

# The Beaufort Sea: Water, Ice and Life

## PLAIN LANGUAGE SUMMARY

*of the*

Beaufort Sea Ecosystem Overview  
Volume One: Status and Trends





January and is above the horizon all day from late May to mid-July. At these times the area can get quite warm. The ocean actually influences coastal temperatures quite a bit. In the spring the ocean is cooler than the land and this slows spring break-up. In the fall the ocean is warmer than the land and delays freeze-up.

## MAJOR INFLUENCES

Many different things affect the environment in the Beaufort Sea. Things like the water temperature, oxygen levels in the water, the amount of nutrients, sediment and light that gets into the water and how salty the water is. There are three major influences that drastically affect the ecosystem in the Beaufort Sea, especially the Southern part. These are:

- (1) the Mackenzie River freshwater plume – which changes salt levels, brings sediments and nutrients
- (2) sea-ice – provides new ground for humans and animals to travel on and stops the sunlight from entering the water
- (3) polynyas – large open water areas in the sea-ice where there is much food for animals

Other influences include upwellings, which are areas where water and nutrients from deeper waters move to the surface. Ocean currents can also affect salinity and nutrient levels. The Beaufort Gyre is the main current in the Beaufort Sea. It circles clockwise from Banks Island towards the delta area.

### *1) The Mackenzie River Freshwater Plume*

Huge amounts of freshwater are carried by the Mackenzie River into the Beaufort Sea every day. Although the flow is highest in the summer, the river is continuously flowing. Even during the winter water flows under the ice.

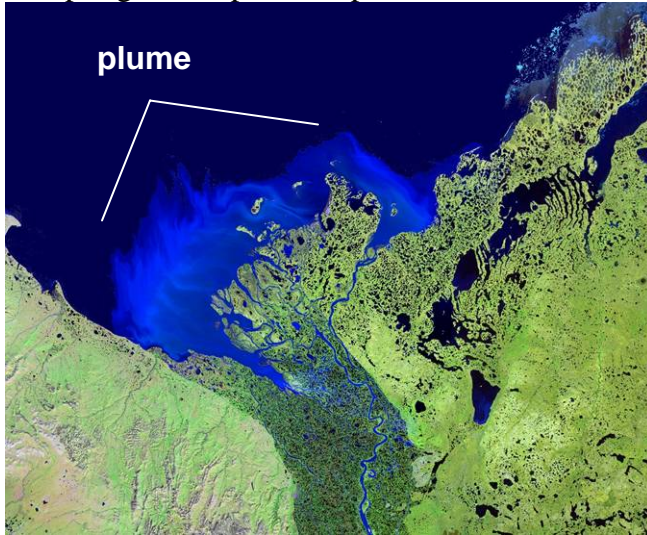
### *Salt Levels (Salinity)*

The freshwater entering the ocean causes different salt layers to form. In summer the surface layer tends to be quite fresh and can be anywhere from 5-10 m deep. The middle layers are somewhat salty and the deepest layers are the saltiest seawater. The depths of each of the layers is different from season to season. In the winter a large *floating* freshwater lake forms under the nearshore ice to a depth of around 30 metres. It is held in place by the *stamukhi* (ice ridges) which occasionally reaches to the seafloor and traps it in place. In the spring this water is washed away by the spring floods which bring a lot of sediment and nutrients into the Beaufort Sea

### *Sediments (Turbidity) and Nutrients*

The Mackenzie River is the biggest source of sediments and nutrients entering the Beaufort Sea. In fact, it is the most sediment rich river in the Arctic. But, some sediment does enter the waters from shoreline erosion. Some shores are eroding as much as one metre (3 feet) per year. But that is very little compared to the 130 million tones of sediment that the river carries every year. The sediment/water layer can be as much as

five metres thick. All this sediment makes the water look darker and especially during the spring the shape of the plume can be seen. The plume can extend up to about 400 km



from the shore during westerly winds. During easterly winds the plume will blow along the Tuktoyaktuk peninsula.

One bad thing about the plume is that light can not pass through the water when it has a lot of sediment in it. Plants cannot grow if there is not enough light.

## 2) *Sea-ice*

Sea-ice is important in the ecosystem. Ice lessens the amount of light that enters the waters of the Beaufort Sea. Microscopic plants in the ocean need the light and during the winter they can not grow. The ice provides a path for animals and people to travel on and hunt on and stops some animals from getting air.

