Nunavik Marine Region Wildlife Board was done through a phone meeting on February 24, 2022.

1.3 STUDY AREA

The study area is in the southeastern Hudson Bay near Whapmagoostui/Kuujjuarapik. It follows the coastline from the northern limit of *Lac-Burton-Rivière-Roggan-et-la-Pointe-Louis-XIV Reserverd Land for Protected Area* at its southern boundary and up to the mouth of Tasiujaq Lake at its northern boundary (Map 1-1). The study area forms a half-moon that is about 70 km wide in its middle and covers over 8,000 km^2. The terrestrial part of the study area is narrower and extends from Black Whale Harbour that is about 30 km southwest of Whapmagoostui/Kuujjuarapik to Boat Opening that is about 60 km northeast of Whapmagoostui/Kuujjuarapik (Map 1-1).

Most of the study area is in the joint zone of the Eeyou Marine Region and Nunavik Marine Region, mostly in Nunavut Territory. Main users of the area are Nunavik Inuit and the Eeyou Istchee Crees.

Belcher Islands

TERRITOIRE DU NUNAVUT /
NUNAVUT TERRITORY

Baie d'Hudson /
Hudson Bay

Parc national Tursujuq
(partie marine / marine part)

Parc national Tursujuq
(partie terrestre / land part)

Lac Tasiujaq

Petite rivière de la Baleine

Passe Umiat /
Boat Opening

Shooner Opening

Paint Islands

Passage de Manitounuk / Manitounuk Sound

PROVINCE DE QUÉBEC /
PROVINCE OF QUÉBEC

Kuujjuarapik
Whapmagoostui

Grande rivière de la Baleine

Rivière Vauquelin

Long Island

Lac-Burton-
Rivière-Roggan-et-
la-Pointe-Louis-XIV
(partie marine /
marine part)

Lac-Burton-
Rivière-Roggan-et-
la-Pointe-Louis-XIV
(partie terrestre / land part)

Chisasibi

Radisson

B-620

B-610

B-600

B-590

Billy-Diamond highway

Route

Chemin de Chisasibi road

Réservoir Robert-Bourassa

Aire protégée en milieu marin / Marine Protected Area

- Parc national / National Park
- Réserve de territoire aux fins d'aire protégée / Land Reserved For Protected Area

Aire protégée en milieu terrestre / Land Protected Area

- Parc national / National Park
- Réserve de territoire aux fins d'aire protégée / Land Reserved For Protected Area

Territoire et province / Territory and Province

- Territoire du Nunavut
- Province de Québec

Limite / Limit

- Zone d'étude / Study area

Infrastructure / Infrastructure

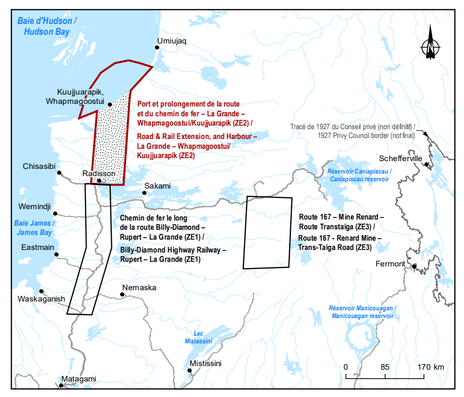
- B-600 — Route Billy-Diamond et borne kilométrique / Billy-Diamond highway and kilometre point

Composante projet / Project Component

- Route projetée / Proposed road
- Variante de la route projetée / Proposed road alternative
- Chemin de fer projeté / Proposed railway

Note: Les alignements proposés ne sont pas finaux / The proposed alignments are not final

La précision des limites et les mesures montrées sur ce document ne doivent pas servir à des fins d'ingénierie ou de délimitation foncière. Aucune analyse foncière n'a été effectuée par un arpenteur-géomètre. / The accuracy of the limits and the measurements shown in this document should not be used for engineering purposes or land delimitation. No property analysis was carried out by a land surveyor.



LA GRANDE ALLIANCE

Étude de préfaisabilité – Phases II et III
Pre-feasibility Study – Phases II and III

Note technique 7 / Technical Note 7
Milieu naturel terrestre / Terrestrial Environment

Carte 1 - ZE2
Milieu naturel marin

MAP 1 - SA2
Marine Environment

Sources :
Adresse Québec, MERN, 2020
BDTA, 1/250 000, MRN Québec, 2002
Zones protégées : Base de données canadienne sur les aires protégées et de conservation / Canadian Protected and Conservation Areas (CPCAD), 2021

0 3,55 7,1 10,65 km
Lambert, NAD83

Février / February 2023

Préparation / Prepared by : S. Cimon
Dessin / Drawn by : D. Gagné
Approbation / Approved by : J. Malouin

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2 OCEANOGRAPHIC PHYSICAL ENVIRONMENT

The parameters presented here are strictly related to surface water, sediment quality and primary production. The physical components of the study area are further discussed in Technical Note 13.

2.1 CIRCULATION OVERVIEW

Hudson Bay is an inland sea with a broad coastal shelf of about 80 m deep, gradual slope where the floor drops from 80 m to 160 m and a smooth continuous seafloor from 160 m to around 270 m deep. This bay is part of the Hudson Bay Complex, or Hudson Complex, along with James Bay, Foxe Basin, Hudson Strait and Ungava Bay. This complex has a general sea surface water circulation coming from Hudson Strait and Arctic Ocean to Foxe Basin then running along Hudson Bay west coast, down to James Bay or up northwest of Belcher Islands, following the Hudson Bay east coast and exiting by Hudson Strait (Figure 2-1) - (Prinsenberg 1986, Stewart and Lockhart 2005). Surface water enters James Bay on its west side then goes up northwest of Belcher Islands and northeast passing through the study area. James Bay has a large inflow of fresh water, mainly from the Albany, Moose, Nottaway, Broadback and Rupert and La Grande Rivers. The latter waterbody is the most notable source of fresh water due to hydrographic modifications from hydroelectric development, resulting in numerous watersheds diverted towards it. Main current in the study area follows the coast from south to north (McDonald *et al.* 1997, Stewart and Lockhart 2005).

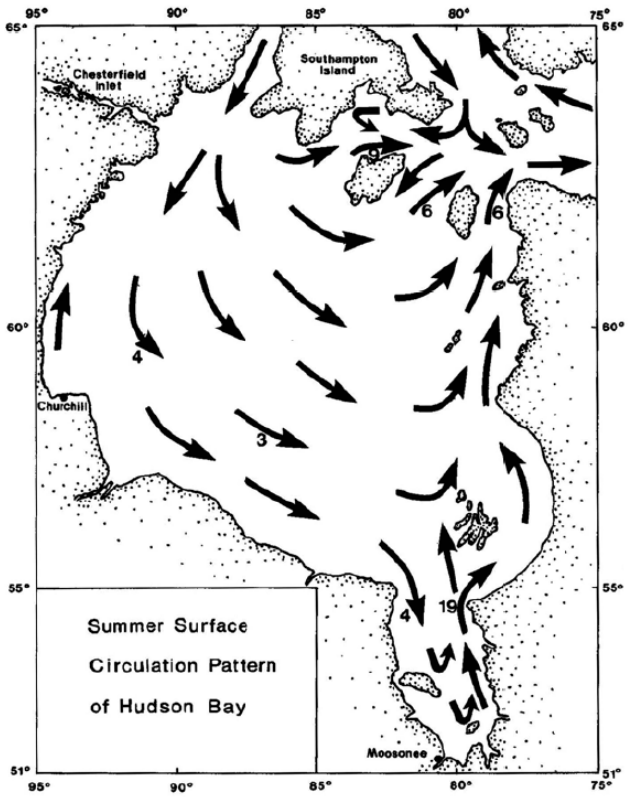

Figure 2-1 General Surface Water Circulation of the Hudson Complex During Summer (from Prinsenberg 1986)

2.2 SURFACE WATER QUALITY

Hudson Bay is an oligotrophic inland sea with low nutritive salts (Roff and Legendre 1986). Few data on surface water quality in the Hudson Bay is available. Its waters are relatively clear with a Secchi disk depth average of 18.2 m offshore and 11-12 m inshore (Anderson and Roff 1980a, Barber 1972 *In* Stewart and Lockhart 2005). In August 1976 in the study area, Secchi depth was measured to be 8.1 m on average in coastal waters, up to 20 km offshore, and 10.2 m on average further offshore (Simard *et al.* 1980). The photic zone (1% of light penetration) was estimated to be around 20 m deep near the shore and 30 m deep offshore (Simard *et al.* 1980). A pycnocline (i.e., boundary between two water layers of different density that is usually dictated by salinity and temperature) is located about 30 m deep for the whole Hudson Bay (Prinsenberg 1986). Below this pycnocline, temperature reaches 0 °C.

Salinity in the Hudson Bay varies from 10 PSU near river mouths to approximately 30 PSU in the centre of the bay for the surface layer while it fluctuates between 30 and 34 PSU for the bottom layer (Prinsenberg 1986, Pett and Roff 1982). Within the study area, water salinity is mainly influenced by The Great Whale River and by James Bay and is generally somewhere between 21 PSU to 24 PSU for surface water and decreases as low as 0 PSU directly at the mouth of the river and up to 33 PSU in deep waters (Can. Dept. fish Env. 1982 *In* Hydro-Québec 1993, Prinsenberg 1984). Along the coast within Manitounuk Sound, mean salinity ranges from 6.8 PSU to 20.3 PSU (Breton-Provencher and Cardinal 1978). The lowest salinity levels are generally observed in March and April (Legendre and Simard 1979a). The southeastern Hudson Bay is highly influenced by freshwater coming from James Bay during winter, the proportion of which increases from fall to late winter (Eastwood *et al.* 2020).

In summer, sea surface temperature can reach 12° C in the Hudson Bay while the bottom layer stays around 0-2°C (Roff and Legendre 1986). In the study area, surface average temperature in August was 8.6 °C in the coastal zone while it was 7.0 °C on average 20 km offshore up to Belcher Islands (Simard *et al.* 1980). Temperature drops quickly and is around 2 or 3 °C on average from 10 m to 30 m deep and 0 °C to -1.3 °C on average 31 m and deeper (Simard *et al.* 1980).

Water nutrients are highly variable and may depend on the tidal cycle during summer months (Legendre and Simard 1979a). Phosphate usually increases with salinity while nitrogen and silicates decrease. In winter, there is an important halocline within the first metres; nutrients are also distributed vertically such that they are in lower concentrations at the surface (Legendre and Simard 1979a). The concentration of nitrogen salts is low in southeastern Hudson Bay (Legendre and Simar 1979a). Phytoplanktonic production appears to be greater in coastal zones than further offshore, as noted by higher carbon concentrations (Simard *et al.* 1980). Offshore, within the study area, minimum concentrations of SiO_4, NO_3+NO_2, PO_3 occurs at the surface (0-20 m) while their concentrations increase with depth.

In the study area, water is generally clear, shows little conductivity, is nutrient-poor and demonstrates low productivity (Table 2.1 and Table 2.2). During winter, ice-free water (known as “polynyas”) may occur, but their locations vary (e.g., Hydro-Québec 1993). The main documented area of polynyas is located around Belcher Islands, but small ones are also present in Schooner and Boat Opening in Manitounuk Sound, and at the mouth of Tasiujaq Lake (see Map 1-1, CSSA 1992).

The pH levels in the study area are slightly below the recommendation for the protection of aquatic life (chronic effect) of the M*inistère de l’Environnement et de la Lutte contre les changements climatiques* (MELCC 2022) and the Canadian Council of ministers of the environment (CCME 1999). Low pH (<6.9) is common in the region and measures ranging from 4 to 6 are usual (e.g., Ungar 1961, Clasen *et al.* 1977). Acidity in marine environments in the Nord-du-Québec and Côte-Nord regions is relatively common, and is usually caused by natural phenomena such as forest fires and ocean bacterial activity, although sulphur and nitrogen oxides from anthropogenic activities can also be present (Dupont 2004). A lake with a pH over 6 is not considered acidic as damages such as species loss generally occurs in waters with pH under 6 (Dupont 2004). The low alkalinity of the water makes aquatic life highly sensitive to acidification by acid rain or mining waste, as the buffer capacity of the water is low (MELCC 2022).

Most Canadian Shield lakes have a low alkalinity (Dupont 2004), which in turn will influence alkalinity within the Hudson Bay especially near river mouths.

In 1989, seven measures of mercury were taken in marine surface water 10 km offshore of Great Whale River (SOMER inc. 1993). Mercury was detected in all samples and concentrations ranged from 2.7 ng/L to 39.9 ng/L (Table 2.3). All samples had a concentration higher than the MELCC recommendation for the prevention of contamination in aquatic organisms, based on a daily consumption of 15 g of fish, mollusk and crustacean. High mercury levels in Nord-du-Québec and in the Canadian Arctic is well known. Mercury occurs naturally in the environment and has a complex cycle (e.g., Braune *et al.* 2015). The creation of the La Grande hydroelectric complex has led to an increase in the level of bioavailable mercury (Hayeur 2001). High mercury levels in the study area before 1993 are coming from local geology, atmospheric fallout and possibly from the La Grande complex.

Table 2.1 Water Quality 10 km Offshore of Great Whale River

PARAMETER	SUMMER	WINTER
Real color (TCU)	21	14
Turbidity (UTN)	2.3	1.2
Dissolve oxygen (% saturation)	110	106
Conductivity (µS/cm)	16	22
pH	6.7	6.6
Alkalinity (mg/L $CaCO_3$)	3.5	6.0
Bicarbonate (mg/L HCO_3)	4.2	7.3
Total inorganic carbon (mg/L C)	1.5	2.5
Total organic carbon (mg/L C)	4.5	4.3
Total Kjeldahl nitrogen (mg/L N)	0.16	0.14
Total phosphorus (µg/L P)	9	4
Silicates (mg/L SiO_2)	1.4	1.7
Chlorophyll *a* (µg/L)	0.94	0.05
Phaeopigment (µg/L)	0.63	0.08

Source: Hydro-Québec 1993

Table 2.2 Water Quality Parameters Measured from 0 to 30 m Deep

PARAMETER	SEASON	RANGE OF MEANS	LOCATION
Temperature	Summer	1.9-10.2°C	Manitounuk Sound[1]
		2.8-8.6°C	Coastal[3]
		2.2-7.0°C	Offshore[3]
Salinity	Winter	18.8-19.0 PSU	Great Whale River Estuary[1]
		15.5-22.7 PSU	Manitounuk Sound[1]
	Summer	19.6-29.0 PSU	Great Whale River to Manitounuk Sound[1]
		23.1-27.8 PSU	Costal-Offshore[3]

PARAMETER	SEASON	RANGE OF MEANS	LOCATION
SiO_3	Winter	9.5-9.6 mat-g/m^3	Great Whale River Estuary[1]
		9.6-12.9 mat-g/m^3	Manitounuk Sound[1]
	Summer	4.7-7.8 mat-g/m^3	Great Whale River to Manitounuk Sound[1]
		4.26-13.13 µM	Offshore[2]
		4.6-7.3 mat-g/m^3	Offshore[3]
NO_3	Winter	2.0-2.8 mat-g/m^3	Great Whale River Estuary[1]
		2.1-3.1 mat-g/m^3	Manitounuk Sound[1]
	Summer	0.1-1.1 mat-g/m^3	Great Whale River to Manitounuk Sound[1]
		0.04-3.44 µM (NO_3 + NO_2)	Offshore[2]
		0.1-0.8 mat-g/m^3	Offshore[3]
PO_4	Winter	0.63-0.83 mat-g/m^3	Great Whale River Estuary[1]
		0.49-0.60 mat-g/m^3	Manitounuk Sound[1]
	Summer	0.18-0.65 mat-g/m^3	Great Whale River to Manitounuk Sound[1]
		0.39-1.28 µM	Offshore[2]
		0.5-0.7 mat-g/m^3	Offshore[3]
Chlorophyll *a*	Winter	0.22-0.64 mg/m^3	Great Whale River Estuary[1]
		0.06-0.18 mg/m^3	Manitounuk Sound[1]
	Summer	0.13-1.99 mg/m^3	Great Whale River to Manitounuk Sound[1]
		0.10-2.14 µg/L	Great Whale River Estuary[2]
		0.07-1.05 µg/L	Offshore[2]
Phaeopigment	Winter	0.13-0.23 mg/m^3	Great Whale River Estuary[1]
		0.11-0.15 mg/m^3	Manitounuk Sound[1]
	Summer	26.1-58.5%	Great Whale River to Manitounuk Sound[1]
		0.10-0.52 µg/L	Great Whale River Estuary[2]
		<0.02-0.27 µg/L	Offshore[2]
ATP	Summer	0.14-1.02 mg/m^3	Great Whale River to Manitounuk Sound[1]
Particulate C	Summer	92-253 mg/m^3	Great Whale River to Manitounuk Sound[1]
		110.6-446.4 µg/L (COP)	Offshore[2]
		128-192 mg/m^3	Offshore[3]
10^6 cell/m^3	Summer	6.6-55.2 x 10^6 cell/m^3	Great Whale River to Manitounuk Sound[1]
		2.7-3.0 x 10^6 cell/m^3	Offshore[3]

Source: [1] Legendre and Simard 1979a, [2] Simard *et al.* 1996, [3] Simard *et al.* 1980

Table 2.3 Water Quality 10 lm Offshore of Great Whale River

PARAMETER (DETECTION FREQUENCE)	MEAN	STANDARD DEVIATION	RANGE (MIN-MAX)	CRITERIA
Mercury (7/7)	10.64 ng/L	13.10 ng/L	2.7-39.9 ng/L	1.8 ng/L[1] 1,100 ng/L[2]

Source: SOMER inc. 1993, [1] Contamination prevention (MELCC 2022), [2] Aquatic life protection (chronic effect) (MELCC 2022)

2.3 SEDIMENT QUALITY

Only one study on sediment quality was found in the study area, whose results are presented in Table 2.4. Samples were collected in Hudson Bay approximately 30 km west of Kuujjuarapik, ranging from Manitounuk Sound in the south and Tasiujaq Lake in the north. Among the 10 parameters that were tested, only arsenic and copper had concentrations higher than levels recommended by of the CCME and Environment Canada and the *Ministère du Développement durable, de l'Environnement et des Parcs du Québec* (EC and MDDEP). Arsenic average concentration was higher than the *threshold concentration producing an effect* (7.2 mg/kg) while some measures were higher than the *concentration of occasional effects* (19 mg/kg) (EC and MDDEP 2007). Copper average concentration was usually lower than all criteria, but some measures were higher than the *rare effects concentration* level (11 mg/kg) (EC and MDDEP 2007). These measures that exceed the criteria are probably due to natural causes. Indeed, arsenic in lakes and streams can be over 21 mg/kg near the study area (Painter *et al.* 1994 *In* Stewart and Lockhart 2005), while copper sediment accumulation has been found to be high in headwater lakes for rivers draining into the study area (SOMER inc. 1993) and lower than median levels for all of Hudson Bay (Painter *et al.* 1994 *In* Stewart and Lockhart 2005). Arsenic and copper come from atmospheric deposition and local geology (SOMER inc. 1993 and references therein).

Table 2.4 Marine Sediment Quality from SOMER Inc. 1993

PARAMETER (DETECTION FREQUENCE)	MEAN	STANDARD DEVIATION	RANGE (MIN-MAX)	CRITERIA
Mercury (6/94)	0.03 mg/kg	0.05 mg/kg	<0.005-0.09 mg/kg	0.13 mg/kg[1] 0.051 mg/kg[2]
As (13/13)	9.45 mg/kg	7.42 mg/kg	0.35-24 mg/kg	4.3 mg/kg[2]
Cd (0/13)	<1 mg/kg	-	-	0.32 mg/kg[1,2]
Cu (13/13)	10.08 mg/kg	3.17 mg/kg	4-16 mg/kg	18.7 mg/kg[1] 11 mg/kg[2]
Ni (13/13)	13.15 mg/kg	5.81 mg/kg	4-23 mg/kg	47 mg/kg[2]
Pb (13/13)	7.0 mg/kg	1.78 mg/kg	4-9 mg/kg	30.2 mg/kg[1]
Se (11/13)	0.19 mg/kg	0.07 mg/kg	<0.05-0.35 mg/kg	-
Zn (13/13)	31.92 mg/kg	12.07 mg/kg	14-49 mg/kg	70 mg/kg[2]
HCH (1/12)	< 1 TR µg/kg	-	<1 TR µg/kg	-
Total PCB (1/12)	20 µg/kg	-	20-20 µg/kg	21.5 mg/kg[1] 0.012 mg/kg mg/kg[2]

Sources: SOMER inc. 1993, [1] CCME 1999, [2] EC and MDDEP 2007

2.4 SUMMARY AND ISSUES

In the study area, water is generally clear, shows little conductivity, is nutrient-poor and shows low productivity. Water stratification in terms of temperature, salinity and density is present around 20 m to 30 m deep.

Water pH is a little under the recommendation for the protection of aquatic life (chronic effect) according to the MELCC (2022) and the CCME (1999). The low alkalinity of the water makes aquatic life highly sensitive to acidification by acid rain or mining waste (MELCC 2022).

Water samples had a mercury concentration higher than the MELCC recommendation for the prevention of contamination in aquatic organisms, based on a daily consumption of 15 g of fish, mollusk and crustacean.

Marine sediments of the study area apparently have naturally high concentrations of arsenic and copper. A recent landslide of approximately 1.8 km in length along the Great Whale River in April 2021 has likely increased the proportion of clay in the sediments at the mouth of the river, which may have resulted in a layer of new sediments in the study area. This could have effects on local flora and fauna.

The development of a harbour is likely to increase the risk of water and sediment contamination through ships and through accidental spillages.

It is not anticipated that the construction of a harbour and a subsequent increase in ship traffic will have an effect on water pH or water alkalinity, nor should it increase water mercury levels as they are already found in low concentrations in sediments.

