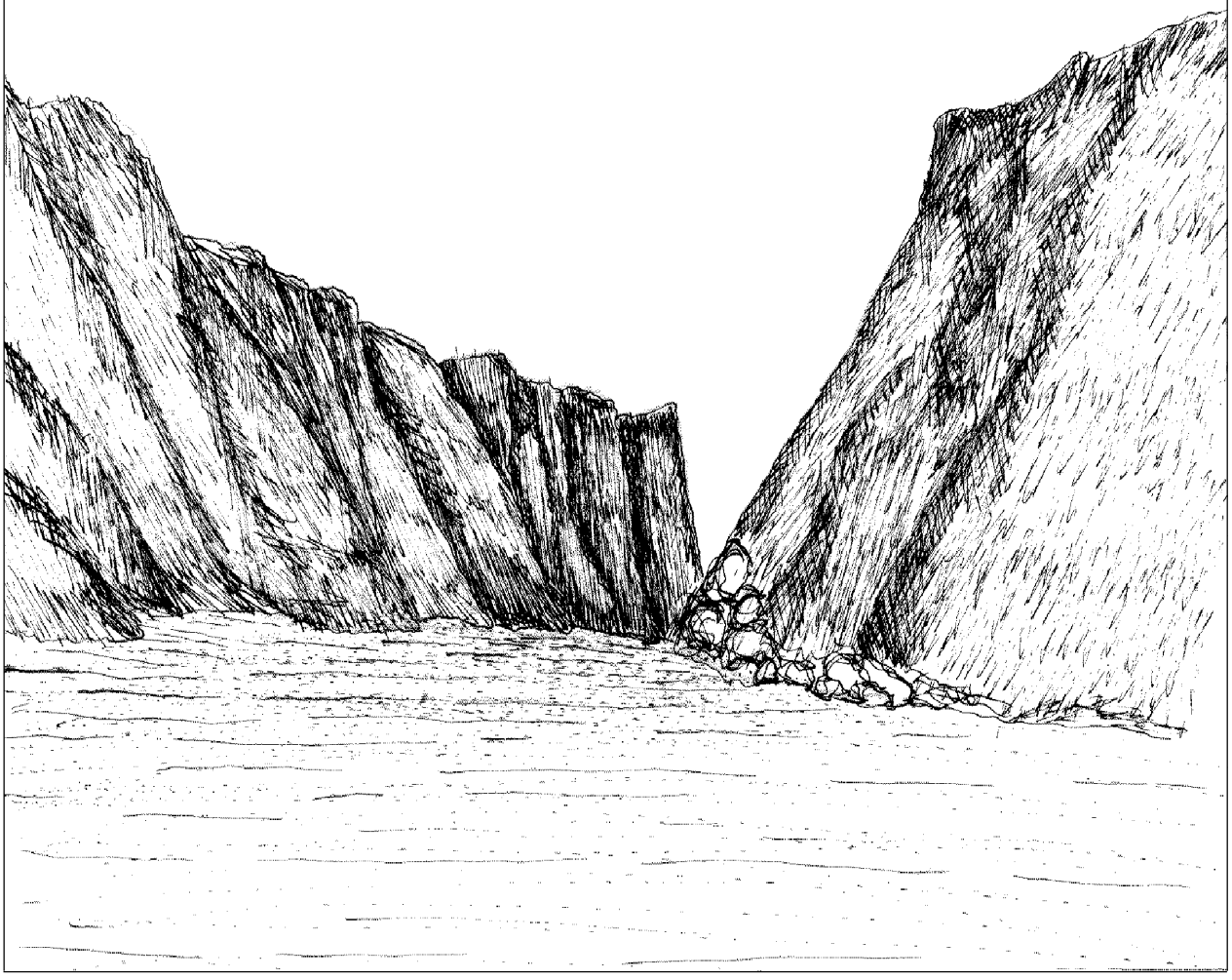
BY THE SEA

A GUIDE TO THE COASTAL ZONE OF ATLANTIC CANADA

MODULE 12: FJORDS



Canada

ACKNOWLEDGMENTS:

FUNDING: Department of Fisheries and Oceans, Environmental Partners Fund of Environment Canada

COORDINATORS: Roland D. Chiasson, Sabine B. Dietz

COORDINATORS, DFO: John A. Legault, Sophie Bastien-Daigle

MAIN AUTHORS: Mark Butler, Roland D. Chiasson, Richard W. Daury, Susan Dean, Sabine B. Dietz, Nancy MacKinnon, Jamie Steel

CONTRIBUTING WRITERS: Léon Lanteigne, Irene Novaczek EDITING: Anne Champagne (English)

LAYOUT: Sabine Dietz, Roland Chiasson

GRAPHICS: Sabine Dietz, Ursula Koch, Elke Leitner, Jean-Raymond Gallien (used with permission from the N.B. Department of Natural Resources and Energy)

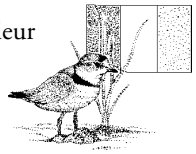
Comments and suggestions from the following people are gratefully acknowledged:

Diane Amirault, T.C. Anderson, Sophie Bastien-Daigle, François Bélanger, Mark Bonan, Yves Bourassa, David Boyce, Alyre Chiasson, Harry Collins, Simon Courtenay, Rosemary Curley, Ted Currie, Jean-Yves Daigle, Adrianne Dorrington, Ernest Ferguson, Phil Ferraro, John Foley, Christopher Hawkins, Denise Henson, Peter Hicklin, Bob Hooper, John A. Legault, Claude Léger, Maurice LeRoy, Allison M. Lowe, Don McAlpine, Mark McLean, Inka Milewski, Randy Milton, Michelle Parsons, Jon Percy, Jim Petrie, Terry Power, Rob Rainer, Lisa Richard, Pierrette Robichaud, Anne Senechal, Tom Sephton, Wendy Skeard, Bruce Smith, Rick Swain, Jacques Thibault, Jackie Waddell, Heather Walters, Judy White.

Également disponible en français.

Fisheries and Oceans / Pêches et Océans

Piper Project/Projet siffleur
4800 Route 11
Tabusintac, N.B.
E9H 1J6



ENVIRONMENTAL PARTNERS FUND
Environment Canada / Environnement Canada
PARTENAIRES DE L'ENVIRONNEMENT

Department of Fisheries and Oceans
Habitat Management Division
343 Archibald Street
Moncton, N.B.
E1C 9B6

Prepared by: Corvus Consultants Inc.,
Tabusintac, N.B., Canada

Cat. no. S-23-289/1996 E ©1996
ISBN 0-660-16410-8

THE MODULES

TABLE OF CONTENTS

FJORDS

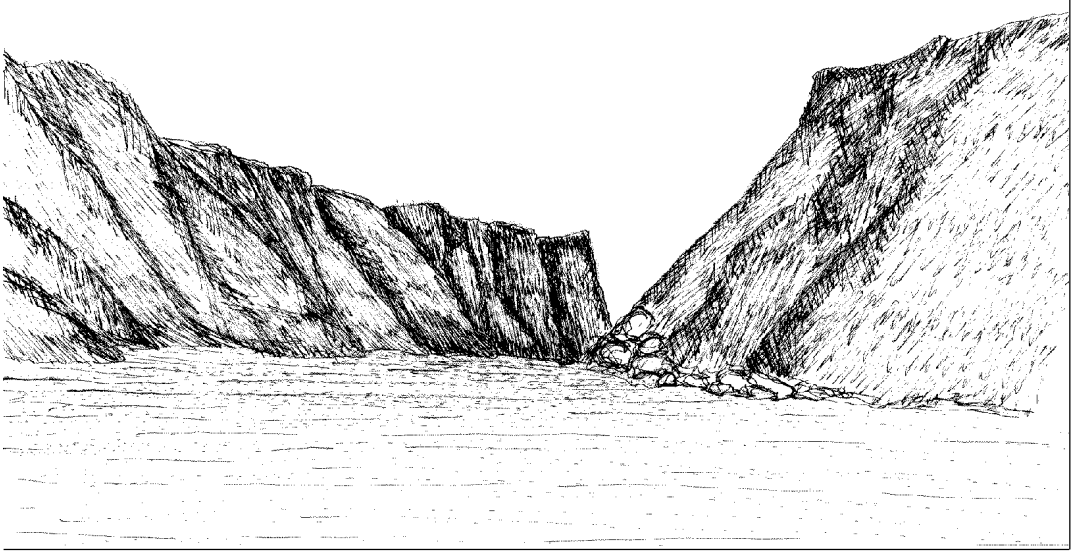
What is a Fjord?

Fjords are deep, glacially carved valleys now flooded by the sea. They are found in northern mountainous areas along the coast, where rivers meet the ocean. Most fjords have towering rocky walls, some with thick woods and roaring waterfalls. Others have small stretches of fertile soil, beach or gravel ridges lying below the fjord wall.

A fjord's steep walls fall far below the surface of the water, making the fjord inlet very deep. Fjords are sometimes called 'inland seas' because of their deep marine basins. Some fjords in Eastern Canada are up to 500 metres deep.

Fjords are also often characterized by a shallow underwater ridge at their mouth called a sill. The sill limits the extent to which deep ocean water can enter the fjord, creating a highly stratified layering in the fjord basin.

These deep 'inland seas' along the coastal zone of Atlantic Canada provide habitat for a unique variety of plants and animals that live and feed at the mouth of the fjord and in the fjord basin.



The Fjord within the Coastal Zone

Fjords play an important role in the coastal zone of Atlantic Canada. Like all estuaries, they are a link between freshwater and saltwater habitats. What makes fjords unique is that they provide a semi-enclosed ecosystem with similar biological properties to the outer ocean. The planktonic animal life in deep fjords is often similar to what is found in the pelagic (i.e. floating in the water) level of the open ocean.

Some fjords have very cold water, which provides habitat for a unique variety of arctic species of plants and animals not normally found in adjacent coastal ecosystems.

Researchers take advantage of the similarities between deep fjords and pelagic level ecosystems. To study plants and animals in the pelagic level of the outer ocean requires considerable time and expense, especially when you are at the mercy of extreme weather conditions. Fjords with their towering walls and shallow, protective entrances offer shelter and easy access.

How do you spell the name of those rocky inlets to the sea?