Ice also helps form the ocean's different salty layers. In the Northern parts of the Beaufort Sea ice begins to melt around the leads. Melting ice forms a freshwater layer at the top of the ocean. In June, as the ice melts it adds to the freshwater coming from the plume. In October the water begins to freeze again, starting with the landfast ice along the coast. Freezing continues, moving out into the ocean and freeze-up is usually complete by the end of November. As the first-year pack ice is freezing it releases a very heavy saltwater that sinks to the sea-floor. As the saltwater sinks it mixes up the water, causing nutrients to move closer to the surface and become available to animals that live in this surface water.

At the edge of the landfast ice is stamuhki where the drift ice combines with the landfast ice. This ice is very jagged and can even gouge holes into the seafloor. Usually, beyond the stamuhki is a polynya and beyond that is the first-year pack ice followed by multiyear pack ice.

## 3) *Polynyas (open water)*

Polynyas are large areas of year-round open water that occur between the stamuhki and the pack ice. In the Beaufort Sea the biggest polynya occurs off Cape Bathurst. The size of the Bathurst polynya can change in size 6000 km<sup>2</sup> to 25 000 km<sup>2</sup> in as little as 5 years. Polynyas are excellent habitat for mammals and birds. This is mostly because the

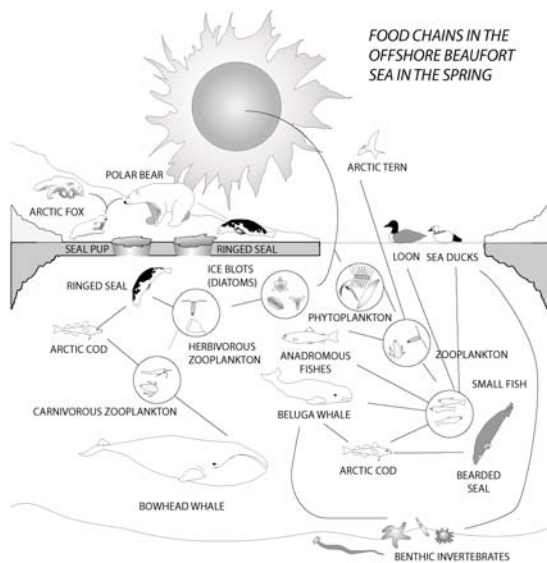
sunlight can enter the water. This means continued growth of microscopic life that these animals can feed on.

## Life in the Beaufort Sea

There are many different kinds of living things (organisms) that are very important for the survival of animals in the Beaufort Sea. A lot of this life you can only see with a microscope. This paper will look briefly at 5 types of microscopic life that live in the waters and are called plankton.

- (1) phytoplankton – microscopic plants that float around in the water;
- (2) *ice algae* – small plants that grow in, or on the top or bottom of sea-ice;
- (3) *bacterioplankton* – bacteria that live floating in water;
- (4) *zooplankton* – microscopic animals that also float around in the water;
- (5) *ichthyoplankton* – the young or *larval* forms of fish.

The microscopic animals (*zooplankton*) eat the ice algae, microscopic plants (*phytoplankton*) and bacteria. *Zooplankton* and small fish are eaten by fish and birds and some whales, like the bowhead whale. Marine mammals eat fish and crabs, while polar bears and foxes will eat some marine mammals. Because they eat each other, it is called a “*food chain*”.



People know a lot about big animals like polar bears, whales and fish, but we thought we would start talking about life by looking at the things people don't know much about. These things are *very* important for the existence of bigger animals.

### 1) *Phytoplankton*

*Phytoplankton* use the energy from the sun to grow. They have a very important role as they are one of the few life forms that can convert the sun's energy into food for *zooplankton*. There are over 100 different kinds (species) of

*phytoplankton*. Because they need sunlight to live they grow only in open water. In the winter, *phytoplankton* only grow in polynyas and only when the sun is above the horizon. The earlier break-up occurs, the more *phytoplankton* is produced in that year. In the spring where the sea-ice is melting *phytoplankton* grow very, very fast and there are huge numbers of them – this is called a “*phytoplankton bloom*”. After a bloom, they die and fall to the seafloor. In this way a huge amount of food (and nutrients) reaches the animals that live on the bottom.

Most phytoplankton live in the top five metres of water and where salt levels are low. There are about 5 times as many close to the shore compared to offshore. They do not grow well in the Mackenzie plume as very little light passes through all the sediment. Phytoplankton that grow offshore quickly use up all the nutrients and then they stop growing.

