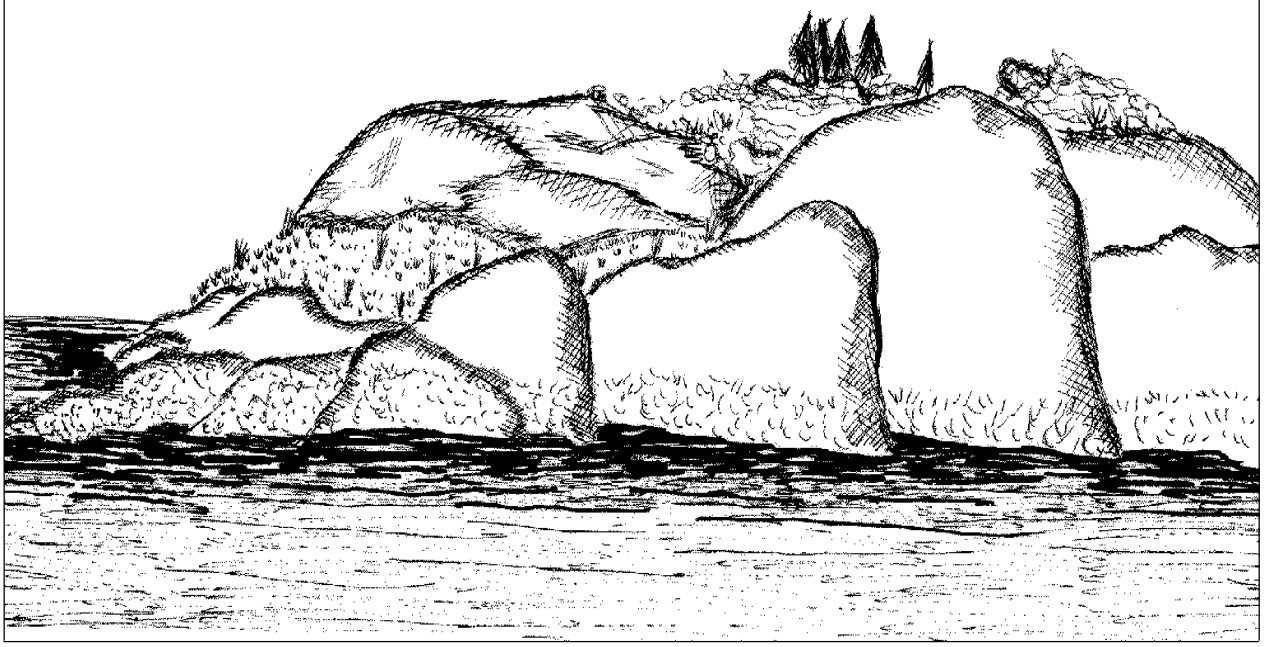
BY THE SEA

A GUIDE TO THE COASTAL ZONE OF ATLANTIC CANADA

MODULE 8:
COASTAL ISLANDS AND CLIFFS



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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)

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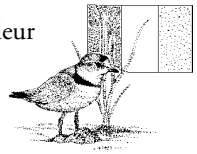
Piper Project/Projet siffleur
4800 Route 11
Tabusintac, N.B.
E9H 1J6



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Department of Fisheries and Oceans
Habitat Management Division
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THE MODULES

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COASTAL ISLANDS AND CLIFFS

What is a Coastal Island?

An island is a land mass completely surrounded by water and isolated from the mainland at least during high tide. During periods of low water (low tide), the island may be attached to the mainland.