Fjord is a Norwegian word applied to the deep bays and inlets along the mountainous coast of Norway. Sometimes you see it spelled fiord, which is an anglicized version of fjord. Another spelling variation, though not as common, is the word fyawrd. In Scotland and Ireland fjords are called sealochs or firths. In Shetland they are called voes. The walls of firths, which are usually drowned river valleys, are typically much lower than those of the towering fjords.

This document will use the term fjord. The fjords of Labrador are spelled with the anglicized version, fiord, but many people continue to use the Norwegian spelling of fjord. You will also note that some inlets that are geologically classified as fjords are not called fjords at all, but bays. This appears to be the case with the fjords of Newfoundland. So don't be deceived when you look for fjords/fiords on a map of Eastern Canada. There are many more fjords than actually listed.

Location

When you think of the word fjord, what places come to mind? Norway, Greenland, New Zealand, Alaska and British Columbia are well-known for their magnificent fjords. Towering waterfalls over rocky walls are pictures that decorate many postcards. But somehow even our encyclopedias forget to mention the fjords of the East Coast in Newfoundland, Québec and Labrador. Though not as tall as Canada's West Coast fjords, they are just as magnificent.

There are many fjords around the coasts of Newfoundland and Labrador. In Québec the Saguenay Fjord is located off the northern shore of the St. Lawrence estuary.

Please refer to the map on the next page.

Nachvak Fiord - an example of a Labrador fjord

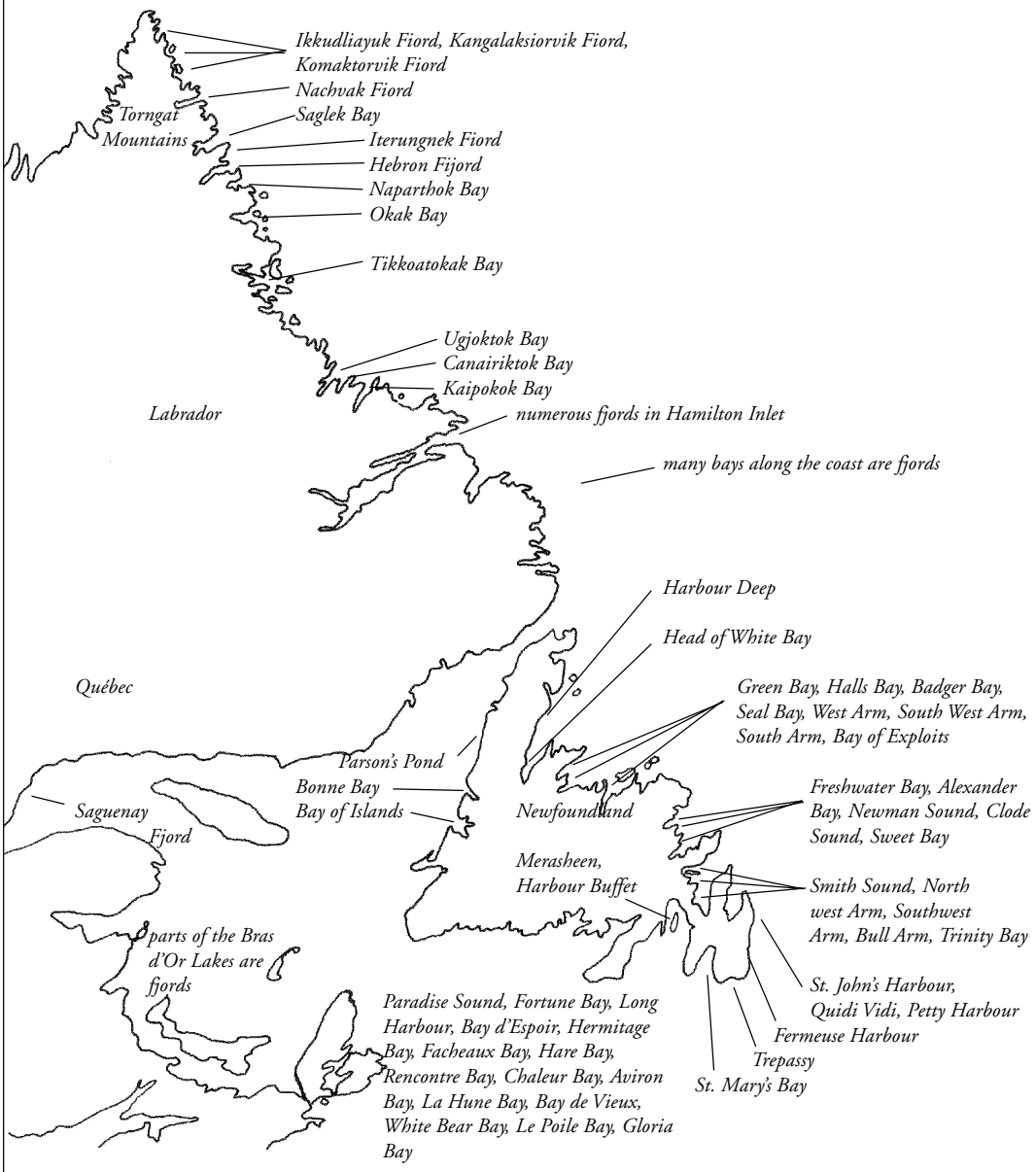
Some of Eastern Canada's most magnificent fjords are located in remote and unspoiled wilderness. Along the coast of northern Labrador exists the highest mountain range in eastern North America, with summits above 1,500 metres. Nachvak Fiord is one of the most spectacular fjords in the region. Sheer walls of grey rock rise 900 metres above the water. The fjord is up to 200 m deep and cuts inland more than 40 km. On its westward extension is a large glacier carved lake, called Nachvak Lake. A number of rivers drain into the fjord and support populations of fish like Arctic Char, which migrate through the fjord to the sea and back again to spawn. Also along the rivers and streams of the fjord coast are Black Bears and River Otters. In the summer Beluga Whales, dolphins and porpoises migrate into the fjord to feed, and sometimes Bowhead Whales feed at the mouth of the fjord.

Bonne Bay - an example of a western Newfoundland fjord

The Bonne Bay fjord is located in Gros Morne National Park and represents one of its most beautiful and scientifically interesting assets. It was carved by two independent glaciers.

The fjord's warm shallows support many temperate seaweed and animals at their northern biogeographic limit. The cold seawater below the warm water supports many arctic species near their southern limits. As a result of this, Bonne Bay harbors the highest diversity of marine plants and animals in Eastern Canada.

Some of the most significant fjords in Atlantic Canada



Saguenay Fjord - an example of a Québec fjord

The Saguenay Fjord is 100 km long and 275 m deep. It consists of three basins of which Lac Saint Jean is the fifth largest lake in Québec and the source for the Saguenay River. At Saint Fulgence is another coastal ecosystem, a very productive salt marsh. Some unique species of zooplankton, normally located in the Arctic, have been found in the cold waters of the fjord. This suggests that the Saguenay fjord is a small pocket of an arctic zone within a boreal region. The same applies also to most Newfoundland fjords.

At the mouth of the Saguenay resident Beluga Whales feed on fish, crustaceans and molluscs.

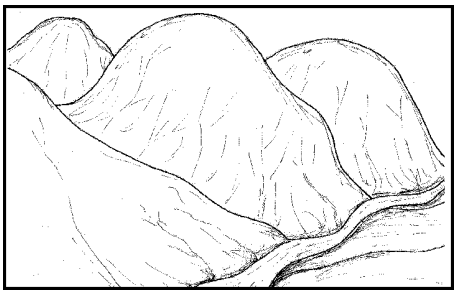
THE PHYSICAL ENVIRONMENT

Formation

When the glaciers moved through pre-existing river valleys they carved the mountainous landscape. As they travelled they straightened, widened and deepened the valleys into the characteristic U-shape found in fjords. Melting ice and sea-water flooded these troughs, creating deep fjord inlets.

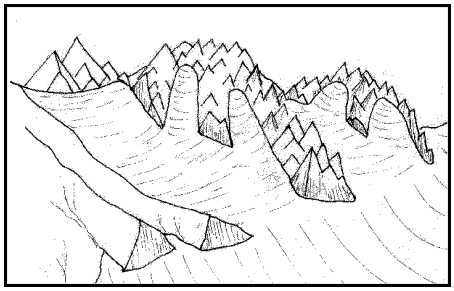
After glaciation the streams that once flowed into the river valleys were left high above the main trough ('hanging valleys'). These streams now plunge into the deepened valleys in the form of spectacular waterfalls.

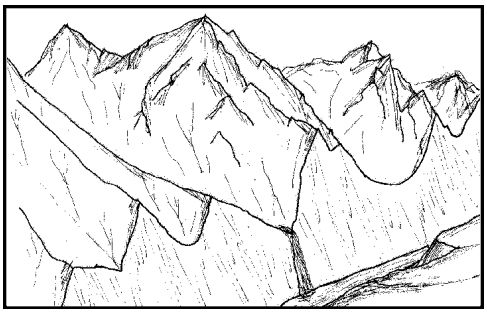
Formation of a Fjord



Before glaciation: topography is shaped by running water. Hills are rounded.

During glaciation: glaciers form in high areas and move down major stream valleys.





After glaciation: sharp, angular landforms characterize topography. Hanging valleys, U-shaped valleys, and waterfalls are characteris tic for fjord landscapes.

after: W. Kenneth Hamblin, *The Earth's Dynamic Systems*

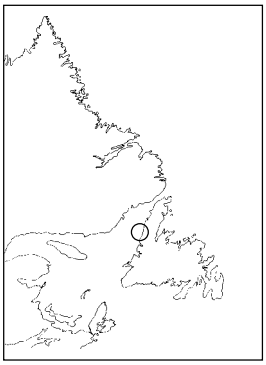
Physical Characteristics

The depth of the sill and height of the tide influence the extent of tide water entering the fjord. In some fjords, for example, there is an inflow of saltwater only during high tide.

Saltwater is denser than freshwater, so when saltwater enters a deep estuary it flows beneath the freshwater. Mixing of upper and lower water over the sill occurs during periods of water turbulence or changes in water temperature. This can result in unique biological communities at the sills.

Once a fjord but not always

It is more than just tall rocky walls that make an inlet a fjord. Geological formation and the inflow of marine water say it all, when determining whether or not an inlet is a fjord, or was a fjord at one time.



There are some inlets that may look like fjords, and may once have been fjords, but are no longer fjords.Western Brook Pond, Trout River Pond, and Bakers Brook Pond on the West coast of Newfoundland fall into that category. They were fjords when there were high sea-levels just after glaciation. Today they are completely cut off from the sea by a wide strip of land, and are deep freshwater lakes.