## 2) *Ice Algae*

Ice algae are microscopic plants like phytoplankton that need the sun's energy to grow. But, ice algae grow *in* or *on* sea ice. Ice algae provide a quarter of all the energy from plants in the Beaufort Sea. The highest numbers of ice algae are typically found on the bottom of first year landfast ice. In the spring, ice algae are almost the *only* food source for zooplankton. Ice algae begin to increase in late February and by mid-May the algae have reached a peak. Sometimes there is so much algae it shades the sunlight from reaching the phytoplankton. Animals can even feed on algae before summer when the phytoplankton grows. Animals on the seafloor can eat ice algae when it breaks off and sinks to the bottom.

## 3) *Bacteria*

Bacteria have a very important job of breaking down dead animals and plants in the oceans. They eat bits of floating dead organisms and they are eaten by zooplankton. Like phytoplankton, most bacteria probably prefer low salinity environments and are found near the coast. Some bacteria eat the dead organisms that the Mackenzie plume brings into the ocean. Bacteria are alive and active even when the sea ice covers the ocean. In fact there are similar amounts of bacteria in the Beaufort Sea as there is in warmer oceans in Canada.

## 4) *Zooplankton*

There are two types of zooplankton. One type eats plant-like organisms and the other type eats other zooplankton. There are more than 100 different species of zooplankton in the Beaufort Sea. Like the other micro-organisms they live in places that they prefer. Salt levels, different depths, different temperatures all affect where zooplankton are. For example, most zooplankton do not like to be inside the Mackenzie River plume. There are even different types of zooplankton during different parts of the year. When the phytoplankton numbers get very high, so do the numbers of plant eating zooplankton.

A lot of animals eat zooplankton. Fish, seals, birds and even the bowhead whale eat zooplankton making them very important to the ecosystem.

## 5) *Ichthyoplankton*

Ichthyoplankton are the eggs and larvae (young) of fish. They tend to be found in similar areas as the zooplankton. Both zooplankton and larval fish are blown around by the wind

and moved with ocean currents. They cannot control where they end up. Most of the larval fish found in southern Beaufort Sea are either young sculpins or young cod. Three types of cod larvae are found, Polar Cod, Saffron Cod and Arctic Cod.

## **Life on the Seafloor (Benthos)**

Animals that live on the seafloor are called “benthic invertebrates”. Benthic invertebrates include animals like crabs, starfish, snails, mussels, clams, octopus and worms. These animals mostly eat the zooplankton and bacteria mentioned above. Scientists have found almost 1000 different kinds of benthic animals. Different animals live in different parts of the seafloor. Again, where they live is affected by the plume of freshwater which changes salt and light levels and temperature. They are also affected by the presence of sea ice which can scrape the ocean floor and destroy seafloor habitats and when it melts the freshwater changes the salt levels. The number and type of animals increase as the water gets deeper and saltier. Harbours and shallow areas do not have very many different benthic invertebrates but they do have some larval insects – like flies. The highest numbers of animals occur past the areas where ice scrapes the sea floor, at depths between 60 and 100 metres.

In a few locations near Sachs Harbour and the Husky Lakes seaweed has also been found growing on the seafloor. But it is very rare. According to Inuvialuit knowledge seaweed also grows in protected bays along the Yukon North Slope.

## **Fish**

Many different kinds of fish are found in the Beaufort Sea LOMA. There are marine fish, which spend all their time in the cold offshore waters. These fish are not used much by the Inuvialuit but play a very important role in the food chain. There are also anadromous fish, which are fish that lay their eggs in freshwater like lakes and rivers but go to warm, somewhat salty coastal waters to feed and grow. There are also freshwater fish which stay in the lakes and rivers which are part of the Large Ocean Management Area. In this section the science knowledge and the traditional knowledge are combined to give a more complete picture of the lives of these fish.

### *Marine Fish*

There are around 71 different species of marine fish. The most commonly found species are Cod (uugaq and uugavik), Sculpins (kanayuq) and Snailfish. Some marine fish are very important to food chain in the Beaufort Sea. These are the Pacific Herring (piqqaqtitaq) and the Arctic Cod (uugaq).