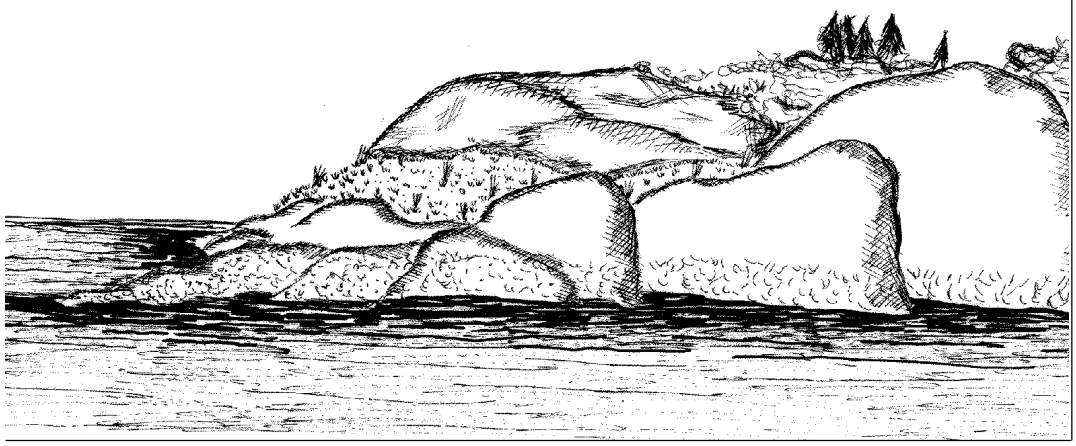
In contrast, a peninsula is a land mass that is always connected to the mainland, even when the tide is high.

Coastal islands often are composed of granite and quartz rocks that rise above the ocean's surface. These types of rock are quite resistant to exposure to wave action. However, in this high energy environment waves wear at surfaces constantly. Over many years, rock surfaces eventually become smoothed and rounded.

In Prince Edward Island the bedrock is soft sandstone. This material erodes easily and the shores made up of sandstone recede up to 1 m per year. As a result the rock surfaces never become smoothed or rounded.

A coastal island normally will have a rocky coastline at the water's edge. As you move farther inland, gradually the rocky shore becomes covered by vegetation as the influence of the sea is less pronounced and soil accumulates.

Islands provide habitat for a variety of wildlife, including plants, crustaceans, mammals, molluscs, birds, and insects. Some species may prefer to inhabit islands while others commonly are found on the mainland.



What is a Cliff?

A cliff is a high, steep slope, often located along a coast. It can comprise unconsolidated materials, such as shale and sandstone, or solid consolidated rock, such as granite.

The most rapidly eroding cliffs are those composed of partially submerged drumlins, which are rolling hills created by a melting glacier, or of sedimentary rock, such as sandstone. They are being eroded away at a rate of approximately one to three metres per year. Cliffs can be hundreds of metres high. In Newfoundland drumlins only occur in very few places. Here most sediment cliffs are created by the erosion of raised seabed sediments.

Sea stacks and sea caves are created by different rates of erosion of different sediments and rocks.

Drumlins and glaciers

A drumlin is a smooth, streamlined hill composed of glacial till (material transported by a moving glacier).

There are two time periods when the Earth's climate cooled and glaciation was prevalent, during the 'Cenozoic Era' (at least one million years ago) and more recently the 'Pleistocene Epoch' (approximately 20,000 years ago). As glaciers moved along the landscape, the weight and force of the ice mass scoured the ground, and the ice picked up pebbles, stones, and boulders.

As climate conditions gradually warmed, the glaciers 'retreated' or melted and in the process deposited their sediment load, or 'glacial till.' Much of the till contains angular rocks, as time has not had a chance to wear and erode the rocks. The load was deposited in streamlined mounds of rock, the drumlins we see today. As the glaciers continued to melt, the sea-water level rose.

Often drumlins became surrounded by water and islands were formed. If the mounds of earth are not surrounded by water, they simply are referred to as drumlins and are often a feature of a hilly landscape.

Glacier retreats have occurred with an estimated average change in the worldwide temperature of only five degrees Centigrade. During peak times of glaciation, approximately one-third (33%) of the Earth's land surface was covered by glaciers. About 10% of the Earth's terrestrial surface presently is overlain by glaciers.