3 MARINE ECOSYSTEM (FLORA AND FAUNA)

3.1 PRIMARY PRODUCERS

3.1.1 MACROPHYTES

The distribution of macrophytes generally depends on localized coastline features. The Hudson Bay is characterized by low-lying coasts on its western side while cliffs, headlands, and complex coastlines are predominant on its eastern side (Stewart and Lockhart 2005). The East coast of the Hudson Bay is generally exposed to waves, wind and ice, and the substrate is mainly classified as coarse sand (CSSA 1992). Thus, intertidal habitats for meadows and macroalgae are limited within the study area. The east littoral of Manitounuk Sound, north of Paint Islands, is characterized by shallow waters (circa 5 m deep) for a few hundred metres from the coastline with loose sediments from sand to clay where macrophytes are limited to a few eelgrass beds (*Zostera marina*) and salt marshes (CSSA 1992, Hydro-Québec 1993). The west coast of Manitounuk Sound and the east coast south of Paint Islands, characterized by coarse materials, are exposed to wave and wind, and have little to no space for macrophyte establishment due to their steep conformation (Hydro-Québec 1993). Ice-scouring can occur up to 20 m deep in Manitounuk Sound (CSSA 1992).

Coastal vegetation is characterized by a vertical succession going from coastal marsh (clay) to coastal meadows (sand) or bogs (clay) and then to spruce when leaving the coast (Payette, 1975). According to Hydro-Québec (1993), the coastal vegetation from Long Island to Nastapoka River is dominated by bogs (107.93 km^2, 50.5%) followed by bare fine sediments (46.5 km^2, 21.8%), bare coarse sediments (31.5 km^2, 14.7%), coastal grasslands (15.2 km^2, 7.1%), eelgrass meadows (7.5 km^2, 3.5%) and salt marshes (5.1 km^2, 2.4%) but proportions vary locally.

The coastline from Vauquelin River to Great Whale River is dominated by bogs (60.2%), while it is mainly characterized by bare fine sediments around Manitounuk Sound (50.5%) and by bogs from Manitounuk Sound to Nastapoka River (53.0%) (Hydro-Québec 1993).

Terrestrial and wetland habitats such as bogs are covered in Technical Note 6. Most of peat bogs located less than 2 km from the coastline are minerotrophic, found on thick unconsolidated deposits (CSSA 1992).

Intertidal and infralittoral benthic habitat are colonized by macrophytes, which will depend on the dominant substrate. The macroalgae are generally present where bedrock and boulders are present in the photic zone where it is not too exposed (Legendre 1977, Breton-Provencher and Cardinal 1978). The west coast of Manitounuk Sound is characterized by steep rock substrate, limiting the colonizing habitat, while the east coast is not favourable to algae fixation with its sandy shores (Legendre 1977).

SALT MARSHES

Salt marshes are important habitats. They are uncommon on the east coast of the Hudson Bay, and most studies regarding salt marshes within the Hudson Bay were conducted on its western side where they are far more prevalent. Most marshes present in the study area are in Manitounuk Sound, on the inner coast, and their presence increases towards the north of the sound (CSSA 1992). Salt marshes cover a total of 2.9 km^2 in Manitounuk Sound, while they cover 0.1 km^2 from Vauquelin River to Great Whale River and 0.6 km^2 from Manitounuk Sound to Nastapoka River (Hydro-Québec 1993). They are generally located above of mudflats. The largest marsh, 0.68 km^2, is in Manitounuk Sound on the opposite shore of Boat Opening, located approximately 55 km north-east from the communities of Whapmagoostui/Kuujjuarapik (CSSA 1992). In Manitounuk Sound, the mean slope of salt marshes is approximately 1%, according to three measures (Hydro-Québec 1993), while slope increases to approximately 20% on the west coast of the Sound (Simard *et al.* 1980).

Salt marshes in Manitounuk Sound are generally separated into four different vegetation zones linked to the tide exposition. Main species are presented in Table 3.1.

Coastal grasslands occur where the slope, wave and wind action prevent the formation of salt marshes (Hydro-Québec 1993). Main species of coastal grasslands are presented in Table 3.1. Coastal grasslands in the study area are more frequent from Whapmagoostui/Kuujjuarapik to Paint Islands.

Table 3.1 Main Plant Species Present in Salt Marshes and Coastal Grassland by Tidal Zonation

LOCATION	SPECIES	
Lower Schorre *Puccinellia* zone	*Puccinellia phryganodes*[1,2]	*Puccinellia langeana*[1,2]
	Plantago maritima[2]	*Stellania crassifolia*[2]
Middle level – Lower limit of the upper Schorre *Carex* zone	*Carex mackenziei*[1,2]	*Carex subspacthacea*[1,2]
	Potentilla anserina & *Potentilla egedei*[2,3]	*Carex glareosa*[1,2]
	Ranunculus cymbalaria[2]	*Carex spp.*[1]
	Montia fontana[2]	*Stellaria humifus*[2]
	Triglochin maritima[2]	*Triglochin palustris*[2]
	Hippuris tetraphylla[2] *(tide pools)*	*Potamogeton filiformis*[2] *(tide pools)*
High Schorre Grass zone	*Festuca rubra*[2]	*Plantago juncoides*[3]
	Calamagrostis neglecta[2]	*Potentilla anserina* & *Potentilla egedei*[2,3]
	Parnassia palustris[2]	*Primula egaliksensis*[2]
	Primula stricta[2]	*Plantago maritima*[2]
	Sagina nodosa[2]	*Dupontia fisheri*[2]
	Triglochin maritima[2]	*Calamagrostis deschampsioides*[2]
	Poa eminens[2]	-
Sandy upper Schorre	*Elymus mollis*[2]	*Lathyrus maritimus*[2]
Backshore *Salix* zone	*Salix arctica*[3]	*Calamagrostis* sp.[3]
	Salix candida[23]	*Shepherdia canadensis*[3]
	Festuca rubra[2]	*Arenaria peploides*[3]
	Carex rariflora[2]	*Calamagrostis deschampsioides*[2]
	Paranassia[2]	*Agrostis hyemalis*[2]
	Stellaria longifolia[2]	*Poa pratensis*[2]
	Salix glauca[2]	*Picea glauca*[2]
	Salix reticulata[2]	*Empetrum*[2]
Coastal grassland	*Elymus mollis*[2]	*Lathyrus maritimus*[1,2]
	Arenaria peploides[1,2]	*Stellaria longifolia*[1,2]
	Festuca rubra[1,2]	*Elymus arenarius*[1]

Sources: [1] CSSA 1992, [2] Hydro-Québec 1993, [3] Lemieux 1979

SEAGRASS BED

The east coast of Hudson Bay was explored for eelgrass along the coast of Quebec from Long Island to Nastapoka River by Consortium Gauthier & Guillemette – G.R.E.B.E. (1990a). In the study area, eelgrass beds were essentially present in Manitounuk Sound. The four main eelgrass meadows of Manitounuk Sound covered 2.12 km^2 (CSSA 1992). Outside of Manitounuk Sound, the coast is exposed, and the substrate is too coarse for eelgrass establishment. At the time of study, eelgrass density was comparable to those of James Bay meadows with 627 to 1,860 shoot/m^2, but the productivity was found to be lower (Hydro-Québec 1993). Dry mass varied from 143 to 390 g/m^2 (G.R.E.B.E 1990a). Four eelgrass beds were investigated in Manitounuk Sound in 1989 and were classified as scarce to discontinuous (Lalumière and Belzile 1989). The four same beds were investigated in 1999 and no eelgrass was found (Lemieux *et al.* 1999).

Eelgrass beds are important migratory areas for the Canada goose (*Branta canadensis*), Snow goose (*Chen caerulescens caerulescens*) and Brent goose (*Branta bernicla*) (G.R.E.B.E 1990a).

A generalized decline was observed in James Bay in 1999, where eelgrass beds historically were far more extensive than Hudson Bay (see review by Dickey 2015). James Bay eelgrass beds are slowly recovering from this decline, although pre-decline abundance was still not reached in 2011 (Dickey 2015 and references therein). Four hypotheses were made: wasting disease, climate change and weather conditions, isostatic uplift, and changes to the hydrologic regime at the mouth of the La Grande River. Of those, meteorological conditions in 1998-1999 and changes to the hydrologic regime of coastal waters including a reduction in salinity and increase of turbidity are the most probable causes (see review by Dickey 2015). The conclusions regarding the potential causes of eelgrass decline as well as the stalled recovery of pre-decline densities seem to be consistent with recent findings presented by researchers participating in a large-scale study on the eastern coast of James Bay overseen by Niskamoon Corporation (Marc Dunn, pers. comm.).

MACROALGAE

There are at least 94 taxa of benthic macroalgae in the Hudson Bay Complex (see Stewart and Lockhart 2005 for review). Available information regarding macroalgae in the study area is scarce. The information below was compiled using two studies: Legendre 1977 and Breton-Provencher and Cardinal 1978 (Manitounuk Sound).

A total of 48 taxa of macroalgae was compiled in the study area, of which 10 were green algae (*Chlorophyceae*), 26 brown algae (*Phaeophyceae*) and 12 red algae (*Rhodophyceae*) (Table 3.2). The macroalgae species present in the study area are generally tolerant to low salinities. Species richness and diversity are generally poor and brown algae is dominant in Manitounuk Sound, characteristic of arctic environments. According to Breton-Provencher and Cardinal (1978), species richness is higher in the subtidal zone compared to the intertidal zone. Richness is also higher on the west coast of Manitounuk Sound then on its east coast due to the type of substrate. The most abundant species are *Chorda filum*, *Dictyosiphon foeniculaceus*, *D. chordaria*, *Ectocarpus siliculosus*, *Elachista fucicola*, *Fucus distichus edentatus* and *Pilayella littoralis*. Manitounuk Sound is dominated by *Fucaceae*, and *Laminariales* (kelp) are present at low densities within the study area.

The low abundance, biomass, diversity, and species richness of macroalgae are related to the lack of a suitable substrate in the Sound, the low tidal amplitude, ice scouring, ice cover, topography, and low salinity. However, even at low density and abundances, these macroalgae may play an important role in the food chain as well as providing important ecological habitats.

McDonald *et al.* (1997) identified kelp, seaweed, and wracks as food resources for Inuit.

Table 3.2 Macroalgae Species Present in the Study Area

GROUP	SPECIES	
Chlorophyceae	*Chlorochytrium cohnii*[12]	*Ulva intestinalis*[12]
	Cladophora sp.[2]	*Ulva prolifera*[12]
	Enteromorpha sp. *or Ulva* sp.[2]	*Percursaria percursa*[2]
	Ulva linza[2]	*Ulothrix* sp.[2]
	Pseudothrix groenlandica[2]	*Vaucheria* sp. (Xanthophyceaen)[2]
Phaeophyceae	*Chaetopteris plumosa*[2]	*Cladosiphon zosterae*[12]
	Chorda filum[12]	*Fucus distichus* subsp. *edentatus*[2]
	Halosiphon tomentosus[2]	*Fucus distichus* subsp. *evanescens*[2]
	Chordaria flagelliformis[2]	*Halopteris scoparia*[2]
	Coilodesme bulligera[2]	*Saccharina longicruris*[2]
	Desmarestia aculeata[2]	*Saccharina latissima*[2]
	Dictyosiphon sp.[2]	*Lithoderma* sp.[12]
	Dictyosiphon chordaria[2]	*Pogotrichum filiforme*[12]
	Dictyosiphon ekmanii[1]	*Pylaiella littoralis*[12]
	Dictyosiphon foeniculaceus[12]	*Scytosiphon lomentaria*[2]
	Ectocarpus sp.[12]	*Sphacelaria* sp.[12]
	Ectocarpus siliculosus[2]	*Sphaerotrichia divaricata*[12]
	Elachista fucicola[2]	*Hummia onusta*[12]
	Eudesme virescens[12]	-
Rhodophyceae	*Ahnfeltia plicata*[2]	*Polysiphonia arctica*[2]
	Antithamnion sp.[2]	*Vertebrata fucoides*[2]
	Antithamnion cruciatum[1]	*Polysiphonia stricta*[12]
	Clathromorphum sp.[2]	*Palmaria palmata*[2]
	Lithothamnion sp.[2]	*Rhodomela lycopodioides*[2]
	Polysiphonia sp.[2]	-

Sources: [1] Legendre 1977, [2] Breton-Provencher and Cardinal 1978

Legendre (1977) also reported the presence of two taxa of blue-green algae (*Cyanophyceae*) in the Manitounuk Sound: *Lyngbya* sp. and *Microcoleus* sp.

3.1.2 PHYTOPLANKTON

The Hudson Bay is an oligotrophic inland sea (Roff and Legendre 1986, Hydro-Québec 1993). Few data are available regarding the biological productivity of the system, but several factors indicate that it is an unproductive environment, with strong stratification and low nutrient concentrations. However, the concentration of marine mammals within the Hudson Bay suggests greater primary production levels than those observed, which may be explained by ice algae production (Hoover 2010).

Most studies in the study area are limited to a 10 km radius around the mouth of Great Whale River and in Manitounuk Sound, all in relation to the Grande-Baleine hydroelectric project.

Primary productivity of Hudson Bay is about 72 g C m^{-2} yr^{-1} which is comparable to interior Arctic shelves (Matthes *et al.* 2021). Ice algae primary production for the Hudson Bay is estimated to 6.8×10^6 t C (Gosselin *et al.* 1990).

Chlorophyll *a* concentrations for the Hudson Bay Complex range from 1.89 mg/m^3 in November down to 0.331 mg/m^3 in March (TWAP 2015). Chlorophyll *a* concentrations are low during winter in the study area with a mean of 0.08 mg/m^3, exceed 1 mg/m^3 in summer and can be as high as 2.5 mg/m^3 nearshore (Legendre and Simard 1979a, Anderson and Roff 1980b, Stewart and Howland 2009). During winter, chlorophyll *a* concentration increases with salinity in bottom ice and at the water interface (Legendre *et al.* 1996), with salinity being the most important factor controlling sea-ice microalgae distribution (Gosselin *et al.* 1986). In spring and early summer, salinity of bottom ice, water turbidity, nutrients, and vertical stability of the water column control the distribution and composition of sea-ice to water column algae (Legendre *et al.* 1996). Chlorophyll *a* concentrations are higher during summer months, with lower carbon concentrations indicate an active primary production process during summer (Legendre and Simard 1979a). The highest chlorophyll concentrations are at the surface (Legendre and Simard 1979a) and up to 40 m deep in the Hudson Bay (Ferland *et al.* 2017). Phaeopigment are abundant during winter compared to chlorophyll concentration directly at the mouth of Great Whale River, indicating a poor health of the cells caused by low light availability and variation in salinity (Legendre and Simard 1979a). Gosselin and collaborators (1990) indicated that phytoplankton is light limited in April then faces an excess irradiance and/or nutrient short supply in May, according to a seasonal increase in ATP (adenosine triphosphate), carbohydrates, and total carbon. However, arctic algae show resilience to varying light conditions (Galindo *et al.* 2017).

PELAGIC PHYTOPLANKTON

The density of phytoplankton in the studied region is low compared to the rest of Hudson Bay (Stewart and Lockhart 2005). The assemblages are generally dominated by dinoflagellates or flagellates where the subsurface chlorophyll maximum occurs (Harvey *et al.* 1997, Martin *et al.* 2010). There is a phytoplanktonic bloom under the ice in May in the Manitounuk Sound and the production of phytoplankton is limited by nitrogen (Legendre and Simard 1979b). The health condition of phytoplankton increases with salinity as suggested by percentages of phaeopigments (Legendre and Simard 1979b, Simard *et al.* 1980).

Within the study area, the density of great phytoplanktonic forms ranges from 826 x 10^3 to 7,924 x 10^3 cell/m^3 with a mean density of 2,789 x 10^3 cell/m^3 according to Legendre and Simard (1979b). Phytoplanktonic biomass increases from Great Whale River to both the sea and the Manitounuk Sound with the increase of salinity. The same pattern is probably observed with increasing distance to the shore as salinity increases. Phytoplanktonic concentrations stay low throughout winter and start going up in May, coinciding with an increase in salinity (Simard *et al.* 1980).

Over 495 taxa of phytoplankton are present in Hudson Bay (Roff and Legendre 1986, Simard *et al.* 1996, Harvey *et al.* 1997). During the summer of 1977, Legendre and Simard (1979b) identified 48 phytoplanktonic taxa from the mouth of Great Whale River to the end of Manitounuk Sound while Simard *et al.* (1996) identified 52 taxa from the mouth of Great Whale River to Belcher Islands (only three stations). At least 93 taxa are likely to be present in the study area (Table 3.3). The phytoplankton diversity consisted mainly of diatoms and Dinophyceae and their relative composition varies locally and seasonally.

Table 3.3 Phytoplanktonic Species Present in the Study Area

GROUPS		SPECIES	
Protozoa	Flagellates[1]	-	-
	Ebriophyceae	*Ebria tripartita*[2]	-
	Microflagellate[1]	-	-
Ciliophora	Oligotrichea	*Ptychocylis cylindrica* (or) *drygalskii* [1]	*Tintinnopsis* sp.[1]
		Tintinnida (order) [3]	-
Euglenozoa	Euglenoidea	*Eutreptiella* sp. [1]	-
Ochrophyta	Dictyochophyceae	*Apedinella radians*[1]	*Octactis speculum*[1,2]
	Chrysophyceae	*Chysophyceae* sp. [1]	*Dinobryon faculiferum*[1]
		Dinobryon balticum[1]	-
	Bacillariophyceae	*Amphiprora* spp. [2]	*Melosira* spp.[2]
		Amphora spp. [2]	*Navicula* spp.[2]
		Asterionella spp. [2]	*Nitzschia acicularis*[2]
		Biddulphia spp. [2]	*Nitzschia longissima*[1]
		Chaetoceros convolutus trisetosa[1]	*Nitzschia sigmoidea*[2]
		Chaetoceros socialis (+hypnospores) [1]	*Nitzschia* spp.[2.3]
		Chaetoceros spp. [1,2,3]	*Pennales* sp. (small) [1]
		Cocconeis spp. [2]	*Pinnularia* spp.[2]
		Coscinodiscus spp. [2,3]	*Rhabdonema* spp.[2]
		Cyclotella spp. [2]	*Rhizosolenia* spp.[2.3]
		Cymatopleura solea[2]	*Rhoicosphenia abbreviata*[2]
		Cymbella spp. [2]	*Skeletonema costatum*[2]
		Diatoma spp. [2.3]	*Surirella* spp.[2]
		Diploneis spp. [2]	*Synedra nitzschioides* f. *nitzschioides*[1]
		Eunotia spp. [2]	*Synedra* spp.[2.3]
		Fragilaria spp. [2]	*Synedra ulna*[2]
		Gomphonema spp. [2]	*Tabellaria fenestrata*[2]
		Grammatophora spp. [2]	*Tabellaria flocculosa*[2]
		Gyrosigma spp. [2]	*Thalassiosira* spp.[1,2,3]
		Leptocylindrus danicus[1]	*Thalassiothrix* spp.[2]
		Leptocylindrus minimus[1]	Unidentified[1,2]
		Licmophora spp. [1.2]	-

GROUPS		SPECIES	
Charophyta	Desmidiales	*Arthrodesmus incus*[2]	*Micrasterias* spp.[2]
Myzozoa	Dinophyceae	*Actiniscus pentasterias*[1]	*Oxytoxum* sp.[1]
		Alexandrium ostenfeldii[1]	*Peridiniella* sp. (small)[1]
		Amylax triacantha[1]	*Phalacroma rotundatum*[1]
		Ceratium arcticum[1,2]	*Protoceratium* sp.[1]
		Ceratium spp. [3]	*Protoperidinium brevipes*[1]
		Cochlodinium spp. [1]	*Protoperidinium cerasus*[1]
		Dinoflagellate spp. (cysts) [1]	*Protoperidinium crassipes*[1]
		Dinophysis acuminata[1]	*Protoperidinium depressum*[1]
		Dinophysis spp. [2]	*Protoperidinium ovatum*[2]
		Gonyaulax spinifera[1]	*Protoperidinium pellucidum*[1]
		Gymnodinium fusiforme[1]	*Scrippsiella acuminata*[1]
		Gymnodinium spp. (big) [1]	*Scrippsiella* sp.[1]
		Gymnodiud/Gyro. sp. (20-50 µm) [1]	*Torodinium robustum*[1]
		Gymnodiud/Gyro. sp. (7-20 µm) [1]	Unidentified[2]
		Lebouridinium glaucum[1]	-
Cercozoa	Imbricatea	*Paulinella ovalis*[1]	-
Cryptophyta	Cryptophyceae	*Cryptophycea* sp. [1]	-
Chlorophyta	Chlorophyceae	*Chlorophyceae* sp. [1]	*Diplostauron elegans*[1]
	Prasinophyceae	*Pterosperma cristatum*[1]	-
	Pyramimonadophyceae	*Halosphaera viridis*[2,3]	*Pyramimonas* sp.[1]

Sources: [1] Simard et al. 1996, [2] Legendre and Simard 1979b, [3] Simard and Lacroix 1980

BOTTOM ICE ALGAE (EPONTIC ALGAE)

Bottom ice algae are the dominant primary producers under ice in the Hudson Bay. Theses algae are also present, to a lower level, within the entire ice column (Poulin *et al.* 1983).

Bottom ice algae and their structure and abundance are patchy and depend on ice type and thickness, salinity, currents, and snow thickness (Gosselin *et al*. 1985, Gosselin *et al.* 1986). Like pelagic phytoplankton, biomass of bottom ice algae increases with salinity (CSSA 1992, Poulin *et al.* 1983). Production, as demonstrated by chlorophyll α concentrations, were shown to reach of 20.0 mg/m^2 22 km offshore Whapmagoostui/Kuujjuarapik (Tremblay *et al.* 1989), compared to only 0.8 mg/ in Manitounuk Sound (Gosselin *et al*. 1985, Poulin *et al.* 1983) and 12 mg/m^2 in other Arctic regions (CSSA 1992 and references therein). Bottom ice algae biomass and their release to the pelagic and benthic habitats will increase with the melting of sea ice (Stewart and Lockhart 2005 and references therein).