Arctic Cod live in cold, offshore waters that have high salt levels. They do not get any bigger than a foot (30 cm) and only live to be about 7 years old. They eat zooplankton and young larval fish. They transfer the energy from the zooplankton to the bigger animals like belugas, seals and birds and big fish. There seem to be more Arctic cod in

the Beaufort Sea than any other fish. This makes them especially important. Half of what most marine mammals and birds eat is Arctic Cod.

### *Freshwater and Anadromous Fish*

There are many different kinds of freshwater and anadromous fish. Some that are very important to Inuvialuit and Gwich'in are Jackfish or Northern Pike, Cisco, Inconnu and Dolly Varden, Grayling and Whitefish. Most of these fish are found in coastal waters in the summer where there is a large food supply. The plume from the Mackenzie River makes the salt levels low enough for even some freshwater species to survive in nearshore waters. In the fall most fish return to the rivers to spawn, some over winter in rivers and lakes. Other fish that are found in the area are some different types of salmon, Rainbow Smelt (iqqaqtqaq) etc. Almost all of these fish, when they are young eat zooplankton and insect larvae. When they are somewhat older they eat benthic invertebrates and small fish. The bigger fish like Dolly Varden, eat full-size fish when they are adults. Smaller fish like Cisco continue eating benthic invertebrates and small fish when adults.

<b>Fish</b>	<b>Water</b>	<b>Over winter</b>	<b>Summer (food)</b>	<b>Spawn</b>	<b>Traditional Knowledge/ Interesting Info</b>
<i>Dolly Varden (iqalukpik)</i>	Both	Rivers holes with thermal springs	Feeding along coast ( <i>adults eat Arctic cod, sculpins</i> )	Run: Aug – Sept Spawn: Oct – Nov Bottom:	<i>If conditions bad, they go to different rivers</i>
<i>Inconnu (siiraq)</i>	Both	Deep bays along coast	Spawning in Mackenzie River	Run: June -Sept Spawn: June – Sept	Can migrate more than 100 km
<i>Broad Whitefish (anaakliq)</i>	Migrate only	Lakes or rivers	Feeding along the Coast ( <i>eat little shrimp, clams</i> )	Run: Fall Spawn: Sept – Nov Bottom:	<i>Small fish stay in lakes for a few years</i>
<i>Lake Whitefish (pikuktuuq)</i>	Both	Lakes or rivers	Feeding along the Coast ( <i>zooplankton and invertebrates</i> )	Run: Fall Spawn: Bottom:	Small fish stay in Mackenzie River for a few years
<i>Least Cisco</i>	Both	Lakes or rivers	Close to the coast, in water with low salt levels.	Run: August Spawn: late Sept – Oct Bottom: sand / gravel	Lake fish look different, heavier and darker
<i>Arctic Cisco (qaaktaq)</i>	Migrate only	Mackenzie river / Tuk. Peninsula	River/Coast – Some even found offshore.	Run: July-September Spawn: October Bottom: gravel	They spawn in areas with fast moving water
<i>Arctic Grayling (sulukopauqaq)</i>	Fresh	Mackenzie River	shallow water / deep channels	Run/Spawn: May to July	Adult fish eat insects that land on the water
<i>Northern Pike - Jackfish (siiraq)</i>	Fresh	Freshwater – rivers and lakes with a lot of plants under water		Spawn: spring/summer Bottom: water warm and slow moving	Adults eat fish, also eat rodents and ducklings
<i>Burbot (tiktaaliq)</i>	Mostly Fresh	Sometimes in deep, low salt level harbours			
<i>Sculpins (kanayuq)</i>	Fresh	Lakes and Streams of Mackenzie Delta			

## **Birds**

There are many, many species of birds that come through the area of the Beaufort Sea LOMA. Many birds nest in and along the coastal waters of the Beaufort Sea. Marine birds, such as ducks and gulls can also be found in offshore waters. They especially like the Cape Bathurst polynya.

### *Birds in Offshore Waters*

Many different birds including the Long Tail Duck, Red Throated Loon and the Glaucous Gull pass through the Beaufort Sea on their way to more northerly parts of the Arctic. King Eiders and Common Eiders go through in hundreds of thousands. In May to June they feed mainly in the early open waters of the Cape Bathurst polynya. They also pass through the Beaufort Sea on their way to moult feathers from June to August. And again when they return south during the fall migration. Young eiders fly through in late November. The open water areas are critical to their survival during migration.