Crevices on the cliff-face can be inhabited by vegetation characteristic of this barren area.

Both coastal island and cliff ecosystems are important to many groups of organisms, including those of the littoral and sublittoral zones. These ecosystems are home to organisms such as fish, crustaceans, molluscs, and seaweed. They are discussed at length in the following modules: module 7: Rocky Shores, module 4: Salt Marshes, module 6: Sandy Beaches and Dunes, module 3: Estuaries, and module 2: To the Horizon - The Nearshore. For the purpose of this module and in order to reduce unnecessary overlap, we will primarily discuss the land-based part of these ecosystems.

Coastal Islands and Cliffs within the Coastal Zone

Coastal island habitat is very important, especially for birds that nest in large groups. Species of birds that nest in large numbers in a small area or on an island are called 'colonial nesting birds.' Many species of birds breed in 'nesting colonies' and these colonies can contain thousands of pairs. This section of the guide will stress the importance of coastal islands to birds, in particular those species (seabirds) that depend on healthy oceans for survival.

Food production on islands is normally low so the surrounding ecosystems are the main source of food (energy). As seabirds consume animals from the ocean, energy is brought to the surrounding ecosystems. As the food is digested, wastes excreted, and birds die, the energy in the form of food is first brought from the sea to land and then returned to the ocean through decomposition and rainfall run-off.

The ocean food resources used by adult seabirds during the year, and especially during breeding season, can be taken back to the island to feed growing and hungry young. In order for a coastal island to be an important area for nesting birds, there must be a substantial food supply nearby, few predators (limited loss of eggs and young to predation), and very little or no disturbance by

people.

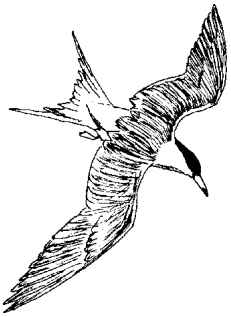
Strength in numbers, you bet!

Birds nesting in a colony allow many eyes to watch for danger (vigilance) and increase chances of young surviving. If a potential danger, a predator for example, is noticed many members of the flock may harass the oncoming predator (mobbing), scaring itaway.

There are negative aspects to nesting in a group as well. Predators may notice large groups of birds and concentrate their hunting activity in these areas. Foxes may eat the eggs and young of birds that nest there. Gulls also have been known to eat eggs and young of terns, for example. Despite the possible entrance of a predator into a nesting area, an individual's chance of survival is improved. A predator will become overwhelmed or saturated with opportunities to kill. This is referred to as‘ swamping.’

Why nest on an island or a cliff?

With Common Terns for example, nesting islands must be free of land predators at least most of the time. This is important as terns are a ground-nesting species most often found in an open area colonized only by grasses.

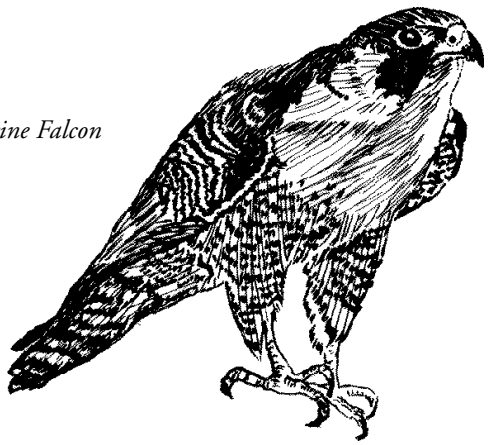


Common Tern

An area free of extensive predation is not the only requirement for terns to colonize a site. Terns fly low over the water and dive for small fishes below the surface of the water. This provides food for the adults or hungry young. Feeding and breeding areas must therefore have clear water, abundant food resources, and few predators (which explains the lack of terns breeding on islands in the Bay of Fundy due to the sediment load in the water).