Dominant bottom ice algae are diatoms of the genus *Navicula* and *Nitzscia* (Poulin *et al.* 1983, Gosselin *et al.* 1990). Poulin *et al.* 1983 identified 146 different epontic taxa (see Table 3.4 for main taxa).

Table 3.4 Most Frequent Bottom Ice Taxa in the Study Area

GROUP	SPECIES		
Bacillariophyceae	*Amphiprora kjellmanii var. kjellmanii*	*Navicula impexa*	*Nitzschia frigida*
	Bacillaria paradoxa	*Navicula kariana var. frigida*	*Nitzschia gelida var. manitounukensis*
	Ceratoneis longissima	*Navicula kryokonites*	*Nitzschia hudsonii*
	Chaetoceros septentrionalis	*Navicula lineola var. perlepida*	*Nitzschia hybrida f. hybrida*
	Chaetoceros spp.	*Navicula oestrupi*	*Nitzschia kryophila*
	Cylindrotheca closterium	*Navicula pelagica*	*Nitzschia laevissima*
	Diploneis litoralis var. artica	*Navicula quadripedis*	*Nitzschia polaris*
	Entomoneis kjellmanii var. subtilis	*Navicula septentrionalis*	*Nitzschia* sp.
	Entomoneis kjellmarnii var. kariana	*Navicula* spp.	*Nitzschia* spp.
	Entomoneis paludosa var. hyperborea	*Navicula subinflata var. subinflata*	*Pinnularia directa var. directa*
	Entomoneis spp.	*Navicula valida*	*Pinnularia quadratarea var. bicontracta*
	Gomphonema septentrionale var. septentrionale	*Navicula vanhoeffenii*	*Pinnularia* spp.
	Navicula gelida	*Nitzschia angularis*	*Pseudonitzschia delicatissima*
	Navicula gelida var. radissonii	*Nitzschia cylindrus*	*Stauroneis radissonii*
	Navicula glaciei	*Nitzschia distans var. erratica*	Unidentified
Dinophyceae	*Gymnodinium* spp.	*Peridinium* spp.	-
Protozoa	Microflagellated	-	-

Source: Poulin *et al.* 1983

3.2 MARINE INVERTEBRATES

There are at least 689 taxa of metazoan invertebrates and 25 taxa of urochordates in the Hudson Bay Complex (see Stewart and Lockhart 2005 for review).

3.2.1 ZOOPLANKTON

Few studies on zooplankton are available for the study area. Biomass and abundance of zooplankton generally increase from south to north along the east coast of Hudson Bay (Harvey *et al.* 2001). The average zooplankton and density measured by Harvey *et al.* (2001) was 1.6 g DM/m^2 and 9,432 ind./m^2 in the lower part of Hudson Bay near the study area. Copepods are the dominant taxa in Hudson Bay (85% of individuals) while chaetognaths are generally dominant in terms of biomass near the study area (Harvey *et al.* 2001). Secondary production coming from copepods is estimated at 120 kJ/m^2 in the study area (Roff and Legendre 1986).

At least 80 species of zooplankton are present in the Hudson Bay (Harvey *et al.* 2001). Zooplankton communities are generally similar from Long Island to Tasiujaq Lake, which includes the study area (Rochet and Grainger 1988, Harvey *et al.* 2001). Peak abundances start in mid-July, but actual density and taxa dominance vary annually (CSSA 1992). Three abundance peaks are documented in the study area, one at the end of June, the other at the end of July and the last one after mid-September (Simard *et al.* 1980). Diversity increases from coast to offshore (Simard *et al.* 1980). At least 81 taxa of zooplankton are present in the study area (Table 3.5).

Table 3.5 Zooplankton Species Present in the Study Area

GROUP	SPECIES	
Cnidaria	*Cnidaria*[1,2,3,4]	*Anthozoa*[1,2]
	Scyphozoa[1,2]	-
Cnidaria- Hydrozoa	*Aeginopsis laurentii*[3]	*Bougainvillia* spp.[1,2]
	Aglantha digitale[3]	*Halitholus cirratus*[1.2]
	Bougaimillia sp.[3]	*Sarsia tubulosa*[1.2]
	Aurelia sp.[3]	*Aeginopsis laurentii*[1.2]
	Halitholus sp.[3]	*Aglantha digitale*[1,2,5]
Ctenophora	*Ctenophora*[1,2]	-
Annelida	*Polychaeta* (larvae)[1,2,3]	-
Mollusca - Bivalvia	*Bivalvia* (larvae)[1,2]	*Pelecyora*[3]
Mollusca - Gastropoda	Gasteropoda (larvae)[1,2,3]	*Clione limacina*[3]
	Limacina helicina[3,5]	*Spiratella* sp.[3]

GROUP	SPECIES	
Arthropoda Copepoda-Calanoid	*Calanoides* spp.[3]	*Eurytemora* spp.[3]
	Acartia spp. (juvenile)	*Eurytemora herdmani*[1,2,3]
	Acartia clausi[1.2]	*Eurytemora affinis affinis*[1.2]
	Acartia (Acartiura) longiremis[1,2,3,4]	*Metridia longa*[3,5]
	Aetidae spp.*3*	*Microcalanus pygmaeus*[1,2,5]
	Calanus hyperboreus[1,2,3,5]	*Pseudocalanus spp.*[3,4,5]
	Calanus glacialis[3,4,5]	*Pseudocalanus minutus*[1,2]
	Calanus finmarchicus[1,2,3,4]	*Temora longicornis*[1,2]
	Centropages spp. [2]	*Tortanus* spp.[2]
	Centropages abdominalis[1.2]	*Tortanus (Boreotortanus) discaudatus*[1,2]
	Centropages hamatus[1,2,3,4]	-
Arthropoda Copepoda-Cyclopoid	*Cyclopina spp.*[1,2]	*Oithona similis*[1,2,5]
	Oncaea spp.[2]	*Triconia borealis*[1,2,5]
Arthropoda Copepoda-Harparcticoid	*Copepod-Harparcticoid*[1,2]	*Parathalestris croni*[3]
Arthropoda - Cirriped	Cirriped (larvae)[1,2,3]	-
Arthropoda - Amphipoda	*Amphipoda* spp.[3]	*Hyperoche medusarum*[3]
	Atylus carinatus[1.2]	*Monoculodes* sp.[3]
	Calliopius laeviusculus[1.2]	*Themisto abyssorum*[3]
	Hyperia galba[1,2,3]	*Themisto libellula*[1,2,3,4,6]
	Hyperiidae (small)[3]	*Themisto* spp.[3]
Arthropoda - Cumacea	*Cumacea*[1,2]	-
Arthropoda - Euphausiacea	*Euphausiacea*[1,2,3]	*Thysanoessa raschii*[3,6]
	Thysanoessa inermis[2]	-
Arthropoda - Mysidacea	*Meterythrops robustus*[3]	*Mysis mixta*[1,2]
	Mysis litoralis[1,2]	*Mysis* spp.[3]
Arthropoda -Decapoda	*Decapoda* (juvenile)[1,2]	Shrimp larvae[3]
	Crab larvae[3]	-
Arthropoda - Ostracoda	*Ostracoda*[1,2]	*Conchoecia* sp.[3]
Echinodermata	Echinodermata (larvae)[1,2]	-
Cheatognatha	*Chaetogntaha* sp.[3]	*Parasagitta elegans*[1,2,3,4,5]
	Eukrohnia hamata[3]	-
Chordata -Fish larvae	Fish larvae[1,2]	-
Chordata -Tunicata	Appendicularia (class)[2]	*Fritillaria* sp.[3]

Sources: [1] Simard and Lacroix 1980, [2] CSSA 1992, [3] Simard *et al.* 1996, [4] Harvey *et al.* 2001, [5] Rochet and Grainger 1988, [6] Breton-Provencher 1979a

3.2.2 BENTHIC INVERTEBRATES

At least 275 species of benthic invertebrates are present in the Hudson Bay (Arctic Biological Cons. 1991 *In* Hydro-Québec 1993). Benthic invertebrates play an important role in the food web of the region as they are consumed by fish, other invertebrates, marine mammals, and birds.

Infralittoral zone is similar to what is found throughout James and Hudson Bays where ostracods, cumaceans, gammaridaen amphipods, foraminifera, gastropods, and polychaetes are abundant.

Studies of benthic invertebrates within the study area were carried out mainly offshore and in Manitounuk Sound. At least 196 taxa of benthic invertebrates were found to be present within the study area (Table 3.6).

McDonald *et al*. (1997) identified sea bottom shells, sea cucumber, starfish, crab, sea clams, mussels, sea urchins and scallops as food resources for Inuit. Mussel harvest occurs mainly in winter.

MANITOUNUK SOUND

Depending on the local conditions (substrate, salinity, depth, currents), different assemblages can be encountered (CSSA 1992).

In coarse zones of the west side, sea urchins and fucales are present in the first metres (0-3 m) while filamentous algae and ascidians colonized calm zones. The subtidal zone is often dominated by mussel beds associated with sea urchins, filamentous algae, and sponges while assemblages over 10 m deep are portrayed by polychaetes, such as urchins, starfish, anemones, sponges, and ascidians. Fine sediment zones are generally poor and show little benthos density. Blue mussel (*Mytilus edulis*) is present from 3 m to 10 m deep everywhere, but density varies with the substrate.

The northeast side is dominated by sand and mud, and little algae grow in the first 5 m. Blue mussel beds with filamentous algae are frequent from 5 m to 8 m deep while Polychaeta, sponges, anemones and ascidians were dominant under 8 m. There are no sea urchins or starfish on the northeast side of Manitounuk Sound.

The southeast side is a dynamic habitat dominated by coarse sand and boulders. Fucales generally dominate this part within the first 3 m (CSSA 1992). Blue mussel beds are denser in this part of the Sound (3-10 m). Bare rock occurs in this part and encrusting algae, sea urchins, starfish and sea cucumber are consequently present. Deeper than 10 m, sand was the dominant substrate and sea urchins, *Polychaeta*, gastropods and clams were present.

Table 3.6 Benthic Invertebrate Species Present in the Study Area

PHYLUM	GROUP	SPECIES	
Porifera	Calcareous sponges and Sponges[1]		
	Demospongiae	*Phakellia ventilabrum*[2]	*Polymastia mamillaris*[2]
Cnidaria	Hydrozoa	Hydrozoa (class)[3,4,5]	Hydractiniidae (family)[2]
	Staurozoa	Stauromedusa (order)[2]	-
	Anthozoa	*Gersemia rubiformis*[5]	*Octocorallia*[2]
		Bolocera tuediae[4]	Actiniaria (order)[4]
Echinodermata	Asteroidea	*Asterias* sp.[2]	*Leptasterias groenlandica*[3]
		Ctenodiscus crispatus[4]	*Leptasterias (Hexasterias) polaris*[3]
		Henricia sp.[2]	*Pteraster militaris*[2]
		Icasterias panopla[4]	*Urasterias lincki*[1,3,5]
	Crinoida	*Heliometra glacialis*[2]	-
	Echinoidea	*Strongylocentrotus droebachiensis*[3]	-
	Holothuroidea	*Dendrochirotida*[4]	*Myriotrochus rinkii*[4]
		Eupyrgus scaber[4]	-
	Ophiuroidea	Ophiuridea (family)[2]	*Ophiocten sericeum*[1,4,5]
		Amphiura sp.[2]	*Ophiopholis aculeata*[2]
		Gorgonocephalus arcticus[1,5]	*Ophiura sarsii*[1,5]
		Ophiacantha bidentata[1,5]	-
Mollusca	*Bivalvia*	*Astarte borealis*[3]	*Musculus discors*[3]
		Astarte crenata[2]	*Musculus niger*[2]
		Astarte montagui[3]	*Mya arenaria*[3]
		Astarte sp.[3]	*Mya truncata*[3]
		Axinopsida orbiculata[2]	*Mytulis edulis*[3,6]
		Bathyarca sp.[2]	*Nucula* sp.[2]
		Bathyarca glacialis[2]	*Ennucula tenuis*[2]
		Ceratoderma sp.[2]	*Nuculana tenuisulcata*[2]
		Chlamys islandica[2]	*Nucula pusilla*[2]
		Ciliatocardium ciliatum ciliatum[3]	*Nuculana pernula*[4]
		Crenella decussata[2]	Pectinidae (family)[3]
		Crenella sp.[2]	*Portlandia* sp.[2]
		Delectopecten binominatus[2]	*Portlandia arctica*[3.4]
		Ennucula tenuis[3]	*Pseudamusium vitreus*[2]
		Hiatella arctica[3]	*Serripes groenlandicus*[3]
		Limecola balthica[3,5]	*Similipecten greenlandicus*[1,4]
		Lyonsia sp.[2]	*Solamen glandula*[2]
		Macoma calcarea[2]	*Thyasira gouldi*[2]
		Macoma sp.[2]	*Yoldiella* sp.[4]
		Musculus glacialis[2]	*Yoldiella intermedia*[2]

PHYLUM	GROUP	SPECIES	
	Gastropoda	*Acmaea* sp.[2]	*Littorina saxatilis*[5]
		Frigidoalvania cruenta[2]	*Margarites costalis*[2]
		Amauropsis sp.[5]	*Margarites olivaceus*[2]
		Ariadnaria borealis[3]	*Oenopota* sp.[2]
		Boreotrophon clathratus[2]	*Onchidiopsis glacialis*[2]
		Buccinum sp.[4]	*Philine* sp.[2]
		Buccinum hydrophanum[4]	*Puncturella noachina*[2]
		Buccinum scalariforme[4]	*Retusa obtusa*[2]
		Cylichna sp.[2]	*Solaria varicosa**[2]
		Cylichna alba[3]	Tellinidae (family)[2]
		Dendronotus sp.[4]	*Velutina* sp.[2]
		Lepeta caeca[4]	-
	Polyplacophora	*Tonicella marmorea*[5]	-
Nematoda[2]	-	-	-
Sipuncula[2]	-	-	-
Bryozoa[2]	*Gymnolaemata*	*Alcyonidium disciforme*[4]	*Eucratea loricata*[3]
		Alcyonidium pseudodisciforme[4]	*Rhamphostomella radiatula*[5]
		Cauloramphus cymbaeformis[5]	*Rhamphostomella costata*[5]
Annelida	*Polychaeta*	*Aldane* sp.*[2]	*Nephtys paradoxa*[3]
		Ampharetidae (family)[3]	*Nicolea* sp.[2]
		Ampharete sp.[2]	*Ophelia limacina*[3]
		Ophelina sp.[2]	*Cistenides granulata*[3]
		Autolytus sp.[1]	*Pectinaria* sp.[2]
		Ceratocephale loveni[4]	*Pectinaria granulata*[2]
		Chaetozone sp.[2]	*Pista maculata*[3]
		Cirratulidae (family)[2]	Polynoidae (family)[4]
		Cirratulus sp.[2]	*Polydora* sp.[2]
		Dipolydora coeca[3]	*Praxillella* sp. [2]
		Eteone sp.[2]	*Prionospio* sp.[3]
		Euchone papillosa[3]	Sabellidae (family)[4]
		Harmothoe sp.[2]	*Sabella* sp.[2]
		Harmothoe extenuata[3]	*Scalibregma inflatum*[3]
		Harmothoe imbricata[3]	*Scoloplos* sp.[2]
		Hesionidae (family)[2]	*Scoloplos armiger*[3]
		Nereides sp.*[2]	*Terebellides* sp.[2]
		Nereimyra aphroditoides[3]	

PHYLUM	GROUP	SPECIES	
Arthropoda	*Decapoda*	*Argis dentata*[2]	*Pagurus pubescens*[2]
		Eualus belcheri[4]	*Pandalus* sp.[6]
		Eualus fabricii[2]	*Pandalus montagui*[1]
		Eualus gaimardi[1,4]	*Pandalus borealis*[6]
		Eualus macilentus[1,4]	*Spirontocaris spinus*[6]
		Hyas coarctatus[1,5]	*Sabinae septemcarinata*[1,4]
	Mysida	*Mysis mixta*[5]	*Mysis* sp.[2]
	Amphipoda	*Acanthostepheia malmgreni*[1,4,5]	Lysianassidae (family)[4]
		Ameroculodes edwardsi[5]	*Megamoera dentata*[4,5]
		Arrhis phyllonyx[4]	*Monoculodes* sp.[2]
		Atylus carinatus[3]	*Monoculodes longirostris*[2]
		Corophiidae (family)[2]	Oedicerotidae (family)[4]
		Gammaridae (family)[2]	*Oediceros* sp.[2]
		Gammaracanthus sp.[5]	*Paroediceros lynceus*[4]
		Gammaracanthus loricatus[5]	Pleustidae (family)[4]
		Gammarus sp.[2]	*Rhachotropis aculeata*[4]
		Gammarus oceanicus[6]	*Rozinante fragilis*[4]
		Lepidepecreum serraculum[4]	*Stegocephalus inflatus*[1.4]
		Lepidepecreum umbo[4]	*Tmetonyx cicada*[1]
	Isopoda	*Saduria sibirica*[4]	*Saduria entomon*[2]
		Eurycope sp.[2]	*Munnopsis typica*[2]
		Gnathia sp.[2]	*Plurogonium spinosissimum*[2]
	Ostrocoda[2]	-	-
	Calanoida	*Pseudocalanus* sp.[5] (plankton)	-
	Cyclopoida	*Oithona similis*[5] (plankton)	-
	Cumacea	*Diastylis rathke*[3,4]	*Diastylis* sp[2]
	Tanaidacea	Tanaididae (family[2]	*Pseudosphyrapus anomalus*[2]
Nemertea	*Nemertea*	Nemertea (phylum[4]	-
Foraminifera	*Monothalamea*	*Astrorhiza limicola*[2]	-
	Nodosariata	*Archimerismus subnodosus*[2]	-
Chordata	*Ascidiacea*	Ascidiacea (class[1,3,5]	*Boltenia echinata*[2]
		Ascidia obliqua[1]	*Rhizomolgula globularis*[2]

Sources: [1] Atkinson and Wacasey 1989, [2] CSSA 1992, [3] Legendre 1977, [4] Pierrejean *et al.* 2020, [5] GBIF 2021, [6] Breton-Provencher 1979a

3.3 FISH

At least 68 fish species use Hudson Bay (CSSA 1992, Arctic Biological Cons. 1991 *In* Hydro-Québec 1993, GBIF 2021). Those species are mainly marine and anadromous, but some are common freshwater fish that tolerate low salinity levels. At least 47 fish species are present in the study area (Table 3.7). Among them, only the mottled sculpin (*Cottus bairdii*) is a strictly freshwater species while the others are either mainly freshwater species (6 species), diadromous (9 species) or mainly marine species (31 species).

None of the fish species listed are at risk or likely to be designated according to the *ministère des Forêts, de la Faune et des Parcs* (MFFP 2022) and the *Species at Risk Act* (S.C. 2002, c. 29). Inuit and Crees mainly fish Greenland cod (*Gadus ogac*), sculpins (*Myoxocephalus* spp.), cisco (*Coregonus artedii*), lake whitefish (*Coregonus clupeaformis*), brook trout (*Salvelinus fontinalis*) and arctic char (*Salvelinus alpinus*) (Hydro-Québec 1993). McDonald *et al.* (1997) identified arctic cod (*Boreogadus saida*), sculpins, and capelin (*Mallotus villosus*) as food resources for Inuit while they identified arctic char, lake trout (*Salvelinus namaycush*), and whitefish for both Inuit and Cree.

Table 3.7 List of Fish Species Present in the Study Area

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME	FOOD RESOURCE
Rajiformes	*Rajidae*	*Amblyraja radiata*	Thorny skate[1,2]	
Clupeiformes	*Clupeidae*	*Clupea harengus*	Atlantic herring[1,3]	
Cypriniformes	*Cyprinidae*	*Couesius plumbeus*	Lake chub[3,4]	
	Catostomidae	*Catostomus catostomus*	Longnose sucker[2,3,4,5]	x[6]
		Catostomus commersonii	White sucker[5]	
	Cyclopteridae	*Cyclopterus lumpus*	Lumpfish[1,2]	
Osmeriformes	*Osmeridae*	*Mallotus villosus*	Capelin[1,2,3,4,7]	
Salmoniformes	*Salmonidae*	*Salmo salar ouananiche*	Landlocked salmon[2†]	
		Salvelinus fontinalis	Brook trout[1,2,3,4,5,8]	x[6]
		Salvelinus namaycush	Lake trout[3,4]	x[6]
		Salvelinus alpinus	Arctic char[1,2,3,4,5,8]	x[6]
		Coregonus artedi	Cisco[1,2,3,4,5,8]	x[6]
		Coregonus clupeaformis	Lake whitefish[2,3,4,5]	x[6]
		Prosopium cylindraceum	Round whitefish[2,3,4,5]	
		NA	*Salmonidae* (family)[3]	
Esociformes	*Esocidae*	*Esox lucius*	Northern pike[4]	x[6]
Gadiformes	*Lotidae*	*Lota lota*	Burbot[3,4,8]	
	Gadidae	*Gadus ogac*	Greenland cod[1,2,3,4,8]	
		Boreogadus saida	Arctic cod[1,2,3]	
		NA	Cods[3]	x[6]

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME	FOOD RESOURCE
Perciformes	*Gasterosteidae*	*Gasterosteus aculeatus*	Threespine stickleback[2,3,4]	
		Pungitius pungitius	Ninespine stickleback[1,2,3,4,5]	
	Cottidae	*Icelus bicornis*	Twohorn sculpin[2]	x[6]
		Icelus spatula	Spatulate sculpin[2]	x[6]
		Myoxocephalus scorpioides	Arctic sculpin[1,2,3,4,8]	x[6]
		Myoxocephalus scorpius	Shorthorn sculpin[1,2,3,4,8]	x[6]
		Myoxocephalus octodecemspinosus	Longhorn sculpin[3,8]	x[6]
		Myoxocephalus quadricornis	Fourhorn sculpin[1,2,3,4,5]	x[6]
		Gymnocanthus tricuspis	Arctic staghorn sculpin[1,2,3,4]	x[6]
		Triglops murrayi	Moustache sculpin[2,3]	x[6]
		Triglops pingelii	Ribbed sculpin[2]	x[6]
		Cottus bairdii	Mottled sculpin[3]	x[6]
		Cottus cognatus	Slimy sculpin[3]	x[6]
	Ammodytidae	*Ammodytes dubius*	Northern sand lance[2,3,4,7]	
		*Ammodytes hexapterus**	Stout sand lance[3,4]	
		*Ammodytes americanus**	American sand lance[1,2]	
		NA	Sand lances[3]	
	Pholidae	*Pholis fasciata*	Banded gunnel[1,2,3]	
	Stichaeidae	*Stichaeus punctatus*	Arctic shanny[2,3,4]	
		Leptoclinus maculatus	Daubed shanny[1,3]	
		Lumpenus fabricii	Slender eelblenny[1,2,3,4,7]	
		Lumpenus lampretaeformis	Snakeblenny[1]	
	Liparidae	*Liparis gibbus*	Dusky snailfish[2,3]	
		Liparis fabricii	Gelatinous snailfish[2]	
		Careproctus sp.	Snailfish[2]	
	Agonidae	*Leptagonus decagonus*	Atlantic poacher[2]	
		Aspidophoroides monopterygius	Alligatorfish[1]	
	Zoarcidae	*Lycodes pallidus*	Pale eelpout[2]	
		Lycodes sp.	*Lycodes* sp.[1]	
Pleuronectiformes	*Pleuronectidae*	*Hippoglossoides platessoides*	Canadian plaice[1,2,3,4,7]	

Sources: [1] CSSA 1992, [2] Hydro-Québec 1993, [3] GBIF 2021, [4] Auger and Power 1978, [5] Verdon 2001, [6] Hydro-Québec 1977, [7] Simard *et al.* 1980, [8] Legendre and Talbot 1977

* Potentially the same species, although both are listed as accepted species in WoRMS (March 2022).