A step back in time reveals the reason for this shift from fjord to non¸fjord status. When the glaciers retreated from Atlantic Canada an enormous weight of ice was removed from the land, allowing the land to rebound (also called glacio-isostatic rebound). As the glaciers melted, the sea-level rose.

Geologists believe that some of the fjords in northern Newfoundland continued to experience the effects of the glacier's retreat as recently as 6,000-7,000 years ago.

At a time when sea¸levels were lower, some fjords that had shallow sills, including the East Arm of Bonne Bay, were lakes. Fjords can also cease to be fjords due to erosion of the surrounding land that can cause the infilling of the basins by sediment. In geological terms, fjords are young and temporary landscapes.

Deep Water Renewal

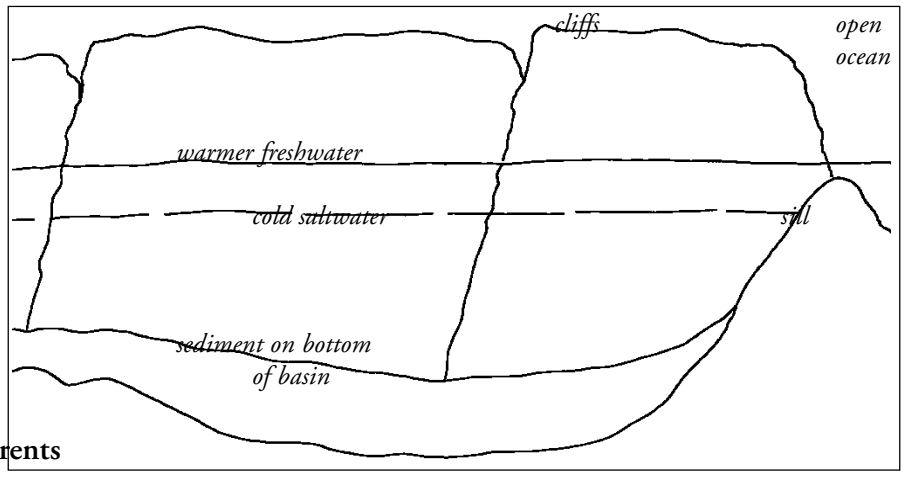
One characteristic that all Eastern Canadian fjords have in common is that they all experience from time to time a flushing away of the old water below the sill with fresh ocean water. This process is called deep water renewal. The frequency of this eventis unique to each fjord and is based on currents, the depth of the sill, and tidal mixing over the sill. Many western continental fjords in British Columbia and in Scandinavia lack this exchange.

Water density is a major component of deep water renewal. Density is a term used to compare the mass of the same volume of different substances. For example, if you mix the same amount of oil and water, which substance remains on top? Water is heavier, or denser, than oil and sinks to the bottom. Oil is less dense and remains on top.

Temperature and salinity affect water density. When warm ocean currents meet cold ocean currents the warm water flows above the cold water. Cold water is heavier and denser than warm water and sinks to the bottom. Saline water is heavier than freshwater and sinks to the bottom.

Deep water renewal depends on differences between the density of the water above the sill and the density of water within the fjord. Seawater is more saline than the existing water in the fjord basin, so it sinks to the bottom, displacing the water in the fjord depths. When the density of external water above the sill is greater than the resident water in the fjord a renewal of water takes place. The mechanisms that drive the denser water across the sill may be long-term, such as seasonal changes in wind speed and direction, or short-term, such as tidal cycles.

Idealized crossection of a fjord

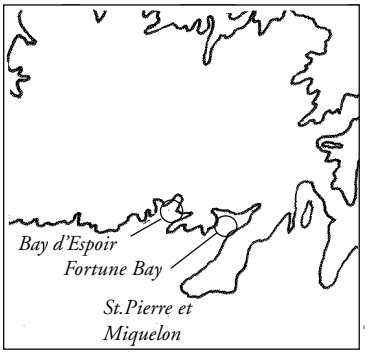


Currents

Currents play an important role in influencing the physical and biological characteristics of fjords. There are several types of currents in action: the daily tidal currents, oceanic currents that move cold or warmer water into the fjord, and the currents of freshwater from rivers flowing out of the fjord.

In fjords the circulatory flow of water is driven by a brackish outflowing surface layer and a deeper inflowing saline layer. The mixing of water in the lower and upper layers is driven by river and tidal currents.

The effects of currents on two Newfoundland fjords



In a study that compared Fortune Bay with Bay d'Espoir, only 40 km apart, it was found that the areas were biologically and physically very differ ent. Both have similar near-surface water properties above the sill depth, but different deep-water masses below the sill. The deep-water mass in Fortune Bay is cold (1°C) and has relatively low salinity levels (32 ppt), while the deep-water mass in Bay d'Espoir is warmer (6°C) and more saline (34 to 35 ppt). Physical oceanographic studies showed that Bay d'Espoir is a relatively constant environment, while Fortune Bay has a dynamic water column, undergoing biannual deep-water renewal. Currents play an important role in influencing the fjord's physical properties.

This coast is influenced by two sources of water, the Labrador Current from the east and slope water from the Laurentian Channel in the west. Shallow water separates the two bays. In the area of Fortune Bay these two conflicting water masses come into direct contact with one another. The warm waters of the Laurentian Channel travel up the Hermitage Channel and lie on the west side of the islands of St. Pierre and Miquelon. The Hermitage Channel leads directly into Bay d'Espoir. The cold Labrador current lies on the east of the St. Pierre Channel. Both these currents help to affect the water properties of the two bays.

The currents also influence the fish species in each bay. Bay d'Espoir contains deep-sea fish entering from the Laurentian and Hermitage Channels. Fortune Bay contains cold-water fish that are derived from the St. Pierre and Hermitage Channels.

Ice

The inner estuarine areas of fjords freeze earlier than open bays or offshore areas in the coastal zone. Most fjords are frozen throughout the winter months. The outer reaches of fjords and the tidal rapids over the sills stay ice-free.

When currents and winds heave ice towards the shore, some areas along the coast experience a scraping or scouring of ice against the rocks and seaweed. The scouring of ice influences the types of plants and animals that live there. Most of the fjords along the west coast of Newfoundland experience some form of ice scouring, but the fjords on the south coast of Newfoundland do not. In these fjords you will find different types of perennial seaweed than in other areas.

Sometimes icebergs influence northern fjords as they move up the fjord and get lodged in shallow areas. Through this process, icebergs grind up the fjord floor and distribute sediments to the deeper water. When they melt they contribute fresh water to the fjord.

Salt

As in all estuaries salinity levels vary in fjords and are greatly influenced by the tides. In some fjords salt water only enters at high tide, while in others salt water enters more frequently.

Salinity levels are also affected by the amount of fresh water flowing into the fjord. During freeze-up freshwater input is often negligible. Once the ice growth lessens, there is a layer of freshwater under the ice. During the spring melting snow and ice increase the amount of fresh water.

Salt water from the open ocean is heavier than fresh water and sinks to the bottom. This usually creates a layering effect of water in the fjord: salt water on the bottom, brackish or freshwater on the top.

Sediment

Fjords are giant traps that collect sediments from the rivers and streams that flow into them. Eventually the sediments fill the basins, and fjords cease to be fjords.

In the deep basins of many fjords some of the sediment dates back to the time of the glaciers, and is a combination of post-glacial mud and glacial marine mud. In deep fjords sediment accumulation can be very thick. In the Bay d'Espoir fjord on the south coast of Newfoundland, the sediment accumulation is 300 metres thick. Bonne Bay on the west coast of Newfoundland has at least 100 metres of sediment on its floor.
Some fjords are in places where they receive sediments from the grinding action of the waves. Storms and ocean swells force powerful waves against the fjord entrance. They not only erode the surrounding headlands and fjord opening of rock, sand or gravel, but also rework the older marine and glacial sediments.

Strong ocean currents and storms can also cause an upwelling of sediments from the ocean floor. These sediments work their way into the fjord basin with each rising tide.

Temperature

Mixing of ocean waters and water within the fjord occurs during temperature changes. In the winter as the surface water cools it becomes heavier and sinks to the bottom. This circulatory process changes or refreshes water in the fjord and helps to circulate sediments.

The upper water layers in fjords experience greater temperature fluctuations than the lower levels. For example, in the Saguenay Fjord in Québec the surface water temperatures can reach 20 degrees Celsius in summer, whereas the bottom layers consistently stay around 4 to 6 degrees Celsius.

Tides

Tides link the sea to a fjord basin. When tidal waters move in and out of a fjord they carry with them sediments. The influence of the tides is dependent on the shape of a fjord. The sill is a gateway that limits the amount of tide water that can enter the fjord. The effects of tides can be felt many kilometers into a fjord. In Saguenay Fjord, for example, tides reach as far as Saint Fulgence, located more than 100 km upriver.

Wind

The towering walls of most fjords provide protection from the elements, but not in all fjords. In Labrador and Western Newfoundland, for instance, many fjord valleys are subject to high winds call 'catabatic' (downward flowing) winds. These winds are caused by surface cooling at higher elevations, creating a local wind that roars down the mountainous slopes and along the river valleys. Locally these winds can exceed 100 km/hr. They are often of short duration.

Properties of an estuary: What makes a fjord estuary different?

Eestuaries are transition zones between saltwater and freshwater ecosystems. They are located at the mouth of rivers where freshwater meets the saline water of the nearshore. No two estuaries are alike and they are often associated with other coastal ecosystems such as salt marshes, mudflats, beaches and bogs. Tides play a major role in the salinity of the water. With each incoming tide there is an influx of saltwater. When saltwater mixes with freshwater it is termed brackish. For more information on estuaries refer to Module 3: Estuaries.