Cliffs composed of unconsolidated materials are important to birds that nest in burrows, such as Bank Swallows. Cliffs composed of consolidated materials that have ledges or crevices provide nesting areas for Common Ravens and, in a few select sites around the Bay of Fundy, the re-introduced and endangered Peregrine Falcon.

Peregrine Falcon



Location

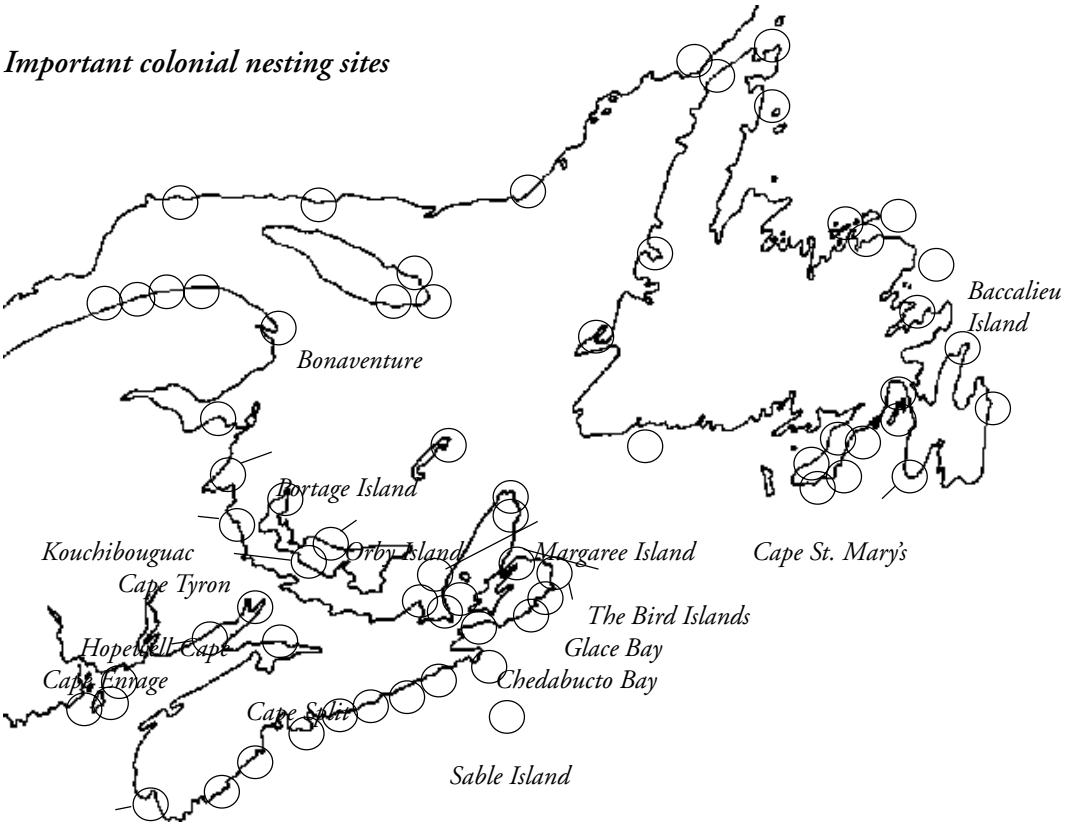
Coastal islands are abundant in Newfoundland and Labrador; they are present to a moderate extent in southern New Brunswick and almost all the Atlantic coast of Nova Scotia (with the exception of the Northumberland coast). There also are few coastal islands in Prince Edward Island.

Cliffs can be formed where erodible land features are exposed to the power of the sea. They are located in southern Nova Scotia, in the Forchu area, Yarmouth County; the basins at the head of the Bay of Fundy (Cape Split and Five Islands); 'The Rocks' at Hopewell Cape, Cape Enrage and Saint Martins, New Brunswick; and Cape Tryon, Point Prim and Orby Head, Prince Edward Island.