† Only in Nastapoka estuary that is north of the study area (Consortium Gilles Schooner *et al.* 1991).

Parasites were found in fish by CSSA (1992) in the study area (Table 3.8).

Table 3.8 Fish Parasites in the Study Area

PHYLUM	GROUP	SPECIES
Acanthocephala	*Echinorhynchida*	*Echinorhynchus gadi*
Platyhelminthes	*Cestoda*	*Pyramicocephalus phocarum*
Arthropoda	*Copepoda*	*Haemobaphes cyclopterina*
Platyhelminthes	*Trematoda*	*Podocotyle atomon*
Nematoda	*Anisakidae*	*Contracaecum* sp.
Nematoda	*Anisakidae*	*Phocascaris* sp.
Protozoa (Kingdom)		Cysts

Source: CSSA 1992

The north end of Manitounuk Sound seems to be an area of importance for the reproduction or rearing for sand lances (*Ammodytes* sp.) and capelin (Simard *et al*. 1980). Spawning grounds for cisco, brook trout, suckers, sticklebacks, and round whitefish have been located within the freshwater portion of Great Whale River estuary downstream of Amitapanuch waterfalls (Consortium Gilles Schooner *et al.* 1991). Sand lance, Artic cod, Arctic shanny, burbot, fourhorn sculpin, Arctic staghorn sculpin, slender eelblenny, Artic sculpins, capelin, gelatinous snailfish, cisco, lake whitefish and sculpins larvae were also found to be present in the plume of the Great Whale River (Drolet *et al.* 1991, Gilbert *et al.* 1992).

3.4 MARINE MAMMALS

Many marine mammal species are present in the Hudson Bay and 10 species may be encountered within the study area (Table 3.9). Among them, the ringed seal is the most common species.

Table 3.9 Marine Mammal Species that may be Present in the Study Area

SPECIES			STATUS	
GROUP	COMMON NAME	SCIENTIFIC NAME	PROVINCIAL[1]	FEDERAL[2]
Pinnipeds	Harbour seal	*Phoca vitulina*	-	-
	Harp seal	*Pagophilus groenlandicus*	-	-
	Ringed seal	*Pusa hispida*	-	-
	Bearded seal	*Erignathus barbatus*	-	-
	Walrus (Atlantic)	*Odobenus rosmarus* (*rosmarus*)	Likely to be designated	-
Cetacean	Beluga (eastern Hudson Bay)	*Delphinapterus leucas*	Likely to be designated	Threatened
	Killer whale	*Orcinus orca*	-	-
	Bowhead whale	*Balaena mysticetus*	-	Endangered
	Minke whale	*Balaenoptera acutorostrata*	-	-
Ursidae	Polar bear	*Ursus maritimus*	Vulnerable	Special Concern

[1] *Loi sur les espèces menacées ou vulnérables*, [2] *Species at Risk Act* (S.C. 2002, c. 29)

Sources: CSSA 1992, Hydro-Québec 1993, MFFP 2022, Government of Canada 2022

Most of these species have been historically hunted within the study area. Studies conducted in the 1970s documented that marine mammals represented 40% of Inuit food supply and 3.5% for Crees in Whapmagoostui/Kuujjuarapik (Hydro-Québec 1977, Hydro-Québec 1978). No information is available regarding their current contribution to local food supplies.

- **Pinnipeds:**
  - Pinnipeds are hunted throughout the year and the intensity varies depending on availability and ice conditions where hunting takes place. Pinnipeds are an essential food and economic resource for Nunavik Inuit and for Eeyou Istchee Crees to some extent. Greater hunting zones are located between Whapmagoostui/Kuujjuarapik and Schooner Opening, 37 km north-east of Kuujjuarapik. In winter, pinnipeds use the ice all over the study area and are more abundant near ice-free water while calving areas are on pack ice (Simard *et al.* 1980). Pinnipeds avoid areas of human activities as shown by low density around Whapmagoostui/Kuujjuarapik (Breton-Provencher 1979b, CSSA 1992).
  - **Ringed seal** (*Pusa hispida*) is a circumpolar species, and it is the most common seal species in Hudson Bay. This species stays in the area overwinter and the study area is used for reproduction and birthing. Winter distribution is linked to zones that are ice-free and to the location of calving grounds. The ringed seal uses pack ice and maintains respiration holes. Reproduction zones are mainly located offshore of the Manitounuk Sound and around Belcher Islands (Breton-Provencher 1979b). The occurrence in the study area is higher along the coast than midway between Belcher Islands and the coast of Quebec. (CSSA 1992, Hydro-Québec 1993, Prescott and Richard 2004). Ringed seal is not listed on the *Species at Risk Act* or *Loi sur les espèces menacées ou vulnérables*, but was listed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in November 2019 as it depends on ice to thrive and as it is an important prey to the polar bear. It is also an important food source for Inuit (COSEWIC 2019).
  - **Bearded seal** (*Erignathus barbatus*) is the second pinniped in abundance in the study area and first in size. Its distribution is sometimes linked to ice conditions, and they generally use drift ice (Mansfield 1968 *In* CSSA 1992). The occurrence is high anywhere in the study area (CSSA 1992). In summer, bearded seals can use Great and Little Whale River estuaries (Archéotec 1990 *In* CSSa 1992). Benthic organisms are their main food resource in the Manitounuk Sound (Hydro-Québec 1993).
  - **Harbour seal** (*Phoca vitulina*) is present in the study area but is less frequent than the ringed seal or the bearded seal. In winter, the harbour seal is associated with ice-free waters while it frequently visits estuaries in summer (Prescott and Richard 2004).
  - **Harp seal** (*Pagophilus groenlandicus*) is not frequent in the study area. Its southern repartition usually stops at Tasiujaq Lake and Belcher Islands and is mainly encountered during summer (Hydro-Québec 1993, Prescott and Richard 2004).
  - **Atlantic Walrus** (*Odobenus rosmarus rosmarus*) sighting and hunting in the study area are not frequent but occur exceptionally (CSSA 1992). The species (Central/Low Arctic population) occurs more frequently around Belcher Islands, Sleeper Islands, Ottawa Islands, northwestern James Bay and Long Island, northern Hudson Bay, Foxe Basin and Hudson Strait (DFO 2016, COSEWIC 2017 and reference therein) although the study area is located within the walrus general distribution area by Lowry (2016) and local knowledge indicates that they are present in low abundance along the coast and near offshore environments of eastern Hudson Bay (EMRWB pers. comm.). A known wintering area is present from Belcher Islands to Sleeper Islands (North of the study area) (Born *et al.* 1995). There are two reported walrus haulout sites in the study area (Stewart and Lockhart 2005, DFO 2016) however there are no details on where and when the information is from. The haulout sites mentioned are likely located on Duck Island (north of Boat Opening) and islands between Vauquelin River and Kuujjuarapik. Inuit ecological knowledge reported that walrus used to move along the coast in winter in the study area (Reeves 1995a In Stewart and Lockhart 2005). The South and East Hudson Bay stock was estimated to 200 walruses in 2014 (DFO 2016). Atlantic Walrus has a narrow ecological niche requiring large areas of shallow water (under 80 m) with a productive bivalve community with open waters over feeding areas, and appropriate land or ice to haul out at a close range (Davis *et al.* 1980 *In* COSEWIC 2017, Born *et al.* 1995). Atlantic Walrus is listed on Appendix III of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), as Special

Concern by the COSEWIC and as Vulnerable by Nunavut. Atlantic Walrus is sensitive to anthropogenic disturbances such as noise and infrastructure development and may leave habitat when disturbed (COSEWIC 2017 and references therein).

- **Beluga whale** (*Delphinapterus leucas*) is a circumpolar species divided into different populations based on summering locations. The study area is part of the territory of the **Eastern Hudson Bay population** that is a threatened species (Schedule 2 of *Species at Risk Act*). In 1978, it was estimated that 300 to 400 individuals frequent the study area (Breton-Provencher 1979a), followed by an estimate of 500 individuals in 1992 with higher densities in the northern part from Little Whale River to Nastapoka River (Le Groupe Boréal 1993a, Hydro-Québec 1993). Total population was estimated to range from 1,124 to 1,904 individuals by Smith and Hammill (1986) and then was estimated up to 3,819 individuals in 2015 (Gosselin *et al.* 2017). A new 3% decline per year has been observed between 2015 and 2021. The most recent population estimate in 2021 situates the population between 2,700 to 3,200 individuals (DFO 2022). New genetic analyses indicate that the Eastern Hudson Bay population is actually a mix of two populations: Belcher Islands and Eastern Hudson Bay proper (BEL-EHB) (DFO 2022). Beluga is gregarious and groups vary from a few individuals to several hundred (Sergeant and Brodie 1975). Beluga concentrate in river estuaries mainly around Little Whale River and Tasiujaq Lake where they feed and breed (Le Groupe Boréal 1993a) but are also present in Great Whale River Estuary which may serve as a rest area, as well as in between (Simard *et al.* 1980, Hydro-Québec 1993, Doidge *et al*. 2002, Breton-Honeyman *et al.* 2016). They come and go in the estuaries following the tides (Hydro-Québec 1993). Beluga whales migrate towards the north of Hudson Bay by the beginning of October to winter around Ungava Bay and the Labrador coast (Finley *et al.* 1982, Hydro-Québec 1993, COSEWIC 2004, 2020), although some remain around Long and Belcher Islands when climatic conditions cause open waters or thin and unstable sea ice (Breton-Provencher 1979a, Jonkel 1969). In the study area, hunting by Inuit takes places in the summer; the best hunting areas are located between the Schooner Opening and Lake Tasiujaq (Hydro-Québec 1977), although hunting may take place almost anywhere along the coast in the study area, depending on the season (Doidge *et al*. 2002). The fall hunt near Long Island is of great importance. In winter, hunting areas are concentrated next to Schooner Opening (north of Kuujjuarapik) on the side of the Hudson Bay and around Long Island (south of the study area) (Doidge *et al*. 2002). In the study area, hunting pressure is applied on both the eastern Hudson Bay and the James Bay populations. Benthic coastal habitats are important for this species as Breton-Provencher (1979a) found that they feed on fish, decapods, amphipods, mysids, gastropods and Polychaeta. Inuit traditional knowledge (hunters and elders) identified *Cottidae*, *Gadidae*, *Salmonidae* and crustaceans to be the most frequent preys (Breton-Honeyman *et al.* 2016). In the study area, beluga hunt is co-managed by Eeyou Marine Region Wildlife Board (EMRWB), Nunavik Marine Region Wildlife Board (NMRWB) and Fisheries and Oceans Canada (DFO). Beluga whale hunting is prohibited for non-natives. Quotas exist for the hunt of belugas and is sometimes prohibited spatially or temporally, and are revised every 3-5 years (Breton-Honeyman *et al.* 2021). The application of quotas is now managed through the Beluga Management System, created to protect the beluga population and the subsistence hunt by Inuit (NMRWB and EMRWB 2020). The 2020-2026 Beluga Management System from EMRWB and NMRWB, accepted by DFO on November 26, 2020, includes the following measures: closing the hunt in the Hudson Strait from September 1st to October 31st; a Total Allowable Take (TAT) of 20 beluga for the Eastern Hudson Bay arc region; prohibition of hunting in three estuaries including Little Whale River Estuary; banning the hunting of calves or adults accompanied by a calf, and measures to obtain biological samples from harvested belugas. This management system is consistent with the latest advice from Fisheries and Oceans Canada (2020, 2022) which suggests limiting the harvest to 0 to 65 belugas per year to maintain the population around 3,400 individuals in the coming years.
- **Other whales** are uncommon in the study area as it is out of their usual distribution area.
- **Polar bear** (*Ursus maritimus*) is a circumpolar species that is not highly present in the study area, which is part of the Southern Hudson Bay Management Unit (Hydro-Québec 1993 and references therein, COSEWIC 2018 and references therein). However, sightings of polar bears are frequent and denning sites are likely present in the north of the study area. They are more common on Long Island, Belcher Islands, Ottawa Islands, western Hudson Bay, James Bay (Obbard *et al.* 2013, 2018) and from the northern end of Manitounuk Sound to Tasiujaq Lake. Several of these denning sites were identified by Cree and Inuit Traditional Knowledge collected

from hunters and trappers from Wemindji, Chisasibi and Whapmagoostui/Kuujjuarapik (Laforest *et al*. 2018), although more may be present throughout the study area (NMRWB 2018, EMRWB 2020). A denning area at the southern limit of the Manitounuk Islands was also reported through interviews with Whapmagoostui/Kuujjuarapik community members (NMRWB 2018). Polar bears distribution is strongly related to the distribution of ringed seals during winter. Polar bear is an apex predator species partly dependent on sea ice in winter, mainly for seal hunting (except for denning females) and on terrestrial habitats in summer for subsistence. They tend to remain near the coast when on land. They prefer an ice cover of about 85% and usually move to land when ice concentration drops to 30-50% (COSEWIC 2018 and references therein). Polar bear is listed in the Appendix 2 of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), is listed as Special Concern on Schedule 1 of the *Species at Risk Act* and is considered vulnerable by the province of Quebec (MFFP 2021a). Polar bear is also listed as vulnerable on the Red List of the International Union for Conservation of Nature (IUCN). The southern Hudson Bay population was estimated at 1,000 individuals by Aars *et al.* (2006) and 780 individuals in 2016 (Polar Bear Technical Committee 2018 *In* COSEWIC 2018). Cree and Inuit traditional knowledge reports that polar bear may eat a wide variety of food including bird eggs, belugas, birds, fish, vegetation and berries and caribou (Laforest *et al.* 2018, NMRWB 2018, EMRWB 2020). Sports hunting of polar bears is prohibited in the study area but subsistence hunting by Inuit and Crees is allowed. TAT and non-quota limitations also exist for the southern Hudson Bay. Polar bear hides are still traditionally used by Inuit to make items such as mattresses and snow pants (NMRWB 2018). Hunting usually happens during winter on pack-ice and near the coast (NMRWB 2018). NMRWB and EMRWB are responsible of the offshore management of the polar bear in the study area. The onshore management is under the responsibility of The Hunting, Fishing, and Trapping Coordinating Committee established under the *James Bay and Northern Québec Agreement* (1975) for Nunavik and Eeyou Istchee regions.

Even though it is not a marine mammal per se, the Arctic fox (*Vulpes lagopus*) uses the littoral during summer and pack ice during winter (CSSA 1992, Prescott and Richard 2004). Arctic fox may follow polar bears to feed on their leftovers (Prescott and Richard 2004).

Red fox (*Vulpes vulpes*), snowshoe hare (*Lepus americanus*) and arctic hare (*Lepus arcticus*) also use the littoral zone in the area (Hydro-Québec 1993).

3.5 AVIFAUNA

Hudson Bay and its coastline represent an important migration route for many bird species. However, it is the extensive marshes along the west and south coasts of the bay that attract the highest concentrations (CDQS 2022). Numerous Important Bird Areas (IBA 2022) are listed in these areas, as well as protected areas. On the east coast, these are the islands and islets that present habitats of interest for avian fauna, particularly Belcher and Salikuit Islands located to the northwest and north of the study area, where four IBAs have been identified (IBA 2022). IBAs are also present on the Great Whale River, Little Whale River and Rivers of the Tasiujaq Lake Basin. These IBAs, if present in the terrestrial study area, are discussed in Technical Note 6 (see Figure 3-2).

Little inventory data is available for the study area. The most recent documents consulted come from the waterfowl and aquatic bird inventories were conducted as part of the preliminary studies for the Great Whale hydroelectric complex in 1989 and 1990 (Hydro-Québec 1993). According to these studies, the greatest concentrations of waterfowl were observed on the islands in the sector of the mouth of the Nastapoka River located at the northern limit of the zone. Waterfowl inhabit the Manitounuk area less, although this is one of the few areas on the east coast of Hudson Bay that has wetlands and a marine environment suitable for feeding and resting during migration, albeit limited. Few individuals have been observed in the estuary of the Great Whale River and the Little Whale River. However, they are mostly sought out in spring when they represent some of the only ice-free water points in the area. The sector between the mouth of the Vauquelin River and the mouth of the Great Whale River is marked by the scarcity of islands and bays, as well as the predominance of foreshore coarse material that is not very productive.

This sector is very little frequented by avian fauna. Other aquatic species such as herring gulls (*Larus argentatus*), terns and loons have also been observed in low density.

Bird concentrations are highest during the spring and fall migrations. Most notably, waterfowl are about five times more numerous at the end of August compared to early July (Consortium Gauthier & Guillemette – G.R.E.B.E. 1990b). The first individuals arrive in mid-May and the last ones leave when the ice sets in mid-November (Hydro-Québec, 1993). Long-tailed Ducks (*Clangula hyemalis*) and Common Eiders (*Somateria mollissima*) linger in open water areas that remain near the Schooner Opening and Boat Opening (Hydro-Québec, 1993). Common Eiders even inhabit the Belcher Islands sector year-round, frequenting the polynyas found a few kilometres offshore (Freeman 1970a, Manning 1976 and Fleming and McDonald 1987 *In* Hydro-Québec 1993). A few small polynyas, sometimes covered with ice, are present at the Schooner Opening and Boat Opening, near the Paint Islands and at the mouth of the Tasiujaq Lake estuary (CSSA 1992).

Several species of waterfowl frequent Manitounuk Sound during the summer season. The main users are American Black Ducks (*Anas rubripes*), scaups, scoters, buffleheads, Herring Gulls and other shorebirds (see review in CSSA 1992). To a lesser extent, the Strait is frequented during the summer season by Canada Goose, Green-winged Teal (*Anas crecca*), Mallard (*Anas platyrhynchos*), Northern Pintail (*Anas acuta*), Blue-winged Teal (*Spatula discors*), Greater Scaup (*Aythya marila*), Common Eider, Long-tailed Duck, Surf Scoter (*Melanitta perspicillata*), White-winged Scoter (*Melanitta deglandi*), Common Goldeneye (*Bucephala clangula*), Mergansers, Glaucous Gulls (*Larus hyperboreus*), and Osprey (*Pandion haliaetus*) (see review in CSSA 1992).

Breeding species observed on the coast include Common Eider, Scaups, common duck, Canada Goose, Common Goldeneye, Common Merganser (*Mergus merganser*), Black Scoter (*Melanitta americana*) and Green-winged Teal. The nesting of Harlequin Duck (*Histrionicus histrionicus*), American Black Duck, Mallard, Northern Pintail, Ring-necked Duck (*Aythya collaris*), Red-breasted Merganser (*Mergus serrator*) and Surf Scoter has also been confirmed by the observation of broods during inventories carried out on a coastal strip along the coast (Consortium Gauthier & Guillemette – G.R.E.B.E. 1990b, c).

According to the available data, 101 bird species in 25 families are likely to frequent the marine area and its coastline on an annual basis (Table 3.10). The study area is likely to be frequented by 9 species with a protection status. The following species have been reported in the area or nearby in the literature consulted:

- The **Barrow's Goldeneye** (*Bucephala islandica*) is listed as vulnerable provincially (MFFP 2022) and is listed as a special concern species at the federal level (Government of Canada 2022). This species could potentially use the study area as migratory site (COSEWIC 2000).
- The **Buff-breasted Sandpiper** (*Calidris subruficollis*) is without status at the provincial level (MFFP 2022) and is listed as a threatened species at the federal level (Government of Canada 2022). This species could potentially use the study area as migratory site (ECCC 2021).
- The **Golden Eagle** (*Aquila chrysaetos*) is listed as vulnerable provincially (MFFP 2022) and not at risk federally (Government of Canada 2022). The species nests on cliffs (MFFP 2021b). Nests are present inland, but near the coast of the study area from Schooner Opening to Tasiujaq Lake (*Centre de données sur le patrimoine naturel du Québec* (CDPNQ) 2021).
- The **Harlequin Duck** is listed as vulnerable provincially (MFFP 2022) and of special concern federally (Government of Canada 2022). The species nests near fast flowing streams (MFFP 2021c). Broods have been observed along the marine shoreline north of Little Whale River and near the Nastapoka River (G.R.E.B.E 1990).
- The **Peregrine Falcon subspecies *anatum*** (*Falco peregrinus*) is listed as vulnerable provincially (MFFP 2022) and of special concern federally (Government of Canada 2022), while **subspecies *tundrius*** is listed as likely to be designated as threatened or vulnerable provincially (MFFP 2022) and of special concern federally (Government of Canada 2022). According to MFFP (2021d), both subspecies are present in Quebec. Subspecies *tundrius* nests north of treeline while subspecies *anatum* ranges from the boreal forest to Mexico. However, the range limits between these two subspecies are not clearly defined. Cliffs remain the preferred nesting habitat of the species. Some falcons also nest successfully in man-made sites such as bridges and quarries.