### *Birds in Coastal Waters*

Many different species of birds come to the Mackenzie Delta area and along the shores of the Beaufort Sea to nest. These birds are here from June until freeze-up. They nest in coastal lagoons, bays, tidal marshes and on protected islands. Some of these species are Pacific Loons, Brants, Tundra Swans and Arctic Terns. Lesser Snow Geese, Black Guillemots, Common Eiders and Thick Billed Murres also nest in this area, but are not as common. All of these birds get their food from the ocean.

Also, more than 100 000 ducks come to the coastal waters of the Beaufort to lose and grow new flight feathers. Species that do this are Long-tailed ducks, White Winged Scoters, Surf Scoters, Scaups and Red-Breasted Mergansers. They come here because there are lots of benthic invertebrates for them to feed on.

## **Marine Mammals**

Marine mammals are the top of the food chain in the Beaufort Sea. Most of them eat fish – especially Arctic Cod. But some of them even eat tiny zooplankton. Marine mammals that live year round in the Beaufort Sea are the Bearded Seal, the Ringed Seal and the Polar Bear. Beluga whales and Bowhead whales come to the Beaufort Sea for long periods of time each year. All other marine mammals are only occasionally seen. Uncommon marine mammals are Killer Whales (aarluit), Narwhals, Gray Whales, Harbour Seals and Walrus (aiviq).

### *Beluga Whales (qilalukkat)*

There are more than 20 000 belugas that live in the Beaufort Sea during the summer. Beluga whales can be found both offshore and in coastal waters around the Mackenzie River. They have been found around Shallow Bay, Kendall Island and the southwest of

Kugmallit Bay. In the shallow, warm waters along the coast they feed and socialize. When they are offshore they feed mostly in the Amundsen Gulf and the McClure Strait.

Inuvialuit knowledge tells us that in bays the beluga eat herring, cisco, smelt, burbot and inconnu. When they are offshore they eat Arctic Cod, sculpins, Arctic char, shrimp, octopus and squid. The only animals that kill and eat belugas are humans, polar bears and sometimes killer whales.

In September the whales travel to the Bering Sea, between Alaska and Russia. They spend the winter in the Bering Sea. Mating takes place near the end of the winter and most belugas have their calves before they come to the Beaufort Sea. Some belugas have been known to calve along the coast in the Beaufort Sea. In April or May the whales leave the Bering Sea and travel back to the Beaufort Sea arriving in late May or early June to spend the summer.

#### *Bowhead Whales (arvit)*

There are two populations of bowhead whales in the world, both are in Arctic Canada. In 1993 there were about 8200 whales using the Beaufort Sea. This was about 90% of all the bowhead whales in the world! Bowhead whales eat zooplankton, they sieve them out of the water as they swim. Bowheads also spend their winters in the Bering Sea. They are usually found around the edges of the pack ice or in polynyas where the zooplankton go in the winter.

Bowhead begin to travel east to the Beaufort Sea in April and May. In late May or early June they reach the west coast of Banks Island. In early summer the bowheads are distributed throughout offshore waters in the Beaufort Sea and the Amundsen Gulf. But in late summer they go where all the zooplankton is. The zooplankton gets blown by wind, and carried by the plume to specific areas. The bowhead whales go to these areas to feed. There are three main areas. One is along the Yukon Coast between Kay Point and Shingle Point. Mostly juvenile whales feed here. Another spot is north east of the Tuktoyaktuk Peninsula. The adult whales all tend to feed in the Amundsen Gulf.

The whales start to leave the Beaufort in September and arrive back in the Bering Sea in November or December.

#### *Bearded Seals (ugyuit)*

Bearded seals are found year round in the Beaufort Sea. The last study of bearded seal population in the 1980s found that there were around 1700 seals. But the number of seals can change a lot from year to year. The population can drop or grow by as much as 2000 seals from one year to the next.

In the Beaufort Sea bearded seals are found off the mainland coast from the Alaska/Yukon border east to the Baillie Islands, in the Cape Bathurst polynya and on the western and southern coasts of Banks Island. They are almost always found in shallow

water areas close to sea-ice, leads or polynyas during the winter. They eat animals that live on the seafloor like shrimp, crabs, clams and sometimes fish. During the summer some seals will follow the pack ice north. The only animals that will kill and eat bearded seals are polar bears and walrus.