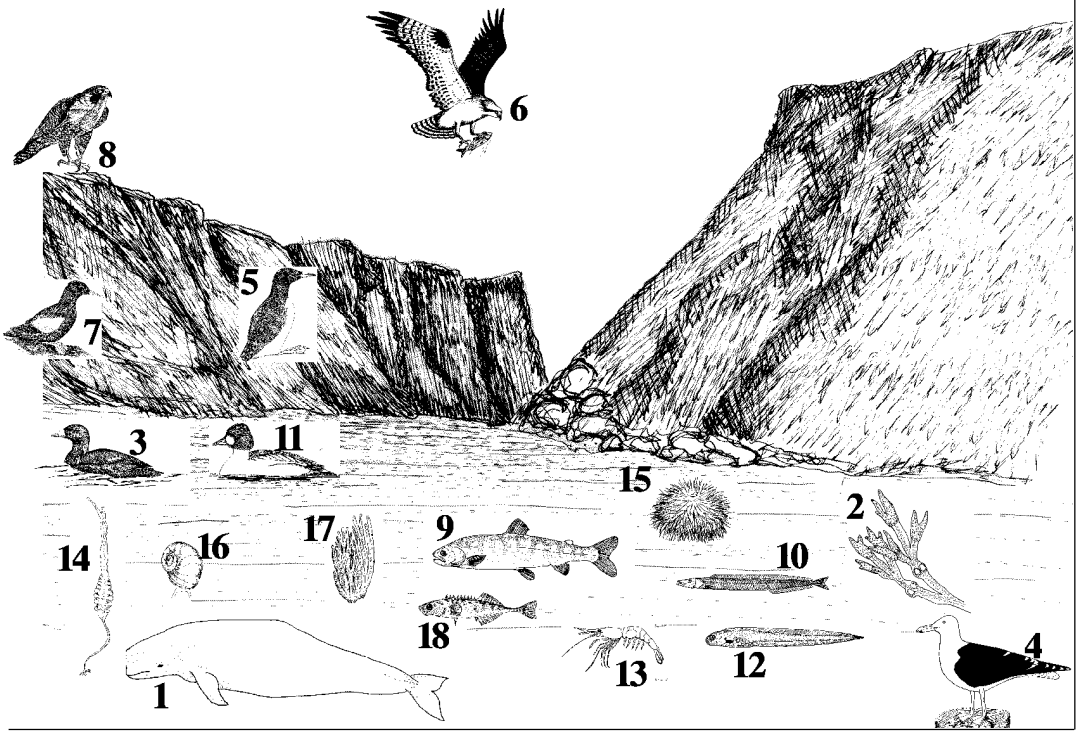
Fjords are the deepest of all estuaries, with their water properties that differ from the classic estuary. The circulation of water in the upper layers (above sill depth) is similar to other estuaries, with a brackish outflowing surface layer and deeper inflowing saline layer. But the circulation of deep water in the fjord is dependent on the depth of the sill, the amount of tide water entering the fjord (tidal mixing over the sill), and the amount and frequency of deep ocean water flushing behind the sill (deep water renewal). In eastern Canada deep water renewal is mostly internal, and happens mainly in winter.

BIOLOGICAL FEATURES

Who Lives Where?

The deep-water basins of fjords provide a marine/freshwater habitat in a relatively sheltered environment. Plant and animal communities in fjords vary greatly depending on water properties. Water depth, temperature, and salinity affect species distribution.

1	*Beluga Whale*	*2*	*Bladder Wrack*
3	*Black Scoter*	*4*	*Great Black-backed Gull*
5	*Common Murre*	*6*	*Osprey*
7	*Black Guillemot*	*8*	*Peregrine Falcon*
9	*Arctic Char*	*10*	*Sand Lance*
11	*Common Goldeneye*	*12*	*Atlantic Soft Pout*
13	*Boreal Red Shrimp*	*14*	*Long-stemmed Kelp*
15	*Green Sea Urchin*	*16*	*periwinkle*
17	*Finger Sponge*	*18*	*stickleback*



Plankton

Plankton are drifters and at the mercy of the water's currents for their transportation. They are divided into two groups, phytoplankton and zooplankton.

For general information on plankton please refer to Module 1: Introductory Module.

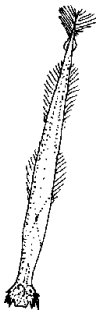
Some of the plankton found in deep fjords is similar to the plankton found in the open sea. As they drift through the fjord they become food for fish, whales and other creatures.

Krill

Krill are tiny shrimp-like planktonic creatures. They live in the cold waters of fjords and can be so numerous that their presence will actually colour the water pink. They eat detritus and plants. They are an important source of food for seals, fish, seabirds and whales. Up to 38 mm when an adult.

Arrow Worm

Arrow Worms are planktonic their entire life cycle. They have stiff hairs around their mouth and transparent bodies. They eat larval fish. 1-3 cm long.



How much krill can a baleen whale eat?

Baleen whales, such as Minke Whales and Humpback Whales eat by filtering food from the water through their baleen plates. Baleen is a strong, light, substance made of keratin, the same protein as human fingernails. The baleen grows in two rows of comb-like plates down the roof of a whale's mouth. The baleen plates strain plankton, small fish and other organisms from the water.

The Blue Whale is the largest animal ever known, and is the size of three or four school buses. It eats about 4 tons of plankton and krill (planktonic crustaceans and larvae) in one day.

Blue Whales feed offshore in the Port aux Basque region of Newfoundland. Minke Whales are often resident around fjords along the coasts.

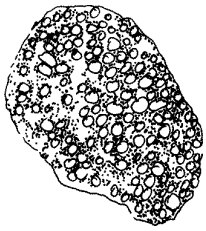
Plants

The plants growing in the fjord ecosystem provide food and shelter for many species of wildlife. As in all marine ecosystems algae, in the form of seaweed, plays an important role in the fjord community.

It is important to note that some of the species of seaweed found in Newfoundland are somewhat different from those found in Labrador fjords, because some seaweed cannot grow and reproduce in Labrador's cold water. On the other hand, some Newfoundland fjords are so much colder and deeper than the surrounding marine environment that they are the only place around the island to find Arctic seaweed. The plant life of each fjord is dependent on the depth of the fjord sill and the water temperature.

Land plants grow around the edges of fjords. The growth of plants on the cliffs and headlands of a fjord is limited by several features: the steepness of the wall, the underlying rocks, prevailing winds and sea spray, and the location.

Atlantic coast fjords are located in two of Canada's ecological regions: the boreal forest and the treeless tundra of northern Labrador. In some fjords the barren rock walls provide no space or habitat for plants, whereas other fjords have forested walls where trees such as spruce and fir grow in clustered mini-forests at the base of the cliffs.



Stone Shrub/Live Rock/Red Rock/coral

The Stone Shrub is a crustose red algae. It belongs to a group of algae that look more like coral than seaweed and grow on rocks in tide pools and in the subtidal zone. Stone Shrub looks like a stony crust with upright branches that resemble knobby projec tions. It can be white, pink or even purple. There are many species of coralline algae, all very different, depending on where they are found.

Hollow-stemmed Kelp

Kelp is a large brown seaweed that grows Mainly below the low tide line. It grows so abundantly in fjords that it forms extensive beds or underwater forests. Living in the kelp bed forests are animals such as Sea Butterflies and Waved Whelk, limpets, and marine worms. Hollow-stemmed Kelp grows in quiet water and is the largest kelp found along the coast. In deep water it grows up to 10 metres long.

Edible Kelp/Alaria kelp

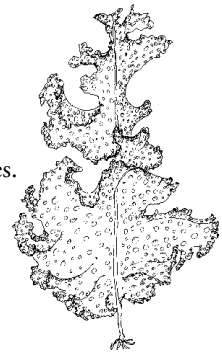
The Edible Kelp grows in shallow water particularly at the mouth of fjords and in the surf of tidal currents. This seaweed is edible and can be dried and used as a seasoning. 2-3 m long.

Arctic Kelp/*Laminaria solidungula*

This kelp is found in large quantities in the arctic fjords of Newfoundland and in Labrador and throughout the Arctic. It grows in the winter from stored food, enabling maximum photosynthesis in summer. (no graphic available)

Sea Colander/Agarum colander

The Sea Colander is a dark brown kelp. It grows at greater depths than any of the other kelps. It can easily be identified by the many small holes puncturing its blades. It normally grows below the low tide line but can sometimes be found washed ashore. Up to 3 m.

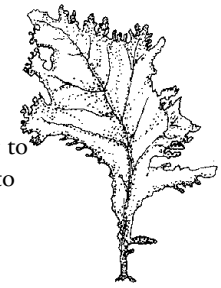


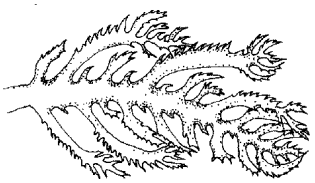
Bladder Wrack

Bladder Wrack is olive-green. Its blades have paired air bladders along its length, and gummy reproductive bladders at their tips, which people love to pop. It is common in the intertidal zone. Up to 1 m long.

Sea Oak/Phycodrys leaf weed

As its name implies, a Sea Oak's blade looks similar to an oak leaf. It grows on seaweeds such as kelp. Up to 50 mm long.





Red Fern/Ptilota feather weed

Red Fern is a bushy red seaweed with fern-like flattened branches. It grows in deep water, often at the base of kelp. Up to 150 mm long.

Arctic fjord plant communities

Arctic fjord plant communities occur in the very deep fjords along the west coast of Newfoundland. Here are many northern seaweed species such as kelps and encrusting coralline algae, which can successfully live and reproduce in very cold water. Some common species include *Turnerella pennyi, Dilsea integra, Phyllophora truncata, Leptophytum laeve, Leptophytum foecundum, Laminaria solidungula, Kvaleya epilaeve*.

Rhodolith beds

Rhodolith beds are composed of red seaweed. What makes red seaweed fascinating are their beautiful colours of pink, red, purple and sometimes black, and their unusual shapes. Some red seaweed, such as those found in Rhodolith beds, look more like corals or lichens than seaweed. They use calcium to stiffen their cells and coat the rocks with their beautiful shapes and colours. These seaweed are called coralline red algae and they often live under the brown kelp beds.

In some fjords there are two types of coralline red algae growing side by side. There are the epiphytic coralline algae. Epiphytic describes their attachment to other plants or animals. And there are the red coralline algae, which grow as free-living plants in separate beds called rhodolith beds.

Rhodolith communities in Newfoundland fjords are extremely old and well established. In northern Norway where researchers have studied similar rhodolith beds it has been discovered that these communities have taken many centuries to develop.

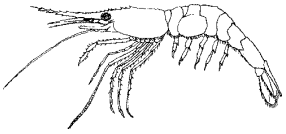
Crustaceans

Crustaceans are a group of animals that include lobsters, crabs, shrimp, amphipods and isopods. They wear their skeleton on the outside of their bodies. As they grow, their bodies increase in size, but their exoskeleton remains the same. To accommodate their expanding bodies they moult out of their old skeleton. With each successive moult young crustaceans look more and more like their parents.