- The **Short-eared Owl** (*Asio flammeus*) is listed as likely to be designated as threatened or vulnerable provincially (MFFP 2022) and of special concern federally (Government of Canada 2022). The species prefers to nest in open areas such as marshes, farmland, and tundra (MFFP 2021e).
- The **Bank Swallow** (*Riparia riparia*) has no special status at the provincial level (MFFP 2022) and is listed as a threatened species at the federal level (Government of Canada 2022). In the wild, this swallow often nests in colonies in cavities of riverbanks and coastal cliffs. In anthropogenic environments, it can also take advantage of sand and gravel pits or more unusual locations such as abandoned sand piles and mines (Falardeau 2019).
- The **Red-necked Phalarope** (*Phalaropus lobatus*) is without status at the provincial level (MFFP 2022) and on the federal list of species of special concern (Government of Canada 2022). The nesting of the species has been confirmed by Hydro-Québec (1993). It nests in subarctic and low arctic wetlands, near ponds, lakes or freshwater streams (Government of Canada 2021a).
- The **Rusty Blackbird** (*Euphagus carolinus*) is listed as potentially threatened or vulnerable provincially (MFFP 2022) and of special concern federally (Government of Canada 2022). The Rusty Blackbird nests in the boreal forest where the species prefers wetland shorelines such as slow-moving streams, bogs, marshes, swamps and beaver ponds (Government of Canada 2021b).

MANAGEMENT

The harvest of avian wildlife in the study area falls into two broad categories: game birds and subsistence hunting, all of which are governed by specific legal provisions.

Game birds are represented by waterfowl, i.e., geese, ducks (with the exception of the Harlequin Duck for which hunting is prohibited), snipe, woodcock, coots and gallinules. The harvest is regulated by the *Migratory Birds Convention Act, 1994* (MBCA), administered at the federal level by the Canadian Wildlife Service of Environment Canada. It should be noted that the American coot is not numerous on the territory and absent from the study area and that the American gallinule is not present.

Subsistence hunting of migratory birds is permitted for Indigenous people by the MBCA and also results in a harvest that is yet to be quantified. According to the *Commission régionale sur les ressources naturelles et le territoire de la Baie-James* (CRRNTBJ 2010), the Canada goose is by far the most sought-after bird species. The traditional Canada Goose hunt is a major spring event for communities and is celebrated.

Eeyou Marine Region Wildlife Board (EMRWB) and Nunavik Marine Region Wildlife Board (NMRWB) are responsible for the wildlife management within their recognized territory. There are no specific TAT or quotas regarding small game and subsistence hunting. EMRWB and NMRWB collect knowledge on species at risk and species traditionally harvested, and inform Eeyou Istchee Crees and Nunavik Inuit on wildlife management decisions regarding species at risk occurring in the EMR and NMR.

Table 3.10 Bird Species that may be Present in the Study Area

FAMILY	COMMON NAME	SCIENTIFIC NAME	NIDIFICATION[1]	MOLT	MIGRATORY	WINTERING	PROVINCIAL* /FEDERAL** STATUS
Alcidae	Black Guillemot	*Cepphus grylle*	X		X		
Anatidae	American Black Duck	*Anas rubripes*	CONF		X		
	American Wigeon	*Mareca americana*			X		
	Barrow's Goldeneye	***Bucephala islandica***			**X**		**Vulnerable /Special concern**
	Black Scoter	*Melanitta americana*	CONF		X		
	Blue-winged Teal	*Spatula discors*			X		
	Brant Goose	*Branta bernicla*			X		
	Canada Goose	*Branta canadensis*	CONF	X	X		
	Common Eider	*Somateria mollissima*	CONF		X	X	
	Common Goldeneye	*Bucephala clangula*	CONF		X		
	Common Merganser	*Mergus merganser*	CONF		X		
	Green-winged Teal	*Anas crecca*	CONF		X		
	Greater Scaup	*Aythya marila*	CONF		X		
	Harlequin Duck	***Histrionicus histrionicus***	**CONF**		**X**		**Vulnerable /Special concern**
	Hooded Merganser	*Lophodytes cucullatus*			X		
	King Eider	*Somateria spectabilis*			X		
	Long-tailed Duck	*Clangula hyemalis*	CONF				
	Mallard	*Anas platyrhynchos*	CONF		X		
	Northern Pintail	*Anas acuta*	CONF		X		

FAMILY	COMMON NAME	SCIENTIFIC NAME	NIDIFICATION[1]	MOLT	MIGRATORY	WINTERING	PROVINCIAL* /FEDERAL** STATUS
	Red-breasted Merganser	*Mergus serrator*	CONF		X		
	Ring-necked Duck	*Aythya collaris*	CONF		X		
	Snow Goose	*Anser caerulescens*	X		X		
	Surf Scoter	*Melanitta perspicillata*	CONF		X		
	Tundra Swan	*Cygnus columbianus*	X		X		
	White-winged Scoter	*Melanitta deglandi*			X		
Phasianidae	Willow Ptarmigan	*Lagopus lagopus*	X			X	
	Rock Ptarmigan	*Lagopus muta*	X				
Charadriidae	Black-bellied Plover	*Pluvialis squatarola*			X		
	Lesser Golden-plover	*Pluvialis dominica*			X		
	Killdeer	*Charadrius vociferus*	X		X		
	Semipalmated Plover	*Charadrius semipalmatus*	X		X		
Scolopacidae	Baird's Sandpiper	*Calidris bairdii*			X		
	Buff-breasted Sandpiper	*Calidris subruficollis*			X		**Without status/ Special concern**
	Dunlin	*Calidris alpina*			X		
	Greater Yellowlegs	*Tringa melanoleuca*	POSS		X		
	Least Sandpiper	*Calidris minutilla*			X		
	Pectoral Sandpiper	*Calidris melanotos*			X		
	Purple Sandpiper	*Calidris maritima*	POSS		X		
	Red Knot	***Calidris canutus***			**X**		**Likely to be designated/ Endangered**

FAMILY	COMMON NAME	SCIENTIFIC NAME	NIDIFICATION[1]	MOLT	MIGRATORY	WINTERING	PROVINCIAL* /FEDERAL** STATUS
	Red-necked Phalarope	***Phalaropus lobatus***			**X**		**Without status/ Special concern**
	Ruddy Turnstone	*Arenaria interpres*			X		
	Sanderling	*Calidris alba*			X		
	Semipalmated Sandpiper	*Calidris pusilla*			X		
	Spotted Sandpiper	*Actitis macularia*	POSS		X		
	Whimbrel	*Numenius phaeopus*			X		
	White-rumped Sandpiper	*Calidris fuscicollis*			X		
	Wilson's Snipe	*Gallinago delicata*	X		X		
Laridae	Arctic Tern	*Sterna paradisaea*	CONF		X		
	Common Tern	*Sterna hirundo*			X		
	Glaucous Gull	*Larus hyperboreus*	X		X		
	Great Black-backed Gull	*Larus marinus*	X		X		
	Herring Gull	*Larus argentatus*			X		
	Iceland Gull	*Larus glaucoides*	X		X		
	Long-tailed Jaeger	*Stercorarius longicaudus*			X		
	Ring-billed Gull	*Larus delawarensis*			X		
Gaviidae	Common Loon	*Gavia immer*	CONF		X		
	Red-throated Loon	*Gavia stellata*			X		
Pandionidae	Osprey	*Pandion haliaetus*			X		

FAMILY	COMMON NAME	SCIENTIFIC NAME	NIDIFICATION[1]	MOLT	MIGRATORY	WINTERING	PROVINCIAL* /FEDERAL** STATUS
Accipitridae	**Golden Eagle**	***Aquila chrysaetos***	**CONF**		**X**		**Vulnerable/ Not at Risk**
	Northern Harrier	*Circus hudsonius*	X		X		
	Rough-legged Hawk	*Buteo lagopus*	POSS		X		
Strigidae	**Short-eared Owl**	***Asio flammeus***			**X**		**Likely to be designated/ Special concern**
	Snowy Owl	*Bubo scandiacus*			X		
Falconidae	Gyrfalcon	*Falco rusticolus*			X		
	Merlin	*Falco columbarius*	X				
	Peregrine Falcon subspecies *anatum*	***Falco peregrinus anatum***			**X**		**Vulnerable/ Special concern**
	Peregrine Falcon subspecies *tundrius*	***Falco peregrinus tundrius***			**X**		**Likely to be designated/ Special concern**
Corvidae	American Crow	*Corvus brachyrhynchos*	X				
	Canada Jay	*Perisoreus canadensis*	PROB				
	Common Raven	*Corvus corax*	POSS				
Paridae	Boreal Chickadee	*Poecile hudsonicus*	X				
Alaudidae	Horned Lark	*Eremophila alpestris*			X		
Hirundinidae	**Bank Swallow**	***Riparia riparia***	**X**		**X**		**Without status/ Threatened**
	Tree Swallow	*Tachycineta bicolor*	X		X		
Regulidae	Ruby-crowned Kinglet	*Regulus calendula*	POSS				
Sittidae	Red-breasted Nuthatch	*Sitta canadensis*	POSS				

FAMILY	COMMON NAME	SCIENTIFIC NAME	NIDIFICATION[1]	MOLT	MIGRATORY	WINTERING	PROVINCIAL* /FEDERAL** STATUS
Certhiidae	Brown Creeper	*Certhia americana*	POSS				
Turdidae	American Robin	*Turdus migratorius*	POSS				
Motacillidae	American Pipit	*Anthus rubescens*	POSS		X		
Fringillidae	Common Pedpoll	*Acanthis flammea*	POSS		X		
	Hoary Redpoll	*Acanthis hornemanni*			X		
	Pine Grosbeak	*Pinicola enucleator*	POSS				
	Pine Siskin	*Spinus pinus*	POSS				
Calcariidae	Lapland Longspur	*Calcarius lapponicus*	X		X		
	Snow Bunting	*Plectrophenax nivalis*	X		X		
Passerellidae	American Tree Sparrow	*Spizelloides arborea*	X		X		
	Dark-eyed Junco	*Junco hyemalis*	PROB				
	Fox Sparrow	*Passerella iliaca*	POSS				
	Lincoln's Sparrow	*Melospiza lincolnii*	X		X		
	Savannah Sparrow	*Passerculus sandwichensis*	PROB		X		
	Swamp Sparrow	*Melospiza georgiana*	X				
	White-Crowned Sparrow	*Zonotrichia leucophrys*	PROB		X		
	White-throated Sparrow	*Zonotrichia albicollis*	POSS				
Icteridae	**Rusty Blackbird**	***Euphagus carolinus***	**X**		**X**		**Likely to be designated/ Special concern**

FAMILY	COMMON NAME	SCIENTIFIC NAME	NIDIFICATION[1]	MOLT	MIGRATORY	WINTERING	PROVINCIAL* /FEDERAL** STATUS
Parulidae	Blackpoll Warbler	*Setophaga striata*	POSS				
	Northern Waterthrush	*Parkesia noveboracensis*	POSS				
	Orange-crowned Warbler	*Oreothlypis celata*	X		X		
	Palm Warbler	*Setophaga palmarum*	X				
	Wilson's Warbler	*Cardellina pusilla*	CONF				
	Yellow Warbler	*Setophaga petechia*	POSS				
	Yellow-rumped Warbler	*Setophaga coronata*	POSS				

* *Loi sur les espèces menacées ou vulnérables*

** *Species at Risk Act* (S.C. 2002, c. 29)

[1] POSS: possible, PROB: probable, CONF: confirmed, X: no nesting code is assigned in the source database.

Species in **bold** indicate a special status species.

Sources: Morrison and Gaston 1986, Consortium Gauthier & Guillemette – G.R.E.B.E. 1990a,b,c, CSSA 1992, Hydro-Québec 1993, Le Groupe Boréal 1993b, AONQ 2021, CDQS 2021, CDPNQ 2021, eBird 2021, GBIF 2021, IBA 2021, MFFP 2022, Government of Canada 2022.

3.6 SENSITIVE HABITATS

IMPORTANT AREAS

In the study area, the Belcher Islands sector is recognized as an Ecologically and Biologically Significant Area (EBSA; see section 4.3) in the Canadian arctic. Within this sector are found numerous polynyas, small estuaries, landfast ice around islands, ecological significant currents around islands and cooler water temperatures. The area is home to eelgrass beds, significantly high benthic production, an endemic resident Hudson Bay common eider subspecies, sea duck nesting and foraging grounds, walrus feeding areas and haul outs, summer beluga estuary aggregations and possible overwintering grounds and polar bear feeding grounds (Fisheries and Oceans Canada (DFO 2011)) - (Figure 3-1).

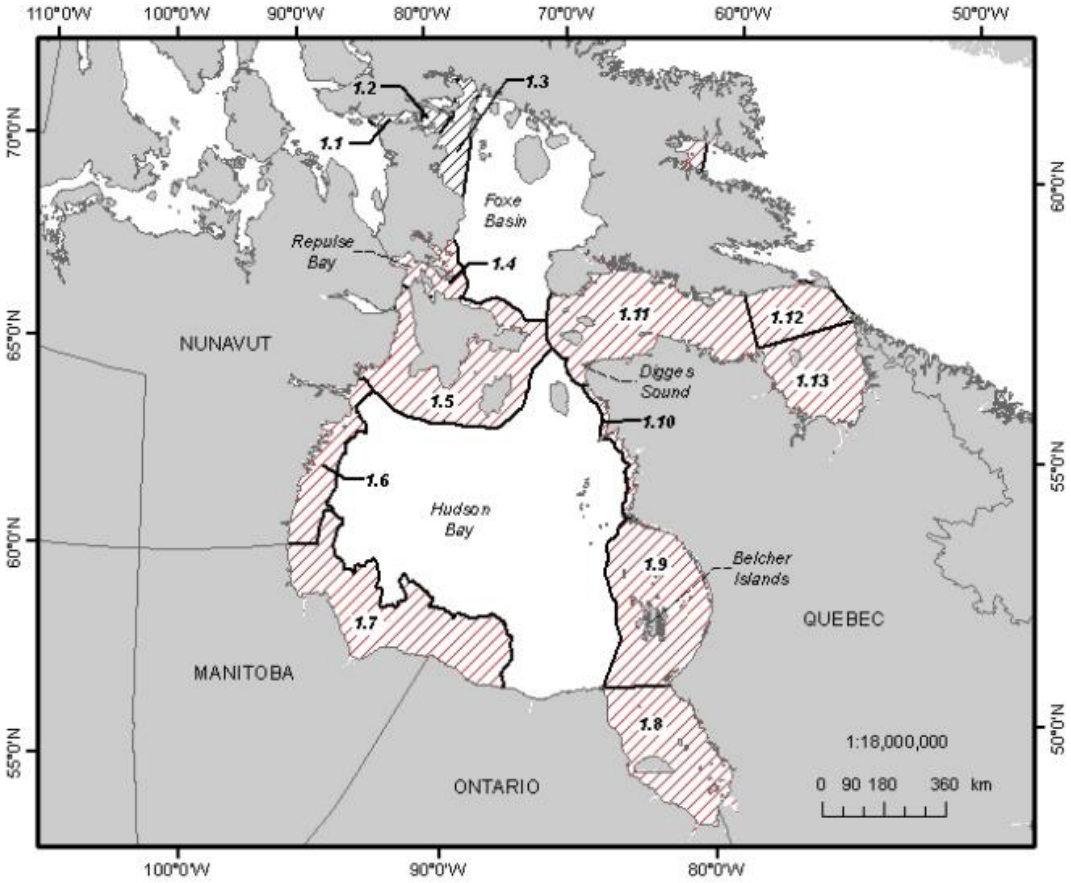

Figure 3-1 Ecologically and Biologically Significant Area (EBSA) in the Hudson Bay Complex (taken from Fisheries and Oceans Canada 2011) – The Belcher Islands EBSA is number 1.9

Several Canadian Important Bird Areas (IBA) are located near the study area. These are (Figure 3-2):

- Belcher Islands, Salikuit Islands and Sleeper Islands for Common Eider;
- Great Whale River, Little Whale River, Tasiujaq Lake and Nastapoka River for Harlequin Duck.

Figure 3-2 Important Bird Areas around the Hudson Bay (taken from IBA 2022)

POLYNYAS

Three small polynyas, areas of permanently open water surrounded by sea ice, that can be covered by thin layers of ice from time to time, are present in the study area: Paint Islands, Schooner Opening and Boat Opening (CSSA 1992). The mouth of Tasiujaq Lake is also a small polynya that persists most of the time (CSSA 1992).

USE BY WILDLIFE

River estuaries are important for diadromous fish and beluga whales. In the study area, belugas are mainly present from Schooner Opening to Little Whale River estuary but use the entire zone. Manitounuk Sound is used by birds from spring to fall and is believed to be an important habitat in the capelin life cycle. Manitounuk Sound also has the greatest concentration of salt marshes and eelgrass meadows of the study area.

The coastal zone around Little Whale River and Tasiujaq Estuary is identified as an important zone for belugas, as well as for the reproduction of peregrine falcon and golden eagle. This zone is also important for Inuit and Cree subsistence (KRG 2007). Beluga hunting is prohibited in Little Whale River estuary and is identified as a sanctuary for the species (KRG 2007).

According to Cree and Inuit Traditional Ecological Knowledge (Crees from Wemindji, Chisasibi, Whapmagoostui and Inuit from Kuujjuarapik), polar bears can be sighted and harvested anywhere in the study area from Long Island to north of Tasiujaq Lake; polar bear denning sites are present from the north end of Manitounuk Sound to Tasiujaq Lake (Laforest *et al.* 2018, EMRWB 2020).

According to Stewart and Howland (2009), there are no important year-round concentrations of marine mammals and birds in the study area.

CONSERVATION PROJECTS

Kativik Regional Government has a natural heritage conservation project for Manitounuk Sound, as this area has particular spectacular landscapes (KRG 2020).

Furthermore, according to Kativik, communities have requested that a 10 km-wide coastal zone receives official protection from governments for its diversity and important productivity (KRG 2020).

3.7 SPECIES AT RISK

Among the different species likely to frequent the eastern Hudson Bay and its coast, 16 species have official protection status (Table 3.11). Beluga whales are usually found in the study area in summer, polar bears are usually found on the ice of Hudson Bay in winter and inland along the coast during summer and ringed seal can be found everywhere in the study area. Nine bird species with status are likely to frequent the study area from spring to fall (Table 3.11). Among them, Harlequin Duck, Golden Eagle, Bank Swallow and Rusty Blackbird are likely to nest near or within the study area (Table 3.10).

Table 3.11 Species at Risk Likely to Frequent the Eastern Hudson Bay and its Coast and Presence Potential in the Study Area

SPECIES	PROTECTION STATUS			PRESENCE POTENTIAL
	QUÉBEC [1]	SARA[2]	COSEWIC[3]	
Marine mammals				
Beluga of eastern Hudson Bay population	Likely to be designated	Schedule 2, Threatened	Threatened	Yes
Bowhead whale	-	Schedule 2, Endangered	Special Concern	No
Narwhal	-	-	Special Concern	No
Killer whale	-	-	Special Concern	No
Ringed seal	-	-	Special Concern	Yes
Walrus (Atlantic)	Likely to be designated	Schedule 1, Extirpated	Special Concern	Not likely
Polar bear	Vulnerable	Schedule 1, Special Concern	Special Concern	Yes
Birds				
Barrow's Goldeneye	Vulnerable	Schedule 1, Special Concern	Special Concern	Yes
Buff-breasted Sandpiper	-	Schedule 1, Special Concern	Special Concern	Yes
Golden Eagle	Vulnerable	-	Not at Risk	Yes
Harlequin Duck	Vulnerable	Schedule 1, Special Concern	Special Concern	Yes
Peregrine Falcon	Vulnerable / likely to be designated	Schedule 1, Special Concern	Not at Risk	Yes
Short-eared Owl	Likely to be designated	Schedule 1, Special Concern	Threatened	Yes
Bank Swallow	-	Schedule 1, Threatened	Threatened	Yes
Red-necked Phalarope	-	Schedule 1, Special Concern	Special Concern	Yes
Rusty Blackbird	Likely to be designated	Schedule 1, Special Concern	Special Concern	Yes

[1] *Loi sur les espèces menacées ou vulnérables*, [2] *Species at Risk Act* (S.C. 2002, c. 29), [3]Committee on the Status of Endangered Wildlife in Canada

Sources: MFFP 2022, Government of Canada 2022

3.8 INVASIVE SPECIES

Chan *et al.* (2012) evaluated the risk of ship-mediated invasion by non-indigenous species in the arctic harbours. Churchill (Manitoba) had a high risk of invasion by biofouling (colonization of ship surfaces by various organisms) and by ballast waters (salt water held in tanks to stabilize ships that may contain various organisms). Risk levels by fouling was determined to be medium in Iqaluit, Erebus Bay and Beechey Island by fouling and low at all other harbours.

In a recent EMR report on invasive species, Eeyou Istchee Crees voiced some concerns regarding increase and introduction of cormorant, green crab, algae, jellyfish, Greenland shark (*Somniosus microcephalus*), bald eagle (*Haliaeetus leucocephalus*), and vulture (EMRWB 2019). Rainbow smelt (*Osmerus mordax*) is also of particular concern and already occurring in James Bay.