### *Ringed Seals (natchiit)*

Ringed seals are probably one of the most studied animals in the Arctic. This is partly because they are very important for the Inuit. It is also because they are *extremely* important in the food chain. Ringed seals eat zooplankton, shrimp and fish, especially Arctic Cod. The young ringed seals mostly eat fish and all ages eat mainly fish during the winter.

Ringed seal numbers change a lot from year to year. In fact, the population can increase or decrease by as much as 10 000 seals within one year. The latest ringed seal estimate for the Beaufort Sea was done in 1984 and estimated to be between 5000 and 7000 seals. But in 1982 there was a very high estimate of forty thousand seals.

The reason the population changes so much might have to do with sea ice. In years of heavy ice cover the seal population drops. In years where the ice breaks up early, ringed seals were in excellent condition. This is probably because ice affects what seals eat. In years with lots of ice hardly any *phytoplankton* can grow, which means that the zooplankton have nothing to eat. If there is not much zooplankton then the fish have nothing to eat. Because seals eat zooplankton and fish –their body condition is very bad, and not too many survive. This can also affect polar bears and Arctic Foxes that eat the ringed seal pups. Humans also use and eat ringed seals. Killer whales and walrus also kill and eat ringed seals.

Ringed seals mate between May and June. During this time they are still in their winter homes along the coast of the southern Beaufort Sea – where water is between 75 and 100 metres deep. Pups are born in mid-April of the following year. The ice breaks up in late June and the seals move to open water. In the late summer and early fall large groups of up to 20 seals come together in the open water, usually north of Tuktoyaktuk Peninsula and in the Amundsen Gulf. As the landfast ice forms in late fall adult seals move into coastal areas. They make breeding territories among the pressure ridges. When there is enough snow they can then make their lairs. There are some lairs for resting and others for giving birth. When the adults are busy setting up their territories the young seals leave. Maybe there is not enough food for them, or maybe they get chased away by adult seals. But they usually travel west to the Bering Sea area. There is open water there year round and they can continue to feed and grow quickly.

### *Polar Bear (nanuq)*

There are two different groups of polar bears that live in the Beaufort Sea, the southern group, and the northern group. The southern group live along the mainland coast from the Baillie Islands and west into Alaska. In 1998 there were about 1200 of the southern

polar bears. The northern groups dens along the coastlines of Banks Island and hunt off the western shores of Banks Island and in the Amundsen Gulf. These bears had a population of about 1800 bears in 1998. Polar bears in the Beaufort Sea breed when they are about 5 years old. The cubs stay with the mothers until they are about two and a half years old. Most of the dens are along the south and western coastlines of Banks Island. Dens are either made in multi-year ice or inland.

Polar bears mainly eat seals, especially ringed seals. In the 1970s and 1980s when there was heavy ice cover the number of seals declined and so did the health of polar bears. The number of new polar bears being born was way down.

Different types of polar bear hunt in different places. For example, female bears with new cubs prefer the landfast ice where the ringed seals have their pups. This is away from the male bears which might be dangerous to the cubs. All other bears, males, lone females and females with two year old cubs prefer to hunt around the floe edge. This is where non-breeding ringed seals and the bearded seals are found.

Polar bears move around during the different seasons. When the ice is present, bears usually hunt in the offshore leads east and west along the coast. They can usually be found around the Cape Bathurst polynya. Polar bears mate during April and May on the sea ice. When the summer comes they follow the pack ice north and hunt along the edges, but some bears will stay on land. The bears go south again as the ice freezes. Female polar bears build their dens during October and November. The cubs are born shortly after.

## **Missing information**

There is a lot that is unknown about many different things in the Beaufort Sea LOMA. First of all, not a lot is known about the Northern part of the LOMA, especially about the area North of Banks Island. In addition, science does not know very much about the Beaufort Sea during the winter time, because it is harder to study during the winter. A lot is known about polar bears, ringed seals and some other marine mammals. Much is also known about different kinds of fish. But most of what is known about fish is only from information gathered around the Mackenzie Delta itself.

There is very little known about the smallest plants and animals, like the zooplankton and the phytoplankton. The only information that exists about benthic invertebrates comes from bringing them to the surface. The same way, not enough is known about where seaweed grows. Is it in a lot of places, or only a few? Seaweed is very important to young fish and invertebrates so it is a good thing to know.

Finally there are still a lot of areas where traditional knowledge is missing. In most cases the information has not been collected yet. For example, there is no traditional knowledge included about marine mammals, birds or the freshwater plume. In time traditional knowledge and new observations will be included in this report.