Crustaceans live in all areas of the fjord basin. They provide food for fish, birds and whales.

mysid shrimp

Mysid shrimp are delicate translucent shrimp. They swim backwards with quick strokes of their fan-like tails when startled. Mysid shrimp live on the bottom but swim to the surface at night to feed where they are sometimes found with surface plankton. Less than 3 cm.



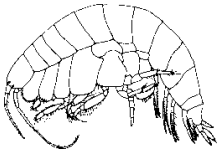
Boreal Red Shrimp

The Boreal Red Shrimp frequents deep waters and is one of the largest cold-water shrimp. An important part of their diet is krill and they migrate to the upper waters with the krill each night. 15 cm.

Travelling with ocean currents or a glacial relict?

The cold arctic-like waters of fjords are havens for some unusual species. Boreomysis nobilis, a tiny shrimp, has rarely been found south of the Arctic Circle, except in some of the fjords of Eastern Canada. It has been collected from the Saguenay fjord of Québec, and some of the fjords in Newfoundland and Labrador. In each fjord where Boreomysis nobilis was found the water temperature was 0 degrees Celsius or colder and the water depth was greater than 200 meters. Some scientists believe that B. nobilis is a glacial relict that has lived in east coast fjords since the time of the last ice age. Other scientists dispute this theory and suggest that B. nobilis travels to east coast fjords with the ocean currents that come from the Arctic.

Either way it is interesting to note that some fjords are deep enough and cold enough to accommodate species typically found in arctic waters.

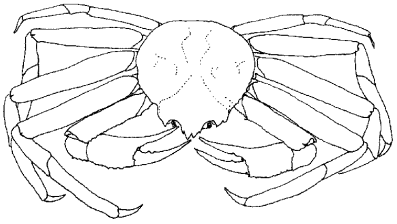


amphipod

Amphipods are tiny shrimp-like creatures that swim on their side. Their travelling technique gives them the common name side-swimmer. They are a common intertidal creature and are usually found under seaweed and rocks.

Snow Crab

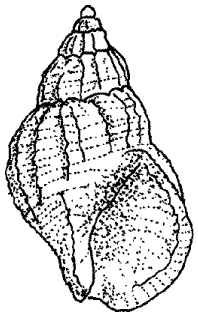
Snow Crabs are sometimes called Queen Crabs and live in soft mud or sandy bottoms, where they prey on small worms or other crustaceans. They cannot tolerate warm water and prefer to moult and breed in cold water at the coldest time of the year. Up to 13 cm across the body shell.



Molluscs

There are a many molluscs in fjord communities. They live in the muddy sediments, on the rocks, and in seaweed. Currents are extremely important for filter feeders. At the mouth of the fjords, where the strong currents flush in suspended food such as plankton or organic detritus, molluscs are abundant. Molluscs are food for birds and fish.

For general information on molluscs please refer to Module 1: Introductory Module.

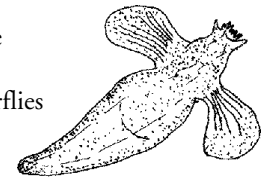


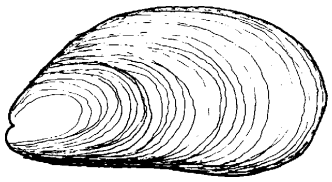
Waved Whelk/Northern or Common Whelk

The adult Waved Whelk lives in water as much as 180 metres deep. The young can be found in shallower water and even tide pools. Their shell is dull whitish to buff and their soft body parts are white or yellow with black specks. Whelks scavenge on dead fish and are regarded as bait stealers by lobster fishermen. Usually 62 mm, but can grow as big as 100 mm.

Naked Sea Butterfly

The Naked Sea Butterfly is a planktonic snail with a slug-like body and wing-like flaps, called parapodia, that are used for swimming. They are pale grey or salmon coloured. Sea butterflies are pelagic and usually found offshore where they gather in swarms. They also live in the cold water of deep basin fjords. They are food for baleen whales. 25 mm.



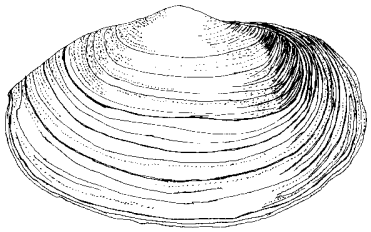


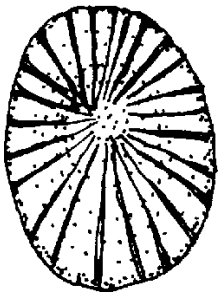
Horse Mussel

Horse Mussels live in the deep fjord basins, particularly in kelp beds. They are similar to the common Blue Mussels in shape, but the shell tends to be longer. The shell is mauve-white to dark blue. They attach themselves to rocks. Up to 150 mm.

Soft-shelled Clam

The shell of the Soft-shelled Clam is white and chalky. It lives in mud and when disturbed squirts its predator with a spray of saltwater. 10 cm.



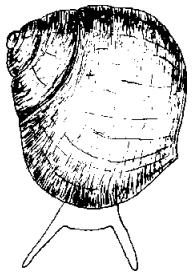


Tortoiseshell Limpet

The Tortoiseshell Limpet is a snail that scrapes seaweed off rocks as a source of food. The shell is marked with brown stripes or spots. Up to 55 mm.

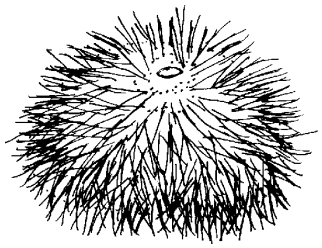
Common Periwinkle

The Common Periwinkle is the largest and most abundant periwinkle found in coastal ecosystems. It is brown with a pale body. It is a herbivore and eats seaweed. 33 mm.



Echinoderms

Echinoderms include sea stars and sea urchins. Sea stars have a fascinating way of devouring their food. They eat with their stomachs outside their bodies. Urchins use strong sharp teeth to scrape seaweed off the rocks. Echinoderms are very sensitive to changes in the salinity of the water. During spring melt a sudden inflow of fresh water can kill them.



Green Sea Urchin

The Green Sea Urchin is common in tide pools, but is also found in depths of down to 792 metres. Despite their prickly covering sea urchins are eaten by fish, sea stars and seabirds. Sea urchins are herbivores and feed on seaweed. Their favourite food is Hollow-stemmed Kelp, which they scrape off the rocks with their teeth. Up to 75 mm in diameter.

Polar Sea Star

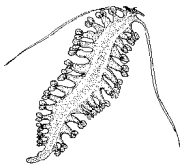
The Polar Sea Star is the most common sea star along the coast. It inhabits very deep water, but also drifts with strong currents. These sea stars are voracious predators and eat molluscs, barnacles, or any animal they can easily catch. Sea stars are food for bottom-dwelling fish. Up to 125 mm.

What do periwinkles, sea urchins and limpets have in common?

A very big appetite for seaweed. In fact their appetites are so big that they will literally eat almost all of the seaweed available. In places where there are many sea urchins below the kelp zone, the only algae left will be the coralline algal crusts. These animals like their vegetables but not their crusts.

Worms

Worms live throughout the fjord ecosystem and play an important part in the food chain. They live in the sediment and on plants. They are food for all kinds of sea creatures, including many species of fish.

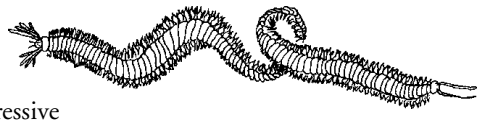


Plankton Worm

The Plankton Worm is a glass-clear swimming worm with little sign of segmentation. 88 mm.

clam worm

The clam worm lives in mud. It has several well-developed antennae on its head and a mouth armed with two fangs that it uses to capture its prey. It is an aggressive predator, and feeds on many different kinds of invertebrates. 20 cm.



Fish

Fish are plentiful in the deep fjord basins. Many of the fish found in fjords are characteristic of the deep ocean waters and come from the offshore continental shelf or local channels. Some fish actually inhabit fjords where the water is colder and deeper than the nearby ocean, making the local fjord a very special and necessary ecosystem in the coastal zone.

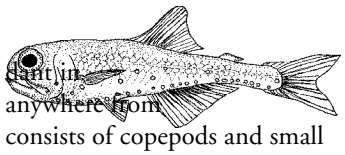
Fjords also provide a link between fresh and saltwater habitats. For anadromous fish, such as salmon, fjords are important travel corridors during the migration from freshwater to saltwater and back again.

Fish are food for birds, seals and other fish.

Atlantic Soft Pout

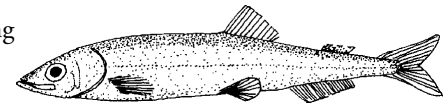
Atlantic Soft Pout are bottom dwellers, living in waters anywhere from 30-366 metres deep. They are brilliant silvery blue and translucent. They eat copepods. 13.8 cm.

Glacier Lanternfish



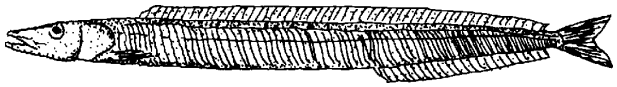
Glacier Lanternfish, found only in Bay d'Espoir, like cold, deep water. During the day they are most abun- water 146-530 metres deep and at night 46-91 metres. Their diet shrimp. They fish dant in anywhere from consists of copepods and small in turn are eaten by commercial species of such as cod. Up to 58 mm.

Capelin



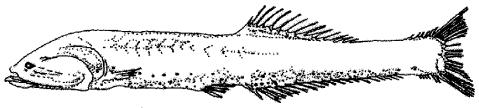
The annual migration of Capelin is a fascinating thing to watch because it actually attracts other animals to the mouth of the fjord. Capelin are offshore cold-water fish that inhabit some fjords. They leave the water to spawn on local beaches. 20 cm.

sand lance

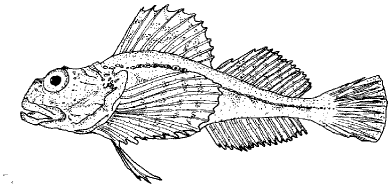


Sand lances are well-known for their burrowing techniques as they burrow into sand or gravel. They have a varied diet and eat shrimp, snails and worms. Sand lance are eaten by birds such as the Thick-billed Murre. Up to 37 cm.