The Canadian Marine Invasive Screening Tool (CMIST) database was searched for recordings of invasive species in the study area. No records of invasive marine species were found in the database (CMIST 2022).

Goldsmit *et al.* (2021) assessed the risk of invasions of the Hudson Bay Complex. The risk assessment evaluated the likelihood of invasion for 31 potential species using CMIST. They identified 14 species with a high risk of invasion (in order of importance): *Chionoecetes opilio, Paralithodes camtschaticus, Acartia (Acanthacartia) tonsa, Mya arenaria, Littorina littorea, Codium fragile* spp. *fragile, Sargassum muticum, Aurelia limbata, Mnemiopsis leidyi, Carcinus maenas, Marenzelleria viridis, Membranipora membranacea, Gammarus tigrinus, and Undaria pinnatifida* (see Table 3.12). On those 14 species, *Mya arenaria*, a species of soft-shell clam, was listed as present in the study area by Legendre (1977) and in the Hudson Bay (Stewart and Lockhart 2005) while three are of major concern:

- *Undaria pinnatifida* is a brown macroalgae (*Phaeophyceae> Laminariales> Alariaceae*) native to the Northwest Pacific Ocean. Introduction may happen by epiphytic hull fouling. It proliferates in protected zones with cold and clear waters in the subtidal zone. *U. pinnatifida* is resistant to organic pollution, salinity variations and has a growth optimum that ranges from 10 °C to 15 °C (Wacquant *et al.* 2021).
- *Mnemiopsis leidyi* is a pelagic Ctenophora that lives in shallow coastal areas with rich organic inputs native to the North American Atlantic. Introduction may happen by ballast waters. It is euryhaline and eurythermal and is also resistant to low oxygenation levels and pollution. *M. leidyi* is a voracious plankton predator and mainly feeds on fish, Cnidaria and crustacean larvae (Ziemski and Maran 2020).
- *Carcinus maenas* is a crab that lives in different coastal habitats from sand to rocky shores and is native to the Eastern Atlantic Ocean. This crab is resistant to low salinities, to pollution and tolerates temperature ranging from 0 °C to 30 °C. *C. maenas* is omnivorous as it feeds on mollusks, annelids, crustaceans, algae, detritus and dead animals (Didierlaurent *et al.* 2021). *C. maenas* introduction occurs mainly by ballast water but could also happen by hull fouling and indirectly by live food industries (CABI 2022).

Table 3.12 High Risk Invasive Species Listed by Goldsmit *et al.* (2021)

TAXONOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	REPORTED IN THE ZONE
Macroalgae	Dead man's fingers	*Codium fragile* spp. *fragile*	No
	Japanese wireweed	*Sargassum muticum*	No
	Wakame	***Undaria pinnatifida****	No
Cnidaria (macrozooplankton)	Brown banded moon jelly	*Aurelia limbata*	No
Ctenophora (macrozooplankton)	**Warty comb jelly**	***Mnemiopsis leidyi****	No
Polycheata	Red-gilled mudworm	*Marenzelleria viridis*	No
Bryozoa	Coffin box bryozoan	*Membranipora membranacea*	No
Mollusk	Soft shell clam	*Mya arenaria*	Yes, Legendre 1977
	Common periwinkle	*Littorina littorea*	No
Crab	Snow crab	*Chionoecetes opilio*	No
	Red King carb	*Paralithodes camtschaticus*	No
	Green crab	***Carcinus maenas****	No
Amphipod	Tiger scud	*Gammarus tigrinus*	No
Copepod	-	*Acartia (Acanthacartia) tonsa*	No

*Species in **bold** are listed on the *100 of the World's Worst Invasive Alien Species* (GISP 2022)

4 MARINE SENSITIVE AND PROTECTED AREAS

The study area is in the Hudson Bay that is part of Nunavut Territory. The study area falls within the *Eeyou Istchee Marine Land Claim* and *Nunavik Marine Land Claim*, with a small part within the *Nunavut Land Claim* (Figure 4-1), all of which are formalized by recognized Agreements.

There are no federal Marine Protected Areas in the study area. Among, other marine protected and conserved areas (listed in the Canadian Protected and Conserved Areas Database, CPCAD), only one is found on the coastal portion of the study area, the Tursujuq National Park (Québec), and another is found south of the study area, the *Réserve de territoire aux fins d'aire protégée du Lac-Burton-Rivière-Rogan-et-la-Pointe-Louis-XIV* (Map 1-1).

Establishment, disestablishment or changing of the boundaries of protected areas must be approved by EMRWB and/or NMRWB. Wildlife boards may advise the Minister on all matters related to protected areas management.

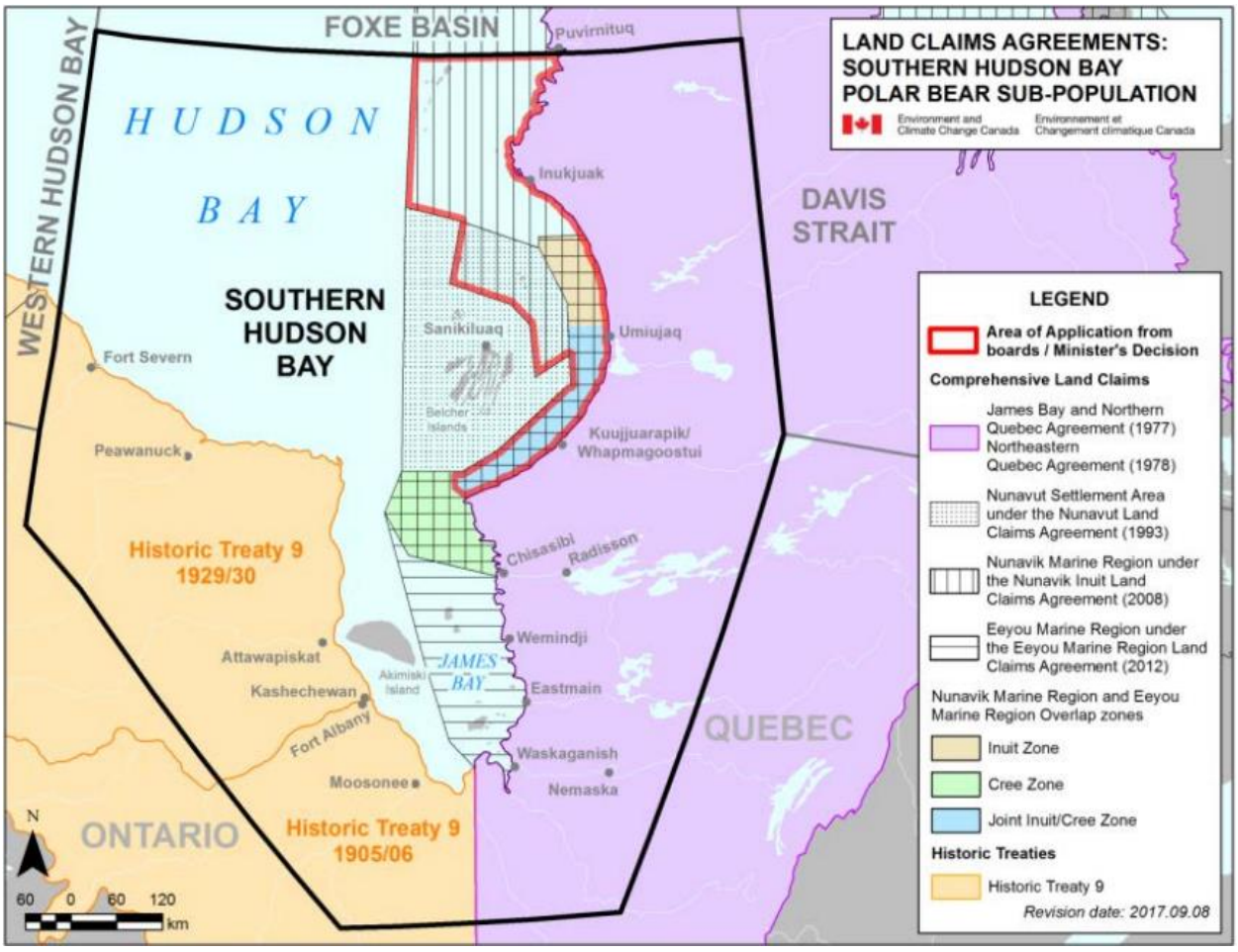

Figure 4-1 Boundaries of Crees and Inuit Land Claims near the Study Area (taken from EMRWB 2020)

4.1 TURSUJUQ NATIONAL PARK

The Tursujuq National Park is a large terrestrial protected area near the community of Umiujaq. Tasiujaq Lake, Wiyâshâkimî Lake (formerly Clearwater Lakes), Lacs des Loups Marins (lake), and Nastapoka River are part of the park. The Lacs des Loups Marins have a unique year-round freshwater subtype of harbour seal (*Phoca vitulina mellonae*). The limits of the park include small bays of Hudson Bay from North of Second River to Little Whale River as well as the entire shoreline between Little Whale River and the Kuugaa'uk Stream.

Nunavik national parks contribute to the development of Arctic territories through tourism whilst promoting Inuit and Cree cultures and protecting natural heritage. Sports hunting is prohibited in the parks. Fishing is permitted with a provincial licence and park fishing permit.

4.2 PROPOSED MARINE PROTECTED AREAS

There are no proposed marine protected areas in the study area. However, there is one project to protect Belcher Islands: Qikiqtait Protected Area. The study area is located within a Priority Area for Conservation by World Wildlife Fund Canada (WWF Canada).

QIKIQTAIT PROTECTED AREA

The Qikiqtait Protected Area project is an Inuit-led conservation program that aims to protect the Belcher Islands (both lands and waters) and build capacity for a conservation economy in the community of Sanikiluaq (Nunavut) for its ecologically and culturally important islands. This project combines characteristics of Marine Protected Areas (MPAs) and National Wildlife Areas (NWAs).

PRIORITY AREAS FOR CONSERVATION (PAC)

The study area is located within the James Bay and Southeastern Hudson Bay Priority Area for Conservation (PAC) (WWF Canada 2021). A PAC is a marine area of value for its biodiversity that should be prioritized for future conservation and management efforts.

4.3 ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSA)

The *Oceans Act* requires the Department of Fisheries and Oceans to designate ecologically and biologically significant areas across all Canadian marine areas. EBSAs are areas that have been identified through formal scientific assessments as having special biological or ecological significance when compared to the surrounding marine ecosystem. EBSAs should be viewed as the most important areas where, with existing knowledge, regulators and marine users should be particularly aware of the risks to resources to ensure ecosystems remain healthy and productive.

EBSA information is used to:

- Inform and guide project-specific or regional environmental assessments;
- Inform and guide industries and regulators in their planning and operations;
- Inform and guide Integrated Oceans Management (IOM) process within Large Ocean Management Areas (LOMAs) and marine bioregions;
- Serve as a basis for the identification of Areas of Interest (AOIs) and of Marine Protected Areas (MPAs).

The area targeted for a harbour development is located within the boundaries of Belcher Islands EBSA. As mentioned in section 3.6, the Belcher Islands EBSA include multiple habitats and components considered to be sensitive or likely to support the productivity and biodiversity of the environment.

Although EBSAs are not a legally marine protected area, they are protected under the *Fisheries Act*. Consequently, any proponent wishing to proceed with the construction or operation of works within the boundaries of an ESBA require a Ministerial authorization to proceed.

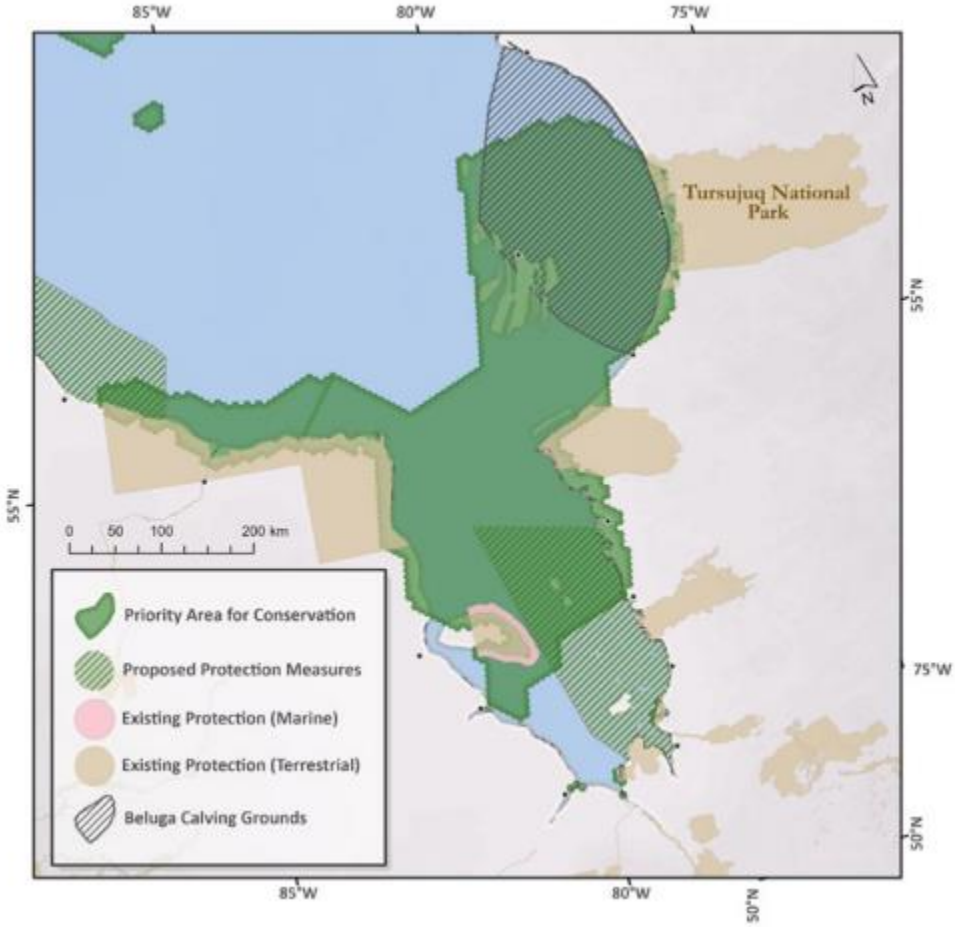

Figure 4-2 James Bay/Eastern Hudson Bay Priority Area for Conservation (PAC) by WWF Canada (taken from WWF Canada 2021)

4.4 MODERN TREATIES AND SELF-GOVERNMENT AGREEMENTS

The projected region for the proposed harbour is located directly in the Eeyou Marine Region (EMR) and in the Nunavik Marine Region (NMR). The northern section of the study area is owned by Nunavut as part of Area B of Nunavut Settlement Area (NSA).

4.4.1 EEYOU MARINE REGION AND NUNAVIK MARINE REGION

The projected region for the harbour is located directly in the Eeyou Marine Region (EMR) and in the Nunavik Marine Region (NMR) more precisely in the Joint Inuit/Cree Zone (Zone B).

EMR is recognized by a treaty signed by The Grand Council of the Crees, the Government of Canada and the Government of Nunavut on February 15, 2012: the *Eeyou Marine Region Land Claims Agreement* (EMRLCA). The Treaty acknowledges Cree ownership and other rights to certain areas in the offshore and it is also a recognition by the Crees that certain Canadian laws apply in these areas. The EMR area covers circa 61,270 km^2 offshore of Quebec both in James Bay and southeastern Hudson Bay where three zones are overlapping: the Cree Zone, the Joint Zone, and the Inuit Zone (EMRWB 2019).

NMR is recognized by an Agreement between Nunavik Inuit and Canada: the *Nunavik Inuit Land Claims Agreement* (NILCA) since July 10, 2007. The Agreement acknowledges Inuit ownership and allows co-management for wildlife, land management, and development impact issues. The NRM area covers over 100,000 km^2 offshore of Quebec and Labrador coast.

The overlap of the marine regions is under an Arrangement between Nunavik Inuit and Crees of Eeyou Istchee: A *Consolidated Agreement Relating to the Cree/Inuit Offshore Overlapping Interests Area Between the Crees of Eeyou Istchee and the Nunavik Inuit* (Cree/Inuit Offshore Overlap Agreement)

With the creation of EMR and NMR, boards were created to manage wildlife: Eeyou Marine Region Wildlife Board (EMRWB) and Nunavik Marine Region Wildlife Board (NMRWB) as well as impact review boards (EMRIRB and NMRIRB).

According to the EMRLCA and the NILCA, primary functions of wildlife boards (EMRWB and NMRWB) are:

- establishing, modifying or removing levels of Total Allowable Take for a species, stock or population of Wildlife, other than anadromous fish spawning in Québec;
- ascertaining and adjusting the Basic Needs Level for a species, stock or population of Wildlife, other than anadromous fish spawning in Québec;
- allocating from the Total Allowable Take opportunities to Harvest a species, stock or population of Wildlife, other than anadromous fish spawning in Québec;
- establishing, modifying or removing Non-quota Limitations;
- participating in research;
- determining sufficiency of information and identifying and undertaking measures necessary to obtain the information to enable it to establish the Basic Needs Levels;
- cooperating with other Wildlife management institutions which deal with species that are harvested in the EMR/NMR and migrate outside the EMR/NMR;
- setting any trophy fees on Wildlife Harvested in the EMR/NMR;
- providing advice to any other management institutions as requested on all matters relating to management, conservation, protection and regulation of Wildlife and Wildlife habitat; and
- any other function the EMRWB/NMRWB is required to perform by the EMRLCA.

According to the EMRLCA and the NILCA, primary functions of impact review boards (EMRIRB and NMRIRB) are:

- to screen project proposals in order to determine whether or not a review is required;
- to gauge and define the extent of the regional impacts of a project, such definition to be taken into account by the Minister in making his or her determination as to the regional interest;
- to review the ecosystemic and socio-economic impacts of project proposals;

- to determine, on the basis of its review, whether project proposals should proceed, and if so, under what terms and conditions, and then report its determination to the Minister; in addition, EMRIRB/NMRIRB's determination with respect to socio-economic impacts unrelated to ecosystemic impacts shall be treated as recommendations to the Minister; and
- to monitor projects.

DELIMITATIONS

The boundary between the EMR and Quebec is not determined in the EMRLCA. It was simply agreed that the regime under the EMRLCA finishes on the coast of Quebec where the regime under the *James Bay and Northern Agreement* (JBNQA) begins. Other noteworthy boundaries found on Figure 4.1 are:

- Eeyou Marine Region
- Nunavik Marine Region
- Overlapping zones:
  - Inuit Zone (Zone A)
  - Joint Inuit/Cree Zone (Zone B)
  - Cree Zone (Zone C)

RESTRICTIONS AND AUTHORIZED USE

The EMR is managed by the Eeyou Marine Region Wildlife Board (EMRWB) which is responsible for wildlife management and research priorities on wildlife while the NMR is managed by Nunavik Marine Region Wildlife Board (NMRWB).

In the overlapping zones, Crees and Inuit share rights. In the Cree Zone, the Inuit have harvesting rights and they own nine islands near Chisasibi. In the Joint Zone, the Cree and Nunavik Inuit jointly own the islands and have equal harvesting rights. In the most northern zone, the Inuit Zone, the Cree have harvesting, and other rights and the Nunavik Inuit are the landowners. The limits of these three zones were agreed upon by the Cree and Inuit of all the concerned communities.

SENSITIVE AND HIGHLY VALUED ELEMENTS TO CONSIDER

According to official documentation, Eeyou Istchee Crees have voiced specific concerns that should be considered by EMR in their decision-making processes. These are:

- Waterfowl, its habitat and how to preserve it;
- A decrease in the abundance of seals, whales and walruses;
- An increase in the eagle and polar bear numbers;
- Changes in beluga whale distribution;
- The presence of the rainbow smelt;
- Changes to the taste of animals;
- Water levels and quality;
- Caribou populations on the islands of the EMR;
- A decrease in the populations of capelin, Arctic char, sardines and other fish as well as the deterioration of fish habitat;
- The decline of eelgrass beds;
- Seafood resources including shellfish and shrimp (EMRWB 2019).

4.4.2 NUNAVUT SETTLEMENT AREA

NSA is recognized by an Agreement between the Inuit of the Nunavut Settlement Area and Canada: the *Nunavut Land Claims Agreement* (NLCA) since May 25, 1993. The Agreement gives the Inuit of the Nunavut self-government and a separate territory. The Agreement acknowledges Inuit ownership and allows co-management of the marine areas for wildlife, land management, and development impact issues. The area is not limited to marine waters.

The wildlife of the NSA is managed by the Nunavut Wildlife Management Board (NWMB). The mission of the NWMB is to conserve wildlife and its habitat for the long-term benefit of all Nunavut residents while fully respecting Inuit harvesting rights and priorities by conducting research, following wildlife harvest and managing it (including quotas), and helping with reallocation of surplus. The NWMB has mandatory functions (s 5.2.33 *Nunavut Agreement*), discretionary functions (s 5.2.34 *Nunavut Agreement*), and research functions (s 5.2.37-5.2.38 *Nunavut Agreement*).

5 LAWS, REGULATIONS AND PERMITTING REQUIREMENTS

Development of potential harbours in the Eeyou marine region implies various issues regarding to laws and regulations, and environmental components. The main issues identified are potential impacts on:

- Fish habitat (lost of surface area and changes in quality and dynamics);
- Introduction of pollutants and contamination;
- Introduction of aquatic invasive species;
- Traditional uses (marine mammals harvesting activities, hunting and fishing) and consultation of Indigenous communities.

Appendix A presents some articles of laws and regulations related to these issues. Mainly, regarding the components of the project and its location, the following issues will be to consider:

- damage to fish habitat will have to be compensated;
- Inuit and Cree rights are important and need to be considered;
- activities are more restricted within Ecologically Significant Areas;
- migratory birds and marine mammals and their habitat are to be protected;
- species at risk or their habitat should not be affected;
- Inuit and Cree communities are to be consulted;
- measures to protected waterbodies from aquatic invasive species are to be implemented, and;
- pollution from ships should be prevented.