Veiled Anglemouth



Several different anglemouth live in fjords (Spottail, Veiled, and Albino). They are deep-water fish and have been caught at depths of 400-1,800 metres. As soon as the male hatches, he attaches himself to a female. The male is integrated into the female and their circulatory system becomes one. Only the gonads are left. Up to 66 mm.



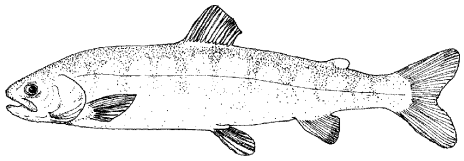
Arctic Staghorn Sculpin

Sculpin are arctic or northern fish found in the cold water of some fjords. They have large spiny or armoured heads. They are mostly bottom dwellers and feed on crabs and small fish. To 25.6 cm.

Slender Eelblenny

The Slender Eelblenny is a benthic species that prefers deep water. It is light brown with pale rounded blotches. Eelblenny eat fish eggs, small worms and crustaceans. They in turn are eaten by Arctic Char, Black Guillemot and Atlantic Cod. 20-23 cm.

Arctic Char



After 5 to 7 years in fresh water, Arctic Char migrate to the sea through the rivers of some fjords. During late summer they return to spawn. They eat crustaceans and small fish such as sand lance, sculpins and Capelin. While they are in the sea they have a metallic-blue back and a silvery side and belly, with coloured spots. When they return to fresh water their colour changes to silvery, with light spots, and lacks the intense blue. Arctic Char have few natural predators except seals. Up to 71 cm.

Arctic Char

All along the fjords of the Labrador coast there are resident populations of an anadromous fish called Arctic Char. When the ice breaks up in the spring, Arctic Char migrate down the rivers to the sea. They return to the fjord in the summer. In fact most of their feeding and growth takes place in fjords, and when they migrate to the ocean they do not stray very far.

Each fjord has its own distinct population of Arctic Char. Biologists have discovered that even though they are all the same species, their growth rates and flesh colours vary according to the fjords they inhabit.

Arctic Char is one the most important fish in the salmon family in Labrador, due to its value to the Inuit fishery. The best Arctic Char populations are found in the Hebron and Saglek fjords. Some rivers and fjords are teeming with Arctic Char and the water is so clear that you can see more fish than you would be able to count.

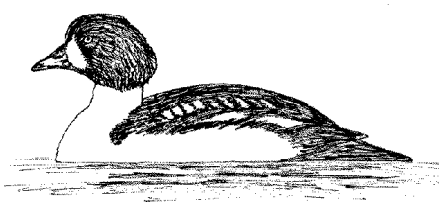
Arctic Char have also been an inspiration to many Inuit artists who have painted and carved Arctic Char-like fish in their drawings or carvings of ivory and soapstone. The Arctic Char's graceful form has become a symbol of the north.

Birds

Fjords are a bird watcher's heaven, because they provide necessary habitat for birds to feed, breed and moult, and a rare opportunity to observe a wide variety of species. Bald Eagles and Ospreys breed along the cliffs, and circle high above the fjordbasins searching for fish. Diving ducks such as goldeneyes and mergansers search for food in the innermost reaches of the fjord and the surrounding rocky cliffs provide dwellings for breeding populations of gulls, kittiwakes and pelagic seabirds such as guillemots.

Fjords even provide habitat for some endangered species. Peregrine Falcon, for example, nest along the rocky interfaces of some fjords and the endangered Harlequin Duck finds prime breeding habitat in some of the fjords along the Labrador coast.

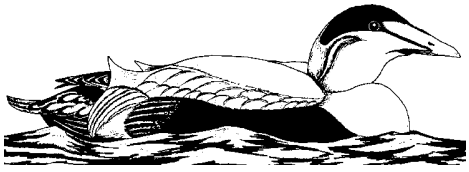
For more information on seabirds and how they nest please refer to Module 8: Coastal Islands and Cliffs.



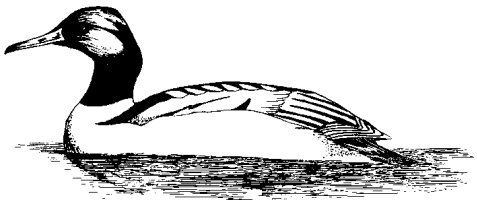
Barrow's Goldeneye

Barrow's Goldeneye, a species whose population is suspected to be in decline, uses some of the fjords of the Labrador coast during moulting. 53 cm.

Common Eider



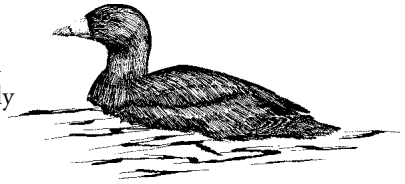
The Common Eider lives along rocky coasts and above shoals. The male can be easily identified by his black belly and white black. Eiders inhabit the fjords of the Labrador coast for feeding during the breeding season. 58-68 cm.



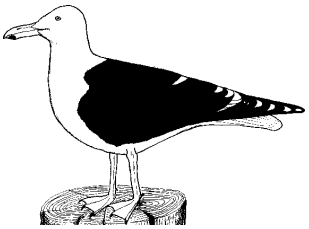
Red-breasted Merganser

Mergansers are diving ducks that capture fish in their spike-like bills. The Red-breasted Merganser is found in salt- or freshwater. It is plentiful along the shores of fjords. 50-65 cm.

Black Scoter



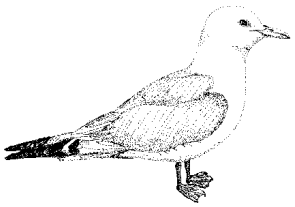
Scoters are called 'sea or bay ducks.' They dive for small aquatic animals and plants. The males are predominately black with white markings, depending on the species. The females are predominately brown. Surf, Black and White-winged Scoters are found in fjords. 46-53 cm.



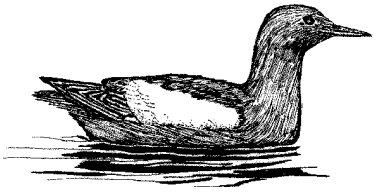
Great Black-backed Gull

The Great Black-backed Gull is unmistakable with its black back and wings with snow-white underparts. It is larger than the common Herring Gull. 70-78 cm.

Black-legged Kittiwake



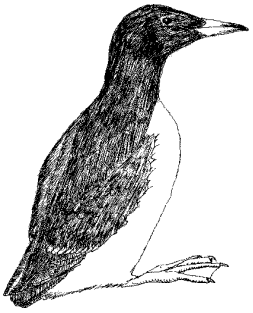
The Black-legged Kittiwake is a small oceanic gull. The black wing tips of the adult are cut straight across and look as if they have been dipped in ink. 43 cm.



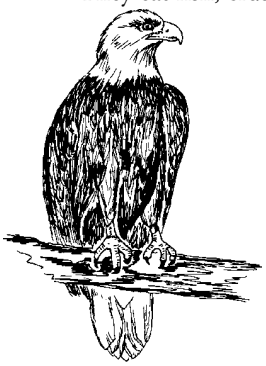
Black Guillemot

The Black Guillemot is a small duck-like bird with bright red feet and a white shoulder patch. Like the murre it is a pelagic seabird and spends most of its time on the ocean. It breeds in small groups or singly in holes or under rocks on cliffs. 30-35 cm.

Common Murre



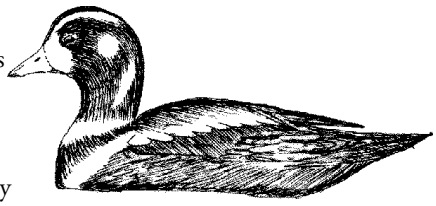
Both species of murre, Common and Thick-billed, look like small ducks with long bills. During breeding season they nest on some of the towering rocky cliffs of fjords. They spend the rest of the year on the open ocean where they search for food. They eat fish, crustaceans, molluscs and algae. 40-48 cm.



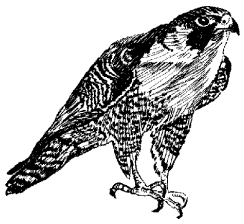
Bald Eagle

Both the Bald Eagle and Golden Eagle have been observed in east coast fjords. A Bald Eagle's diet consists mainly of fish and dead animals, while a Golden Eagle eats rabbits and large rodents. Bald Eagle 75-108 cm. Golden Eagle 75-100 cm.

Harlequin Duck



The Harlequin Duck inhabits mountain streams in the summer and rocky coastal waters in the winter. Both the male and female have round white spots on their heads. The male has chestnut-coloured sides while the female is dusky in colour. 45 cm.



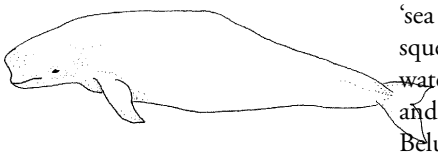
Peregrine Falcon

The Peregrine Falcon is a streamlined bird of prey. It is endangered in many places throughout Atlantic Canada. It has been observed nesting on some of the rocky faces of fjords along the east coast. 38-50 cm.

Mammals

Many mammals such as bears, porcupines, foxes and caribou visit the freshwater streams and rivers flowing into fjords. Here they find food and a source of water. At the entrance to some fjords sea mammals such as whales, walruses, dolphins and porpoises can be observed. Harp Seals, Beluga Whales, dolphins and porpoises migrate and feed in some fjords in the summer.

Humpback and Minke Whales can be observed around the mouths of some fjords, particularly in Newfoundland, where they come to feed on the migratory Capelin. Minke Whales are often resident in fjords. Pilot Whales, which are toothed whales, are occasional visitors to the fjords.



Beluga Whale

Beluga Whales have a few nicknames. They are sometimes called 'white whales' because of their pure white skins, and 'sea canaries' because of the variety of whistles, clicks and squeals they make that are audible above the surface of the water. Their diet consists of a wide variety of crustaceans and fish, including Capelin, char, Sand Lance and cod. Belugas usually travel in small groups of 2-3, but will congregate in much large groups over the summer. They are prey for killer whales and the occasional polar bear. The Beluga Whales of the Gulf of St. Lawrence are endangered. Up to 4.5 m.