Finally, anyone who aims to develop a project in the EMR or the NMR will have to conform with the regimes and processes established under the EMRLCA and the NILCA, including the regimes for the protection of wildlife, land use planning, and the impact review of development projects.

6 LOW IMPACT SHIPPING CORRIDORS INITIATIVE

Under the Oceans Protection Plan, the Northern Low-Impact Shipping Corridors initiative is co-led by the Canadian Coast Guard (CCG), Transport Canada, and Canadian Hydrographic Service. The Corridors initiative intends to minimize potential effects of shipping on wildlife, respect culturally and ecologically sensitive areas, enhance marine navigation safety, and guide economic development of the North. The main objectives of the Corridors initiative are to collaboratively develop a governance framework to support the corridors and identify priority areas for service enhancement with Inuit, First Nations and Metis organizations and governments, provincial and territorial governments, and other key stakeholders through the Canadian Arctic region.

The *Oceans Act* requires the Department of Fisheries and Oceans to designate ecologically and biologically significant areas across all Canadian marine areas. The large overlap of these areas with corridor designations illustrates a pressing need for greater study and integration of multiple environmental and Inuit-use information into corridor design as shown on Figure 6-1. This initiative aims to significantly limit each area available for shipping activity and provide a strong starting point for integration to protect marine environment and traditional uses.

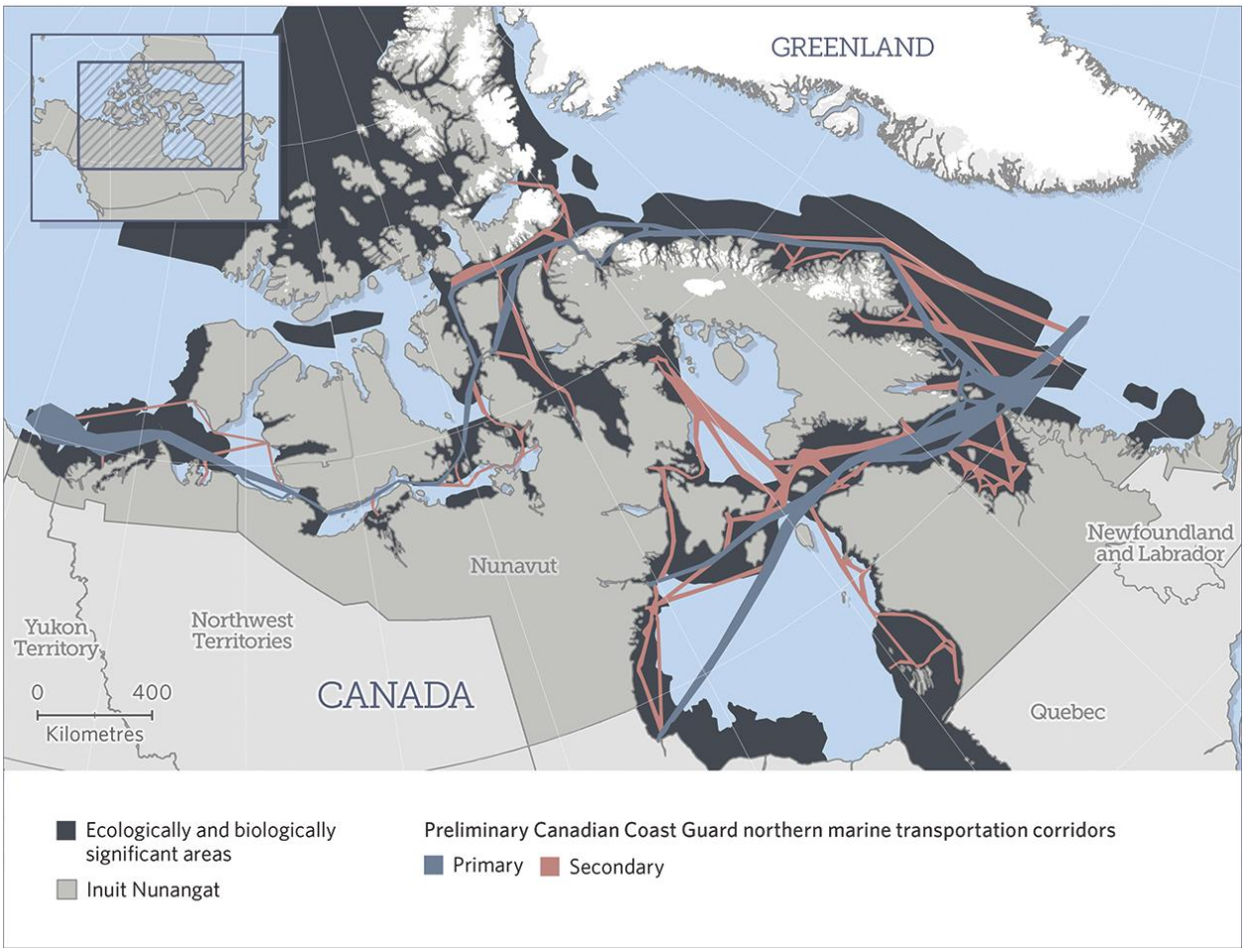

Figure 6-1 Primary and Secondary Northern Marine Transportation Corridors and Designated Ecologically and Biologically Significant Areas (taken from The Pew Charitable Trusts 2016)

A five-step process was proposed to build integrated Arctic corridors across Canada:

Step 1 aims to establish Canadian Arctic Corridors Commission by CCG, co-chaired by Inuit and the Coast Guard. This Commission would include representatives from Transport Canada, Environment Canada, Fisheries and Oceans Canada, all three territorial governments and appropriate Inuit land organizations. The Commission's mandate would be to develop the integrated corridors, and then become their permanent administrative management body overseeing the system.

Step 2 is to meaningfully engage the Inuit peoples who must be part of the designation, classification and management of corridors. In this purpose, the Commission must hold a formal consultation with all settled Inuit land claims regions to ensure significant participation that would provide for the opportunity for Inuit traditional knowledge about sensitive marine and coastal areas to shape corridor choices. This national process would also allow gathering Inuit views on shipping, develop effective communication and linkage channels between the various stakeholders.

Step 3 concerns the integration of information. To account for the complexity of the region, the Commission would collect all available data into the Canada's Arctic Marine Atlas. This will allow the Coast Guard to verify and address information and identify gaps. Major gaps exist in the data on Arctic offshore ecology, which is particularly relevant for shipping corridors. The understanding of oil spill sensitivity and response will need to be improved. This information is especially important as the eastern and western Arctic both have extended periods when spill response is not possible because of environmental conditions.

Step 4 is to designate shipping corridors based on the analysis of all relevant information. Once an integrated mapping and assessment process has identified the optimal shipping routes, the Commission should formally establish a system of corridors that excludes sensitive areas.

Step 5 will finally lead to the classification of corridors based on three tiers: 1- low risk, 2 – medium risk, and 3 – high risk. According to their tier designation, corridors would receive targeted investment and management, including environmental protected areas, enhanced service, site-specific contingency planning, improved charting, and enhanced regulation and oversight.

These steps are described with more details in The Integrated Arctic Corridors Framework published in 2016 by The Pew Charitable Trusts. In its recommendations this report noted that the Commission must create local and regional maps of high-risk areas and use the risk assessments conducted during the information-integration stages to identify where shipping corridors pass through high, medium, and low-risk areas.

More specifically, in the Eeyou marine region, the development of harbour facilities could cause an increase of maritime traffic in the Belcher Islands Ecologically and Biologically Significant Area. This area is particularly sensitive in connection with overwintering habitat of Beluga and Walrus. It is also a seasonally important feeding area for the southern Hudson Bay Polar Bear population and high primary productivity region due to strong vertical mixing.

As maritime traffic currently remains limited due to the absence of major harbour facilities in southeastern Hudson Bay, the impacts of navigation are consequently limited on the marine environment so far. Depending on the type, capacity, traffic and characteristics of the harbour facilities, the need to integrate the low impact corridor initiative could be relevant to guide and supervise development of navigation activities in the Eeyou marine region.

7 ISSUES AND RECOMMENDATIONS

7.1 DEVELOPMENT ISSUES AND CONSTRAINTS

Main issues and constraints to the development of a potential seasonal harbour are related to higher maritime traffic that would increase collision risk with marine mammals, increase the risk of water and sediment contamination as well as increase the risk of invasion by non-indigenous species. Such a development also means higher disturbance both under- and above-water, habitat loss, changes in local water dynamics, and possibly a better access to harvested resources. Depending on the location of the harbour, it might also have a localized impact on the landscape appreciation (Manitounuk Sound).

It is also important to note that according to laws and regulations, no one is allowed to disturb marine mammals or migratory birds.

Higher maritime traffic may also need the development of new infrastructure to help with ship orientation.

In a letter transmitted on March 31, 2022 (Appendix B), the Eeyou Marine Region Wildlife Board (EMRWB) raised concerns regarding polar bear behaviour and reproductive success as well as harvesting success along the eastern Hudson Bay coast in the event of the construction of a deep-water harbour. EMRWB also raised concerns regarding potential impacts on belugas on near-shore feeding environments, noise pollution and introduction and transmission of disease, as well as harvesting success along the eastern Hudson Bay coast. EMRWB stressed the importance of culturally important fish species within the study area and that any alterations to water quality, flow, habitat quality or prey species could affect Cree and Inuit harvesting rights. EMRWB also highlighted that disturbance by boats could negatively affect shorebirds including species at risk and that changes in shorebirds behaviour could have an impact on harvesting success. EMRWB pointed out the research on seals in eastern Hudson Bay is scarce and that the construction of a harbour and boat traffic could have impacts on seals and walruses. EMRWB also expressed concerns regarding the introduction of invasive species, an alteration in primary production and introduction of toxic materials and mobilization of contaminants. Many of those concerns are linked to a potential disturbance of ice regimes as many species lifecycles are directly related to ice and as ice plays an important role in primary production.

CONSTRUCTION ACTIVITIES

The construction of a small harbour will result in an alteration of the existing fish habitat as well as benthic invertebrate habitat. The existing habitat will be lost while new habitats are formed by the harbour. Existing habitats such as salt marshes and eelgrass meadows shall be avoided for the development of the harbour since they are scarce in the study area and of importance to waterfowl.

The construction will generate subaquatic noise and suspended matter.

Mitigation measures should include sediment control, marine mammal surveillance, measures to prevent accidental oil spill, measured to limit noise and subaquatic noise, and consideration should be given to the bird migration periods if the location is a known migration habitat.

EXPLOITATION PHASE

During the exploitation phase, the intensified ship traffic will increase the probability of introducing invasive species, increase the risk of collision with a marine mammal, increase the disturbance of fauna and increase the risk of contamination.

Dredging will probably be a necessity from time to time to maintain acceptable depths for ships access and safety. This will affect fish and invertebrate habitat.

Mitigation measures should include sediment control, measures to prevent accidental oil spill, determination of a low-impact shipping corridor, sediment quality control and appropriate management regarding their contamination. Breaking the ice to extend the shipping season should be avoided because the pack ice of the study area is used by pinnipeds for reproduction and is also used by other mammals such as polar bears and by Inuit and Crees for hunting.

7.2 GAPS IN AVAILABLE INFORMATION

Most of the information available is from localized studies and are over 20 years old. It is recommended to proceed with a photointerpretation campaign of the littoral to identity salt marshes and possibly eelgrass meadows as those habitats are scarce but important within the study area. Specific inventories on species at risk, bird colonies, fish spawning areas and shellfish beds are recommended as well as inventories of summer haul out areas for seals and walrus as there is little to no information regarding these areas in the study area. These studies would allow a better understanding of the use of the study area and would allow to better mitigate impacts on these species. It is also recommended that the communities of Whapmagoostui/Kuujjuarapik participate in the Low Impact Shipping Corridors Initiative to help determine the best ship traffic route. It is recommended to better document the sediment quality of the study area to better determine the impacts of a higher ship traffic.

Nunavik Inuit and Eeyou Istchee Crees community consultations are recommended about a higher shipping traffic and to obtain their view if such a development would give a better access to the resources in the bay, mainly to non-indigenous people, and what would be the mitigating measures related to that usage.

In the event that a harbour becomes a project, it would be important to sample local benthic species over several years as a pre-invasion measure to establish a baseline on local native and non-indigenous species.

8 CONCLUSIONS AND ADDITIONAL CONSIDERATIONS

Within the framework of La Grande Alliance studies, the development of a small seasonal harbour is considered in the southeastern Hudson Bay near Whapmagoostui/Kuujjuarapik. The area under consideration extends from the northeastern boundary of the *Réserve de territoire aux fins d'aire protégée du Lac-Burton-Rivière-Rogan-et-la-Pointe-Louis-XIV* to the mouth of Tasiujaq Lake. The study area is in Belchers Islands Ecologically and Biologically Significant Area (EBSA) that is also a Priority Area for Conservation by WWF Canada and small bays are protected from Little Whale River towards the northern boundary of the study area. A review of previous projects, databases and scientific literature was conducted to document the quality of the waters and sediments, the species using the area and the sensitive habitats. Special attention was given to species at risk and invasive species. To complete these data sources, requests for inputs from local organizations were made. The existence of marine protected areas and land claims in the study area was investigated. A review of the legislation and regulations specifically applicable to harbour development, ship traffic, invasive species and sensitive marine features was also conducted.

The main factors to consider are listed as follows:

- Habitat in the study area used by fauna, most notably for species at risk:
  - Rare habitats such as polynyas, even if they are not permanent;
  - River estuaries important for diadromous fish and belugas. In particular, the coastal zone around Little Whale River and Tasiujaq Estuary which are important for beluga, for the reproduction of peregrine falcon and golden eagle as well as for Inuit and Cree subsistence.
  - Salt marshes, eelgrass distribution and intertidal habitats, generally limited within the study area and mainly present within the Manitounuk Sound, in particular for capelin as well as for birds between spring and fall;
  - Use of pack ice by pinnipeds for reproduction;
  - General use of the study area by beluga, polar bear, waterfowl, and seals;
- The projected Kativik Regional Government led natural heritage designation for Manitounuk Sound for its spectacular landscapes as well as the request for the protection of a 10 km-wide coastal zone throughout the study area;
- The increased risk of introducing invasive species to the study area;
- Changes in the abundance and habitat availability for ecologically important and/or culturally valued species such as waterfowl, capelin, Arctic chars, other fish, belugas, polar bears, seals, shellfish and shrimp;
- Laws and regulations, including environmental components, around fish habitat, the introduction of pollutants and contamination, the introduction of aquatic invasive species, and the protection of traditional lifestyles within the study area;
- Low-impact shipping corridors to minimize potential effects of shipping on wildlife that respect culturally and ecologically sensitive areas, enhance marine navigation safety, and guide economic development of the North;
- The presence of a natural reserve and of a national park at both ends of the marine study area.

The main issues and constraints to the development of a seasonal harbour are related to higher maritime traffic that would increase collision risk with marine mammals, increase the risk of water and sediment contamination as well as increase the risk of invasion by non-indigenous species. Such a development also means higher disturbance both under- and above-water, habitat loss, changes in local water dynamics, and possibly a better access to harvested resources. Depending on the location of the harbour, it might also have a localized impact on landscape appreciation (Manitounuk Sound).

If the harbour proceeds, it is recommended to plan, in future stages:

- A photointerpretation campaign of the littoral to identity salt marshes and eelgrass meadows;
- To perform specific inventories on species at risk, bird colonies, shellfish beds, summer haul out areas for marine mammals, and fish spawning areas.

These studies would allow a better understanding of the use of the study area and would allow to better mitigate impacts on those species. Cree and Inuit community consultations will also be extremely important.

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APPENDIX

A LAWS, REGULATIONS AND PERMITTING REQUIREMENTS

APPENDIX

LAWS, REGULATIONS AND PERMITTING REQUIREMENTS

Development of harbours in the Eeyou marine region implies various issues regarding to laws and regulations, and environmental components. The main issues identified are :

- Potential impacts on Fish habitat (lost of surface area and changes in quality and dynamics);
- Introduction of pollutants and contamination;
- Introduction of aquatic invasive species;
- Traditional uses (marine mammals harvesting activities, hunting and fishing) and consultation of Indigenous communities.

The following sections present some articles of laws and regulations related to these issues.

FISHERIES ACT (R.S.C., 1985, C. F-14)

The purpose of this Act is to provide a framework for the proper management and control of fisheries; and the conservation and protection of fish and fish habitat, including by preventing pollution.

2.3 This Act is to be construed as upholding the rights of Indigenous peoples recognized and affirmed by section 35 of the *Constitution Act, 1982*, and not as abrogating or derogating from them. (2019, c. 14, s. 3)

2.4 When making a decision under this Act, the Minister shall consider any adverse effects that the decision may have on the rights of the Indigenous peoples of Canada recognized and affirmed by section 35 of the *Constitution Act, 1982*.

35.1 (1) The Minister may designate, as a work, undertaking or activity that is associated with a designated project, any work, undertaking or activity that the Minister considers likely to result in the death of fish or the harmful alteration, disruption or destruction of fish habitat.

Work, undertaking or activity designated by Minister

(2) The Minister shall designate any work, undertaking or activity that is part of a designated project and that the Minister considers likely to result in the death of fish or the harmful alteration, disruption or destruction of fish habitat.

Issuance of permit

(3) The Minister may issue a permit to carry on any work, undertaking or activity designated under subsection (2) and attach any conditions to it.

Prohibition

(4) No person shall carry on any work, undertaking or activity that is designated under subsection (2) except in accordance with a permit issued under subsection (3).

Ecologically significant area

35.2 (1) No person shall carry on a work, undertaking or activity prescribed under paragraph (10)(a) or that belongs to a prescribed class under that paragraph, in an ecologically significant area except in accordance with an authorization issued under subsection (7).

APPENDIX

35.2 (3) Any person who proposes to carry on a work, undertaking or activity referred to in subsection (1) in an ecologically significant area shall provide the Minister with any document and other information that is required by

regulation in respect of the prescribed work, undertaking or activity, or the water, place, fish or fish habitat that is likely to be affected by the prescribed work, undertaking or activity

Throwing overboard of certain substances prohibited

36 (1) No one shall (a) throw overboard ballast, coal ashes, stones or other prejudicial or deleterious substances in any river, harbour or roadstead, or in any water where fishing is carried on; (b) leave or deposit or cause to be thrown, left or deposited, on the shore, beach or bank of any water or on the beach between high and low water mark, remains or offal of fish or of marine animals; or (c) leave decayed or decaying fish in any net or other fishing apparatus.

OCEANS ACT

The *Oceans Act* provides a framework for modern and future ocean management initiatives. It is designed to be implemented in such a way that it provides policy direction for an integrated approach to ocean management, coordination of policies and programs across governments and an ecosystem approach to ocean resource management and environmental assessment.

Integrated management plans

Development and implementation of strategy

29 The Minister, in collaboration with other ministers, boards and agencies of the Government of Canada, with provincial and territorial governments and with affected aboriginal organizations, coastal communities and other persons and bodies, including those bodies established under land claims agreements, shall lead and facilitate the development and implementation of a national strategy for the management of estuarine, coastal and marine ecosystems in waters that form part of Canada or in which Canada has sovereign rights under international law.

Principles of strategy

30 The national strategy will be based on the principles of

(a) sustainable development, that is, development that meets the needs of the present without compromising the ability of future generations to meet their own needs;

(b) the integrated management of activities in estuaries, coastal waters and marine waters that form part of

Canada or in which Canada has sovereign rights under international law; and

(c) the precautionary approach, that is, erring on the side of caution.

31 The Minister, in collaboration with other ministers, boards and agencies of the Government of Canada, with provincial and territorial governments and with affected aboriginal organizations, coastal communities and other persons and bodies, including those bodies established under land claims agreements, shall lead and facilitate the development and implementation of plans for the integrated management of all activities or measures in or affecting estuaries, coastal waters and marine waters that form part of Canada or in which Canada has sovereign rights under international law.

APPENDIX

Marine protected areas

35 (1) A marine protected area is an area of the sea that forms part of the internal waters of Canada, the territorial sea of Canada or the exclusive economic zone of Canada and has been designated under this section or section 35.1 for special protection for one or more of the following reasons:

(a) the conservation and protection of commercial and non-commercial fishery resources, including marine mammals, and their habitats;

(b) the conservation and protection of endangered or threatened marine species, and their habitats;

(c) the conservation and protection of unique habitats;

(d) the conservation and protection of marine areas of high biodiversity or biological productivity;

(e) the conservation and protection of any other marine resource or habitat as is necessary to fulfill the mandate of the Minister; and

(f) the conservation and protection of marine areas for the purpose of maintaining ecological integrity.

CANADA WILDLIFE ACT

The Act allows for the creation, management and protection of wildlife areas for wildlife research activities, or for conservation or interpretation of wildlife.

The purpose of wildlife areas is to preserve habitats that are critical to migratory birds and other wildlife species, particularly those that are at risk.

The *Wildlife Area Regulations* prohibits all activities that could be harmful to species and to their habitat, unless a permit is issued indicating the permitted activity.

Protected marine areas

4.1 (1) The Governor in Council may establish protected marine areas in any area of the sea that forms part of the internal waters of Canada, the territorial sea of Canada or the exclusive economic zone of Canada.

Endangered Wildlife

Measures for protection

8 The Minister may, in cooperation with one or more provincial governments having an interest therein, take such measures as the Minister deems necessary for the protection of any species of wildlife in danger of extinction. R.S., 1985, c. W-9, s. 8; 1994, c. 23, s. 10(F).

SPECIES AT RISK ACT

The *Species at risk Act* intend to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened. The following articles and paragraphs apply more specifically to La Grande Alliance harbour Proposed Infrastructure.