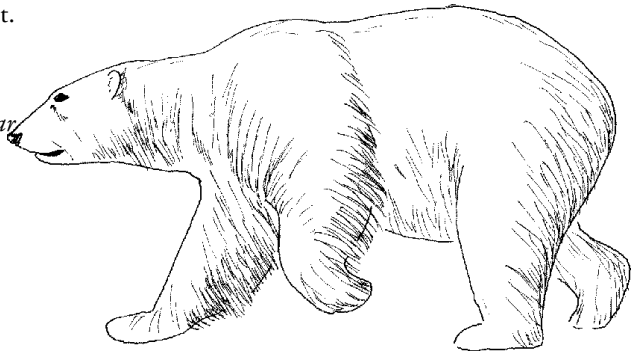
Harp Seal

Unlike whales, Harp Seals must return to land or ice floes to give birth. They feed on a variety of sea life such as plankton, crabs and fish. They sometimes enter fjords to feed. 2 m and 180 kg.

Labrador fjords and the two bears

The coast of Northern Labrador is the home of two species of bears: tundra-dwelling Black Bears and Polar Bears. Polar Bears roam the entire Labrador coast from Killinek to Blanc Sablon. Research shows that the core of the range is from Saglek Bay north to Ramah and Nachvak Fiord. Denning habitat has been observed north of the entrance to Saglek Bay. The Northern Labrador coast is the only region in the world where black bears occupy treeless tundra. The growing season in the north is short, making food scarce. As a result, northern Black Bears, unlike their southern cousins, require enormous amounts of land to search for food. Females are known to range up to 700 km2 and males up to 3,000 km2. Compare this with the average home range for black bears in other parts of Canada: 27 km2 for females and 80 km2 for males. These northern black bears are also known to have the longest recorded annual denning periods, over 200 days for some adult female bears. Black bears have been seen in various fjords up the Labrador coast.

Polar Bear



ECOLOGY

Stress and Survival

Along the coast of Atlantic Canada, fjords are a blending zone between the marine and terrestrial worlds, and contribute to the ecology of the entire region. With their estuarine water circulation, rocky coastline, spectacular cliffs and deep basins, fjords contain a wide variety of habitats. In fjords, estuaries, rocky shores, cliffs, and the outer shore coastal ecosystems merge and become one.

Stress and survival in fjords is similar to life on rocky shores and in estuaries. Organisms must find ways of hanging on when tides sweep in and out, and ways of coping with changes in salinity in the upper layers of water. But life in deep basins is a little more stable in terms of salinity, because tidal waters never reach bottom levels of a fjord.

In any biological system, temperature changes and food shortage can cause stress. Summer warming and winter cooling of surface water can be more than some animals can tolerate. They may respond to these extremes by migrating into deeper water for the winter, or by producing a biological anti-freeze as the water around them chills.

Temperature can also affect breeding times. Higher or lower temperatures than normal may shift breeding times and eventually affect other animals in the food chain.

Despite the abundance of food in surface waters in the summer, winter is a time of food scarcity. When ice covers a fjord, light levels are too low to support photosynthesis. Much of the primary production in fjords comes from seaweed, which are often eaten during winter. The biomass may fall drastically as a result of extended periods of ice cover.

Animals adapt to scarcity of food by moving to other areas or by feeding little and not growing.

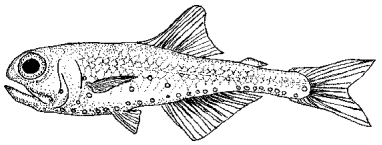
Some Unique Adaptations in Fjords

Unlike other coastal ecosystems, light is limited in the deep fjord basins. Those plants and animals that inhabit deep waters have developed interesting ways of dealing with the lack of sunlight.

Krill and deep pelagic fish such as Lanternfish and Anglemouth have light-producing organs called photophores. The scientific name for krill is 'euphausiids,' which means 'a shining light' in Greek. Their photophores look like red spots and are located on two of their legs, the base of their eye stalks, and on the underside of their abdomens.

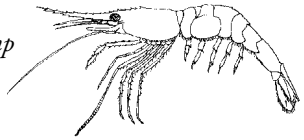
Lanternfish get their name from photophores on their belly or head.

Glacier Lanternfish



Some animals, such as the Boreal Red Shrimp, use their red colour to help protect themselves from predators. Since red wavelengths of light don't penetrate into the deeper water, the Boreal Red Shrimp does not reflect light and appears black in the absence of red light.

Boreal Red Shrimp



Productivity

Not much is known about the productivity of fjords.

The cold lower photic layers have shown to be high in plant productivity despite lower levels of light, probably because cold water contains more nutrients.

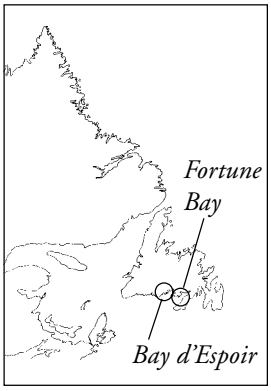
FJORDS AND US

The fjords of Atlantic Canada provide some of the grandest panoramas along our coastline, and act as a rich geological, biological, and archeological time-capsule.

We can step back in time and discover the powerful effects of the glaciers that carved and shaped the landscape by viewing the towering cliffs of a fjord. These stalwart images from the past are present still today and provide us with a glimpse of ancient geological times.

There is a rich archeological presence around the fjords of Labrador. Historical artifacts found there tell a lot about the people and how they used the resources of the fjords to survive. This may be related to the fact that fjords could provide a sheltered harbour for boats in prehistoric times, for the explorers, and up to the present time.

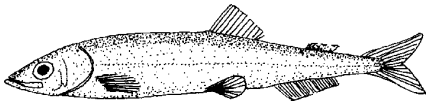
Through studying the biology of fjords we can develop a greater understanding of other coastal ecosystems beyond the rocky walls. The plants and animals that live in the deep, cold fjord basins are often similar to species in the outer shore, illustrating the essential links among all ecosystems in the coastal zone of Atlantic Canada.



Fjords also provide edible resources. Several fjords in Newfoundland, such as Fortune Bay, and Bay d'Espoir are prime areas for commercial aquaculture where salmon and shellfish such as scallops and mussels are grown. In Labrador fjords, Arctic Char is a valuable resource.

Capelin are fished commercially in Newfoundland and are a very important food source. During Capelin migration fishermen position themselves at the mouth of some fjords where they are ensured of a good catch. Capelin are mainly caught in the off-shore region.

Capelin



Galapagos of geology

Because of its unusual and varied rock types, Gros Morne National Park on the west coast of Newfoundland has been called the 'Galapagos of geology.' Its mountainous terrain, deep glacial lakes, coastal bogs, wave-carved cliffs and fjord valleys provide a natural place to explore the monumental effects of the glaciers. In 1987 Gros Morne National Park became a UNESCO (United Nations Educational, Scientific, and Cultural Organization) World Heritage Site in recognition of the importance of its geology and scenery. There are good examples of fjord ecosystems within the park, especially Bonne Bay.

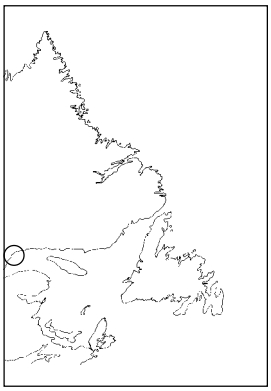
Archeology and fjords

On the Labrador coast there are some very interesting archeological sites. The area was inhabited 8,000 years ago by Maritime Archaic Indians, later by Palaeoeskimo cultures, and more recently by both Indian and Inuit cultures. In the area of the Torngat mountains there are hundreds of archeological sites including tent rings, stone caribou fences, caches and graves.

In the area of Saglek Fiord and Ramah Bay there is a unique stone called Ramah chert. Early hunters prized chert for its hardness and flaking qualities, which allowed the stone to be easily worked. In prehistoric quarries, chert was mined with tools made of wood, bone and antlers. Today, millions of chert fragments from these early mines can still be observed. Ramah chert was made into such items as arrowheads and tools. It was prized for trading. Tools made from the distinctive Ramah chert have been found in other archeological sites in the Maritimes and as far away as Connecticut. Many archeologist feel that the area is so significant that it is worthy of World Heritage Site status.

Problems in the Ecosystem

Several problems have the potential to seriously affect Atlantic Canada's fjords. Water pollution in some fjords, particularly in Humber Arm and Bay of Islands has been a continuous problem. Some homes, cottages and hunting camps have direct flows of sewage into the fjords, resulting in bacterial contamination of shellfish. This contamination has affected the establishment of aquaculture sites.



Of all the fjords on the east coast of Atlantic Canada, Saguenay Fjord is the most influenced by industrializa tion. Towns and industries line the shoreline of the fjord, and the strain of human development shows by the number of pollutants found in the water. Mercury, uranium and zinc have all been collected from the water. The Beluga Whale, a species at the top of the food chain, has such a large quantity of contaminants in its body that dead whales have to be disposed of as hazardous waste.

Some 'mystery spills' of oil and other pollutants have made their way into some fjords, particularly along the south coast of Newfoundland. The pollution is thought to come from international tankers and freighters flushing their tanks and bilges as they pass through the Laurentian Channel.

As more and more people inhabit fjords, conflicts develop with local wildlife. In Saguenay Fjord the population of Beluga Whales has declined and there is speculation that increased power boat traffic has caused them to abandon the fjord as an important feeding site.

In recent years Capelin have declined seriously. Some suggest that the capelin fishery should be better controlled because Capelin are an important food source for many fish and birds.

Another area of concern, particularly in Labrador, is the development of mines in the vicinity of some fjords. As mining companies continue to stake areas in northern Labrador there is concern that mining activities will pollute or otherwise alter the nearby fjord ecosystems.

The restricted circulation of deep fjord basins is particularly susceptible to the accumulation of materials such as heavy metals.

Fish wastes are dumped in several fjord basins such as Humber Arm, Bay of Islands, Bonne Bay, etc.

Protection of the Ecosystem

Some human-caused problems in fjords are now being alleviated. There is a concerted effort to prevent water pollution near fjords along the west coast of Newfoundland, and mining interests in the fjord regions of Labrador are under review.

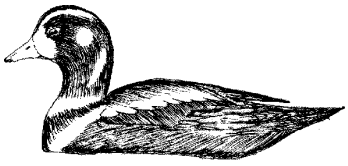
A real boost for protection has been the establishment of national and provincial parks in the vicinity of some fjords. In Newfoundland, Gros Morne National Park, Terra Nova National Park and Blow Me Down Provincial Park are located near important fjords. One of the most significant developments in the protection of fjord ecosystems in northern Labrador is the potential establishment of the Torngat Mountains National Park. With the development of this new national park several fjords could be preserved for all time if marine areas are included.
Government agencies can do a lot to protect fjords, but true protection begins with our own understanding of the role they play in the marine ecosystems of Atlantic Canada. By understanding a fjord we can better understand estuaries, rocky shores, seaside cliffs and the outer shore. The best way to explore a fjord ecosystem is by visiting a national or provincial park where fjords are located, or get out a map and plan on visiting a fjord nearby.

Fjords are more than just breathtaking views. They are a vital and necessary part of the coastal zone of Atlantic Canada, and like all ecosystems along the coast they deserve our respect and protection.

Harlequin Ducks: Protection of an endangered species in the fjords of Labrador

Harlequin Ducks are diving ducks that breed at the edge of fast flowing rivers and winter along rough rocky shores, where the sea is turbulent and the surf breaks constantly. They are secretive birds during breeding season. In 1990 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the eastern North American population of Harlequin Ducks as endangered.

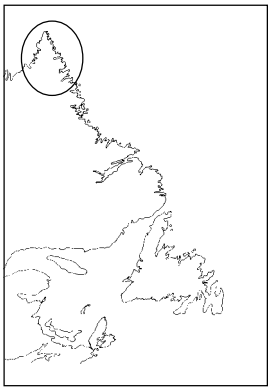
Harlequin Duck



There are fewer than 1,000 of these sea ducks left along the Atlantic Coast and there are several possible reasons for their decline in numbers. Harlequins are extremely sensitive to changes in their breeding rivers. A single oil spill or construction along a river can severely alter their environment. There is also speculation that some of the reduction in numbers is due to widespread hunting. Even though they are a protected species they look similar to other species of legally hunted waterfowl and become easy prey for hunters. Hunting and habitat destruction have caused the population of Harlequin Ducks to reach dangerously low levels.

A group called Recovery of Nationally Endangered Wildlife in Canada (RENEW) has recommended that key breeding areas and main staging areas should be protected. Censuses show that the core breeding range in Labrador is between Hopewell and Nain, and the northern limit of their range is near Nachvak Fiord. Harlequins are also found on Nakhvararsuk Brook and Ikarut River, inland from Hebron and Saglek fjords. The future looks grim for Harlequin Ducks unless their habitat is protected. But there is hope that with the establishment of the new Torngat Mountains National Park in northern Labrador the Harlequin Duck will find a safe and protected place to live.

Working to protect some important Atlantic Coast fjords in the proposed Torngat Mountains National Park.



The proposed Torngat Mountains National Park in Labrador encompasses a spectacular arctic wilderness of towering mountains, magnificent fjords and rugged coastal areas. Along with its natural beauty the Torngat region provides a rich cultural heritage where Innuit groups and their ancestors have lived for thousands of years.

The area provides habitat for a wide range of species. Caribou, Polar Bears, unique tundra-dwelling Black Bears, wolves, Arctic Fox, Peregrine Falcon and Golden Eagles live within the proposed park boundaries.

Interest in establishing the Torngat region as a national park began in the 1960s. Since that time working groups from the federal government, Newfoundland and Labrador government, and the Labrador Inuit Association have been working to establish the boundaries for the park.

SPECIES LISTS

The following lists are by no means a complete account of the organisms living in this ecosystem. They are representative species that might be seen when visiting a fjord. There are also great regional and local differences, and we realize the difficulty in accommodating all of these.

Plants

Sea Colander/Agarum Colander	*Agarum cribrosum*
Long-stemmed Kelp	*Laminaria longicruris*
Edible Kelp/Alaria Kelp	*Alaria esculenta*
Arctic Kelp	*Laminaria solidungula*
rockweed/bladderwrack	*Fucus vesiculosus*
rockweed/sea wrack	*Fucus distichus*
	Fucus edentatus
Knotted Wrack	*Ascophyllum nodosum*
Spiny Sour Weed/Desmarestia	*Desmarestia aculeata*
Stone Shrub/live rock/red rock/coral	*Lithothamnium glaciale*
Green Thread Algae	*Chaetomorpha melagonium*
Red Fern/Ptilota feather weed	*Ptilota serrata*
Sea Oak/Phycodrys leaf weed	*Phycodrys rubens*
filamentous red seaweed	*Callithamnion sp.*

Molluscs

Horse Mussel	*Modiolus modiolus*
Tortoiseshell Limpet	*Acmaea testudinalis*
Common Periwinkle	*Littorina littorea*
Waved Whelk	*Buccinum undatum*
Soft-shelled Clam	*Mya arenaria*
Naked Sea Butterfly	*Clione limacina*
Dogwinkle/dogwhelk	*Nucella lapillus*
American Pelican's Foot/ Pelican Foot Whelk	*Aporrhais occidentalis*

Crustaceans

krill	*Thysanoessa raschii*
	Thysanoessa inermis
mysid shrimps	*Mysis litoralis*
	Mysis gaspensis
	Mysis mixta

arctic mysid	*Boreomysis nobilis*
Boreal Red (pink) Shrimp	*Pandalus borealis*
Snow Crab	*Chionoecetes opilio*
	Onacea borealis
	Onacea similis
amphipod	*Atylus carinatus*
amphipod	*Gammaracanthus loricatus*
big-eyed amphipod	*Hyperia sp.*
	Sympleustes pulchella
	Tryphosa spitzbergensis
	Microcalanus pygmaeus

Echinoderms

Green Sea Urchin	*Strongylocentrotus droebachiensis*
Polar Sea Star	*Leptasterias polaris*
blood star	*Henricia sp.*
brittle star	*Ophiopholis sp.*
Arctic Cushion Star	*Pteraster militaris*
asteriid sea star	*Asterias vulgaris*

Worms

lugworm	*Arenicola marina*
Blue Fan Worm	*Myxicola infundibuliformis*
clam worm	*Nereis zonata*
	Ophiopus arcticus
Plankton Worm	*Tomopteris helgolandica*
arrow worm (planktonic)	*Sagitta sp.*

Sponges

Finger Sponge	*Haliclona oculata*

Bryozoans

lacy crust	*Membranipora sp.*
lacy crust	*Electra*
	Cysticella

Cnidarians

Moon Jelly	*Aurelia aurita*
Lion's Mane/Red Jelly	*Cyanea capillata*
siphonophore (hydrozoan)	*Nanomia cora*

Ctenophores

comb jelly	*Mnemiopsis sp.*
Sea Gooseberry	*Pleurobrachia pileus*
beroe's comb jelly	*Beroe cucumis*

Brachiopods

lamp shell	*Terebratulina septentionalis*

Fish

Slender Eelblenny	*Lumpenus fabricii*
Arctic Staghorn Sculpin	*Gymnocanthus tricuspus*
Kanoyok/Spatulate Sculpin	*Icelus spatula*
Atlantic Cod	*Gadus morhua*
Greenland Halibut/Turbot	*Reinhardtius hippoglossoides*
Golden Redfish	*Sebastes marinus*
eelpout	*Lycodes sp.*
Pale Eelpout	*Lycodes pallidus*
Yellow Perch	*Perca flavescens*
White Sucker	*Catostomus commersoni*
Greenland Shark	*Somniosus microcephalus*
Atlantic Sturgeon	*Acipenser oxyrhynchus*
whitefish	*Coregonus artedii*
Striped Bass	*Morone saxatilis*
American Shad	*Alosa sapidissima*
Grey Sole/Witch Flounder	*Glyptocephalus cynoglossus*
Arctic Char	*Salvelinus alpinus*
Arctic Cod	*Boreogadus saida*
Atlantic Soft Pout	*Melanostigma atlanticum*
Glacier Lanternfish	*Benthosema glaciale*
Capelin	*Mallotus villosus*
Spottail Anglemouth	*Cyclothone braueri*
Veiled Anglemouth	*Cyclothone microdon*
Albino Anglemouth	*Cyclothone alba*
	Cyclothone pseudopallida

	Cyclothone pallida
sand lance	*Ammodytes sp.*
Sea Tadpole	*Careproctus longipinnis*
Sloane's Viperfish	*Chauliodus sloani*
American Plaice	*Hippoglossoides platessoides*
Kelp Snailfish	*Liparis tunicatus*
Longhorn Sculpin	*Myoxocephalus octodecemspinosus*
Arctic Sculpin	*Myoxocephalus scorpioides*
Marlin-spike	*Nezumia bairdi*
Blacksnout Seasnail	*Paraliparis copei*
Pouty Seasnail	*Paraliparis garmani*
Pollock	*Polachius virens*
redfish	*Sebastes sp.*

Birds

Glaucous Gull	*Larus hyperboreus*
Great Black-backed Gull	*Larus marinus*
Herring Gull	*Larus argentatus*
Red-breasted Merganser	*Mergus serrator*
Rock Ptarmigan	*Lagopus mutus*
Golden Eagle	*Aquila chrysaetos*
Peregrine Falcon	*Falco peregrinus*
Bald Eagle	*Haliaeetus leucocephalus*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Black-legged Kittiwake	*Rissa tridactyla*
Black Guillemot	*Cepphus grylle*
Common Eider	*Somateria mollissima*
Black Scoter	*Melanitta nigra*
White-winged Scoter	*Melanitta fusca*
Surf Scoter	*Melanitta perspicillata*
Harlequin Duck	*Histrionicus histrionicus*
Common Murre	*Uria algae*
Thick-billed Murre	*Uria lomvia*

Mammals

Beluga Whale	*Delphinapterus leucas*
Harbour Seal	*Phoca vitulina*
Blue Whale	*Balaenoptera musculus*
Humpback Whale	*Megaptera novaeangliae*
Minke Whale	*Balaenoptera acutorostrata*

Narwhal	*Monodon monoceros*
Bowhead Whale	*Balaena mysticetus*
Polar Bear	*Ursus maritimus*
Black Bear	*Ursus americanus*
Harp Seal	*Phoca groenlandicus*
Ringed Seal	*Phoca hispida*
Bearded Seal	*Erignathus barbatus*
Pilot Whale	*Globicephala malaena*
Fin Whale	*Balaenoptera physalus*
River Otter	*Lontra canadensis*
Porcupine	*Erethizon dorsatum*
Woodland Caribou	*Rangifer tarandus caribou*
Arctic Fox	*Alopex lagopus*