Aboriginal and treaty rights

3 For greater certainty, nothing in this Act shall be construed so as to abrogate or derogate from the protection provided for existing aboriginal or treaty rights of the aboriginal peoples of Canada by the recognition and affirmation of those rights in section 35 of the *Constitution Act, 1982*.

APPENDIX

Damage or destruction of residence

33 No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.

Destruction of critical habitat

58 (1) Subject to this section, no person shall destroy any part of the critical habitat of any listed endangered species or of any listed threatened species — or of any listed extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada — if

(a) the critical habitat is on federal land, in the exclusive economic zone of Canada or on the continental shelf of Canada;

(b) the listed species is an aquatic species; or

(c) the listed species is a species of migratory birds protected by the *Migratory Birds Convention Act, 1994*.

Protected areas

(2) If the critical habitat or a portion of the critical habitat is in a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, the Rouge National Urban Park established by the *Rouge National Urban Park Act,* a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act*, the competent Minister must, within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry, publish in the *Canada Gazette* a description of the critical habitat or portion that is in that park, area or sanctuary.

Habitat of migratory birds

(5.1) Despite subsection (4), with respect to the critical habitat of a species of bird that is a migratory bird protected by the *Migratory Birds Convention Act, 1994* that is not on federal land, in the exclusive economic zone of Canada, on the continental shelf of Canada or in a migratory bird sanctuary referred to in subsection (2), subsection (1) applies only to those portions of the critical habitat that are habitat to which that Act applies and that the Governor in Council may, by order, specify on the recommendation of the competent minister.

<u>Agreements and Permits</u>

Powers of competent minister

73 (1) The competent minister may enter into an agreement with a person, or issue a permit to a person, authorizing the person to engage in an activity affecting a listed wildlife species, any part of its critical habitat or the residences of its individuals.

Purpose

(2) The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that

(a) the activity is scientific research relating to the conservation of the species and conducted by qualified persons;

(b) the activity benefits the species or is required to enhance its chance of survival in the wild; or

(c) affecting the species is incidental to the carrying out of the activity.

APPENDIX

Pre-conditions

(3) The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that

(a) all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted;

(b) all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and

(c) the activity will not jeopardize the survival or recovery of the species.

Explanation in public registry

(3.1) If an agreement is entered into or a permit is issued, the competent minister must include in the public registry an explanation of why it was entered into or issued, taking into account the matters referred to in paragraphs (3)(a), (b) and (c).

Consultation

(4) If the species is found in an area in respect of which a wildlife management board is authorized by a land claims agreement to perform functions in respect of wildlife species, the competent minister must consult the wildlife management board before entering into an agreement or issuing a permit concerning that species in that area.

Consultation

(5) If the species is found in a reserve or any other lands that are set apart for the use and benefit of a band under the *Indian Act*, the competent minister must consult the band before entering into an agreement or issuing a permit concerning that species in that reserve or those other lands.

Terms and conditions

(6) The agreement or permit must contain any terms and conditions governing the activity that the competent minister considers necessary for protecting the species, minimizing the impact of the authorized activity on the species or providing for its recovery.

MARINE MAMMAL REGULATIONS

All marine mammals are subject to the provisions of the *Marine Mammal Regulations* under the *Fisheries Act*. Under this regulation:

7 (1) No person shall disturb a marine mammal except

(a) when carrying on a work, undertaking or activity that is authorized, otherwise permitted or required under the Act;

(b) when fishing for marine mammals under the authority of these Regulations;

(c) in the manner set out in a licence issued under the Fishery (General) Regulations authorizing them to fish for marine mammals for experimental, scientific, educational or public display purposes; or (d) in the manner authorized under the *Species at Risk Act.*

APPENDIX

Marine Mammal Disturbance

Authorized Disturbance

38 (1) Despite sections 7 and 7.2, the Minister may authorize the disturbance of marine mammals if it is established that the activity causing the disturbance

(a) could benefit marine mammals without jeopardizing the survival of the species in the wild;

(b) could improve a marine mammal's immediate chance of survival;

(c) would contribute to the conservation and protection of marine mammals;

(d) could ease the pain and suffering of a marine mammal that is in distress;

(e) would contribute to marine scientific research; or

(f) would permit the production of audiovisual records of activities of marine mammals, which could facilitate a better understanding of marine mammals and thereby contribute to their conservation and protection.

(2) The authorization may be subject to any condition respecting

(a) the waters in which marine mammals may be disturbed;

(b) the marine mammals that may be disturbed;

(c) the period during which marine mammals may be disturbed;

(d) the type, size, number and identification of vehicles that are permitted to be used and the persons who are permitted to operate them;

(e) the manner in which those vehicles are to be operated, including the distance they are required to maintain from marine mammals, their speed and direction and the requirement to avoid impeding the path of marine mammals;

(f) the manner in which marine mammals may be disturbed and the measures that are required to mitigate or minimize the negative effects of disturbing them;

(g) the diagnostic assessment or any other assessments that are to be carried out in respect of marine mammals before, during and after the disturbance;

(h) the information that must be reported to the Minister, as well as the method by which, the times at which and the person for whom the report is to be made; and

(i) the records that must be maintained with respect to the activity causing the disturbance as well as the manner and form in which the records are to be maintained, the times at which and the person for whom the records are to be produced and the period for which the records are to be retained.

APPENDIX

MIGRATORY BIRDS CONVENTION ACT, 1994

Canada seasonally hosts approximately 450 species of native birds, the majority of which are protected under the *Migratory Birds Convention Act, 1994*, and are collectively referred to as "migratory birds." *The Migratory Birds Convention Act, 1994,* provides for the protection of migratory birds through the *Migratory Birds Regulations* and the *Migratory Birds Sanctuary Regulations*.

12 (1) The Governor in Council may make any regulations that the Governor in Council considers necessary to carry out the purposes and provisions of this Act and the Convention, including regulations

(a) providing for the periods during which, and the areas in which,

(i) migratory birds may be killed, captured or taken,

(ii) nests may be damaged, destroyed, removed or disturbed, or

(iii) migratory birds or nests may be bought, sold, exchanged, given or made the subject of a commercial transaction;

(b) for limiting the number of migratory birds that a person may kill, capture or take in any period when doing so is permitted by the regulations, and providing for the manner in which those birds may then be killed, captured or taken and the equipment that may be used;

(c) respecting the possession of migratory birds and nests that have been killed, captured, taken or removed in accordance with the regulations;

(d) for granting permits to kill, capture, take, buy, sell, exchange, give or possess migratory birds, or to make migratory birds the subject of a commercial transaction;

(e) for granting permits to remove or eliminate migratory birds or nests where it is necessary to do so to avoid injury to agricultural interests or in any other circumstances set out in the regulations;

(f) respecting the issuance, renewal, revocation and suspension of permits;

(g) for regulating the shipment or transportation of migratory birds from one province to another province or country and providing for the imposition of conditions governing international traffic in migratory birds;

(h) for prohibiting the killing, capturing, injuring, taking or disturbing of migratory birds or the damaging, destroying, removing or disturbing of nests;

(h.1) respecting the conditions and circumstances under which migratory birds may be killed, captured, injured, taken or disturbed, or nests may be damaged, destroyed, removed or disturbed;

(i) prescribing protection areas for migratory birds and nests, and for the control and management of those areas;

(i.1) respecting documents, records and data that any person or vessel or class of persons or vessels is required to keep or provide under this Act;

(i.2) excluding from the application of any provision of this Act or the regulations a military vessel, a naval auxiliary vessel or a vessel that is owned or operated by a state while it is being used only on government non-commercial service;

(j) for charging fees for permits, leases, stamps or other authorizing documents required to carry on any activity under this Act or the regulations, and for determining the amount of the fees and the terms and conditions under which they are to be paid;

(j.1) defining, for the purposes of this Act, any word or expression that is used in this Act and is not defined;

(k) authorizing the Minister to vary or suspend the application of any regulation made under this Act if the Minister considers it necessary to do so for the conservation of migratory birds; and

(l) designating provisions of the regulations for the purposes of paragraphs 13(1)(c) and 13.03(1)(b).

APPENDIX

AQUATIC INVASIVE SPECIES REGULATIONS

The *Aquatic Invasive Species Regulations* help protect waterbodies all across Canada by preventing the spread and introduction of aquatic invasive species into Canadian waters and managing them once introduced. Under these regulations:

- **6/7/8/9** It is prohibited for any person to import/transport/release or engage in any activity that may lead to the release of, members of a species set out in Part 2 of the schedule […].
- **10** It is prohibited for any person to introduce an aquatic species into a particular region or body of water frequented by fish where it is not indigenous unless authorized to do so under federal or provincial law.

Table 1 Schedule Part 2 - Species Subject to Prohibitions and Controls

COMMON NAME	SCIENTIFIC NAME
Grass carp	*Ctenopharyngodon idella*
Bighead carp	*Hypophthalmichthys nobilis*
Silver carp	*Hypophthalmichthys molitrix*
Black carp	*Mylopharyngodon piceus*
Zebra mussel	*Dreissena polymorpha*
Quagga mussel	*Dreissena bugensis*

Table 2 Schedule Part 3 - Species Subject to Controls Only in Areas Where They Are Not Indigenous

COMMON NAME	SCIENTIFIC NAME
Club tunicate	*Styela clava*
Vase tunicate	*Ciona intestinalis*
Golden Star tunicate	*Botryllus schlosseri*
Violet tunicate	*Botrylloides violaceus*
Didemnum	*Didemnum vexillum*
Bloody red shrimp	*Hemimysis anomala*
European green crab	*Carcinus maenas*
Chinese mitten crab	*Eriocheir sinensis*
Smallmouth bass	*Micropterus dolomieu*
Largemouth bass	*Micropterus salmoides*
Northern pike	*Esox lucius*
Pumpkinseed	*Lepomis gibbosus*
Walleye	*Sander vitreus*
Yellow perch	*Perca flavescens*

APPENDIX

CANADA SHIPPING ACT, 2001 (S.C. 2001, C. 26)

Regulations exist regarding transport of oil substances and other pollutants sources.

Canada adheres to many International Conventions regarding shipping and transport by ship, namely:

- *International Convention for the Prevention of Pollution from Ships (MARPOL)* that prevent pollution of the marine environment by ships from operational or accidental causes.
- *International Convention on the Control of Harmful Anti-fouling Systems on Ships* that prohibits harmful anti-fouling paints.
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)* that aims to prevent the spread of harmful aquatic organisms from one region to another.

BALLAST WATER REGULATIONS (SOR/2021-120)

The *Ballast Water Regulations* aim to reduce the spread of aquatic invasive species within Canada, as well as their transfer from Canada to other countries, and to help protect global biodiversity.

The new regulations, introduced in 2021, mark a transition from the traditional method of ballast water management (the exchange of ballast water in mid-ocean) to the use of modern ballast water management systems (which clean ballast water of organisms before release).

Canadian ships travelling abroad and those coming into Canada from abroad are now required to meet standards by 2024.

To increase environmental protection for sensitive Canadian fresh waters, vessels arriving in these waters from another country will exchange their ballast water in mid-ocean in addition to using a ballast water management system.

Annex.14 (1) A vessel that enters waters under Canadian jurisdiction from waters other than the United States' waters of the Great Lakes Basin and that conducts ballast water management to meet the ballast water exchange standard must conduct the exchange

(a) in an area that is at least 200 nautical miles from the nearest land and where water depth is at least 2,000 m;

(b) in an area described in, and in accordance with, regulation B-4.1 of the Annex, if the vessel cannot meet the requirements of paragraph (a); or

(c) in one of the alternate ballast water exchange areas designated by the Minister in TP 13,617, if the vessel cannot meet the requirements of paragraph (a) or (b).

REVIEW BOARDS

The impact process is reviewed in technical note 2. However, there are also specific review boards for the marine study area.

When the *Eeyou Marine Region Land Claims Agreement* (EMRLCA) and the *Nunavik Inuit Land Claims Agreement* (NILCA) came into action, wildlife boards were created to manage wildlife and regulate access to wildlife in their respective and shared marine regions (EMR and NMR). The Eeyou Marine Region Wildlife Board (EMRWB) and the Nunavik Marine Region Wildlife Board (NMRWB) have a responsibility to determine wildlife research priorities and support wildlife research in their regions, respectively.

EMRLCA and NILCA also established impact review boards that have the responsibility to evaluate the environmental and socio-economic impacts of development projects within the EMR and the NMR.

Thus, anyone who aims to develop a project in the EMR or the NMR will have to conform with the regimes and processes established under the EMRLCA and the NILCA, including the regimes for the protection of wildlife, land use planning, and the impact review of development projects.

APPENDIX

B

EEYOU MARINE REGION WILDLIFE BOARD LETTER

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EEYOU MARINE REGION WILDLIFE BOARD
CONSEIL DE GESTION DES RESSOURCES
FAUNIQUES DE LA RÉGION MARINE D'EEYOU
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P.O. Box 580
6 Chief Isaiah Salt Rd.
Waskaganish, Quebec
J0M 1R0

Tel: 819-895-2262
Fax: 819-895-2474

March 31st, 2022

Julie Malouin, Marine Biologist, B. Sc.
WSP Canada Inc. 1890, avenue Charles-Normand
Baie-Comeau (Québec) G4Z 0A8

Re: Information request regarding environmental data as part of a pre-feasibility study for La Grande Alliance

Dear Julie Malouin,

Below you will find the EMRWB's response to your request for information and general concerns regarding the potential impacts of phases II/III of the La Grande Alliance project. Our organization is mandated to store information regarding marine wildlife in the Eeyou Marine Region and Eeyou Marine Region Cree/Inuit Overlap Joint Zones, and thus we can only comment on one aspect of the project, which is the proposed deep-water port near Whapmagoostui/Kuujjuarapik. In our response, we have carefully considered the potential impacts of deep-water port construction and potential year-round port function on marine ecosystem dynamics and Cree/Inuit harvesting rights. We have outlined our concerns by species or species groups below.

Polar Bear

The Southern Hudson Bay (SHB) polar bear population is present in the area surrounding Whapmagoostui/Kuujjuarapik year-round (EMRWB, 2020; Laforest, 2018). During aerial surveys, it was observed that of the total SHB polar bear population (943) few were found in the areas stretching from Pointe Louis XIV to north of Inukjuak (Obbard et al., 2015). However, local knowledge tells a different story, as local land users have observed that abundance of polar bear has increased locally and are found in the vicinity of the community, along the coast, south and north of the community, inland, and on many of the nearshore islands close to the community (Laforest, 2018). Additionally, local land users have noted that polar bears den in the vicinity of town, with participants classifying den sites as being in areas of deep snow, far from human activity (e.g., snow machines), and close to the shore (Laforest, 2018). The construction and function of a deep-water port could impact polar bear behaviour and reproductive success through disturbance of ice regimes, feeding locations, and denning locations (COSEWIC. 2018). In terms of harvesting impacts, 6-7 polar bears are harvest annually in the Whapmagoostui/ Kuujjuarapik area (NMRWB, 2018) and the construction and use of a deep seaport could impact harvesting success and rights along the eastern Hudson Bay coast.

Beluga

The Eastern Hudson Bay (EHB) beluga population spend June-October near Whapmagoostui in the major rivers Little Whale River and Nastapoka River (respectively located about 100 km and 200 km north-west of Whapmagoostui) and coastal areas ranging from 0-75 km offshore, any activities in these waters have potential to impact the EHB population (Lewis et al., 2009; Breton-Honeyman et al., 2016; COSEWIC, 2016). Additionally, construction and shipping in the area have potential to impact the EHB beluga population through impacts on near shore feeding environments and prey species (sculpin, cod, salmon, crustaceans) (Breton-Honeyman et al., 2016), noise pollution (Chion et al., 2021), and introduction and transmission of disease (COSEWIC, 2020). In terms of harvesting impacts, harvest of EHB Beluga is open for Inuit hunters near Whapmagoostui and the construction and use of a deep seaport could impact harvesting success and rights along the eastern Hudson Bay coast (NMRWB & EMRWB, 2020).

Fish

Eastern Hudson Bay and the Great Whale Estuary host ecologically and culturally significant fish communities. The most common fish species found in the estuary include longnose sucker, lake cisco, brook trout, round cisco, and fourhorn sculpin (Hydro-Quebec, 1991; 1993). Species found in the Great Whale River include round whitefish, brook trout, lake whitefish, lake cisco and northern pike (Kemp, 1988). Presence of spawning grounds for lake cisco, brook trout, sucker, stickleback, round whitefish have been reported in the lower section of the Great Whale River, below the Amitapanuch waterfalls, located about 13 km from the river mouth (Consortium Gilles Schooner et al., 1991). Additionally, a study on fish larval drift held around ice breakup in and outside the plume of the Great Whale River found that Arctic cod and sand lance were the most abundant larvae; Arctic shanny, burbot and sculpins were also present (Gilbert et al., 1992). A deep seaport near the Great Whale River and the presence of ships in the area could potentially impact the spawning activity, as well as the fish larvae that subsequently drift down the river to grow in the Bay. Other culturally relevant species that occur near Whapmagoostui but are understudied include Atlantic salmon, Arctic char, capelin, and sardines. Atlantic salmon is not widely distributed and is limited to the Nastapoka River and adjacent coastal areas (CGSASAI 1991f; Morin 1991; Verdon 2001). Arctic char are not recorded as a resident species and are not known to spawn near Whapmagoostui, however, when caught they are of great cultural and economic value (Scott and Crossman 1973; CGSASAI 1991a; Bernatchez and Giroux 2000; Verdon 2001). In terms of harvest, cisco, whitefish, trout, pike, Atlantic salmon, Arctic char, capelin and sardines are all culturally significant species and any alteration to water quality, flow, habitat quality or prey species could impact Cree/Inuit harvesting rights (EMRWB, 2018).

Migratory Birds

Several federally listed at-risk birds have breeding or stopover territory in the eastern Hudson Bay region including the bank swallow, harlequin duck, Barrow's goldeneye, red-necked phalarope, red not, rusty blackbird, short-eared owl, buff-breasted sandpiper, and peregrine

falcon (COSEWIC). Additionally, several culturally significant birds have breeding or stopover territory in the eastern Hudson Bay region including arctic tern, sea ducks (scoter, eider, mergansers), snow goose, brant goose, Canada goose, common loon, and other duck species (mallard duck, American black duck, green-winged teal, northern pintail). Additionally, the Great Whale River basin is listed as an Important Bird Area. Several studies have identified important breeding, moulting, staging, and feeding sites for specific species within the eastern Hudson Bay region (Henri et al., 2020, Lamb et al., 2019, Brown et al., 2017). Multiple studies have demonstrated that repeated human-related disturbance, including boats, can negatively affect shorebirds, disrupting behaviour patterns and affecting energy balance. (COSEWIC, 2020). Activities related to construction or shipping in relevant habitats (open water, coastline, tidal habitat, marshes, steep banks, waterfowl feeding grounds) could have impacts on federally listed at-risk or culturally significant species. In terms of harvesting impacts, culturally significant birds are frequently harvested in the region, additionally, many species eggs are harvested for consumption. Any alteration to important stopover, breeding, or feeding habitat could have implications for harvesting success.

Seals

Ringed seals are widely distributed throughout Hudson Bay, relying heavily on sea ice near open water polynya in the winter and open water areas and rivers near the coast throughout the summer. Single ringed seal pups are born between March and May, in a birth lair that has been excavated by their mother, above a breathing hole in a snowdrift. (COSEWIC, 2020). Ringed seals thrive under a limited set of environmental conditions and rely heavily on capelin and cod as prey sources (COSEWIC, 2020; Ferguson et al., 2017), any alterations to seal habitat or prey could impact the species success. Additionally, small populations of harbour seals and bearded seals are present in the eastern Hudson Bay region. Little research has been done on these species in eastern Hudson Bay, but habitat disruption, construction and boat traffic could have impacts on the bearded seal population (Protection of the Arctic Marine Environment).

Walrus

In the literature, the Atlantic walrus is recorded to occur mostly on the offshore islands of eastern Hudson Bay, however, local knowledge suggests that they occur in small numbers along the coast and near offshore environments of eastern Hudson Bay. Walruses occupy a relatively small ecological niche, requiring large areas of shallow water (80 m or less) with productive bivalve communities, open water over these feeding areas, and suitable ice or land nearby upon which to haul out (COSEWIC, 2017). The disturbance of ice regimes, prey species and the introduction of human or shipping presence could impact walrus success and result in habitat abandonment (COSEWIC, 2017). In terms of harvesting, 30-60 Atlantic walrus are hunted per year for the entirety of Nunavik. There is currently no reported harvest in eastern Hudson Bay suggesting that the development of a deep seaport will not impact current harvesting practices.

General Concerns

In addition to species specific concerns, the EMRWB has identified several general wildlife concerns. First, the potential to introduce invasive species due to increased ship presence and construction (Goldsmit et al., 2021; Goldsmit et al, 2014). Additionally, the potential of altering primary production (phytoplankton, algae) due to the disturbance of ice regimes and introduction of new material could have implications at the base of the food web, impacting prey items for species in higher trophic levels (Nozais et al., 2021). Finally, there is reason to be concerned about the potential introduction of toxic materials and mobilization of contaminants through spills and disturbance of sediments and soils throughout construction and shipping processes.

Please find attached a folder containing a list of relevant publications sorted by marine species/groups and sub-folders containing the relevant publications.

In conclusion, the EMRWB has many concerns about the impacts of deep-water port construction and function on marine ecosystems and Cree/Inuit harvesting rights. We appreciate WSP's and CDC's commitment to minimise the impacts of this project and are looking forward to engaging with the project proponents as it develops. Please feel free to contact us to follow up on any of the materials provided or for further questions.

Sincerely,

Angela Coxon
Wildlife Director
Eeyou Marine Region Wildlife Board

c.c. Gordon Blackned, EMRWB Chairperson
Stephanie Varty, EMRWB Wildlife Management Biologist
Felix Boulanger, EMRWB Wildlife Management Biologist

Attachments:

WSP Data Request.zip
20220331_EMRWB_Relevant_Publications.docx