The second process leading to the formation of cliffs involves faults or splitting of the Earth's surface. This occurs in the northern portion of Nova Scotia, at Chedabucto Bay and Glace Bay. Cliffs occurring from faults in hard and consolidated rock are common in Cape Breton, Nova Scotia, and the entire province of Newfoundland.

Cliffed islands are, as the name implies, islands with cliff-faces. They are found at Spencer's Island, near Advocate, the Bird Islands, Cape Breton and Isle Haute, Minas Basin, Nova Scotia.

Important colonial nesting sites



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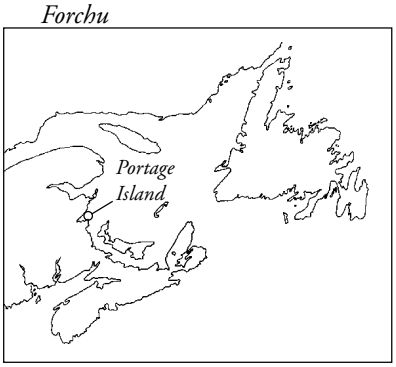


Portage Island, in northeastern New Brunswick, is one of many sites where colony nesters gather each spring. Other major colonies of breeding birds are located on coastal islands and cliffs indicated in the map. This is by no means comprehensive but rather a representation of the areas where colonial nesting birds occur.

THE PHYSICAL ENVIRONMENT

Formation

Many islands have formed after once submerged offshore drumlins (hills composed of material transported by glaciers) are swept clear of unconsolidated materials by wave action, leaving behind large rock 'outcrops.'

Cliffs, or sea-cliffs as they are often referred to, are formed when easily eroded substrate (soil composed of shales, sandstones, and other unconsolidated materials is worn and transported away by wave action. Beaches or marshes, which contain fine sediments, may form nearby when the material transported from a cliff-face is deposited in low energy environments (i.e., sheltered coves).

Cliffs also may be created by structural weaknesses or faults (cracks in the Earth's surface) in consolidated (hard or solid) rock. Through time, with freezing and thawing as seasons pass, these weaknesses may eventually cause a portion of rock to break free. The remaining rock usually will form a steep-sided cliff-face.

Physical Characteristics

Physical parameters of a site will often shape ecosystems and dictate which organisms will be capable of living at a certain site.

Currents

The presence or absence of currents and/or productive waters nearby often will influence whether a site is used by a nesting colony. Currents also will influence the substrate along the shoreline. Strong currents, for example, will round the rocks found on the shore.

For more information on currents please refer to module 1: Introductory module.

Ice

Coastal islands and cliffs made of consolidated substances are not easily worn away by ice. However, cliffs comprising shales and sandstones (easily erodible material) often are worn away extensively. Pack ice and alternate freezing and thawing can play a significant role.

For more information on ice and ice cover in Atlantic Canada please refer to module 1: Introductory module.

Precipitation

Certain sides of coastal islands and cliffs tend to receive more precipitation. Both plant and animal communities are affected by the amount of precipitation that falls. North-conditions, while south-facing slopes are drier and inhabited by organisms that prefer or need dry areas. Heavy precipitation may create new cliff habitat as older cliff-faces are washed away.

Salt

Salt spray from the ocean affects low-lying areas near the shoreline. Only grasses and shrubs capable of withstanding salt are found near the spray zone. Likewise, organisms less tolerant of saline conditions, such as insects and small mammals, are found farther inland.

Seabirds constantly are exposed to salt from sea-water, so adult seabirds are quite tolerant of salt spray. Nests of seabirds sometimes are located near or in the spray zone. Although the adults often become wet with sea-water, the effect of salt on the eggs is minimal.

The choice of nest location is influenced by the lack of vegetation, which is influenced by salt spray. However, at times birds make mistakes and nest too close to the spray zone. Nests in this area can be swept away during storms.

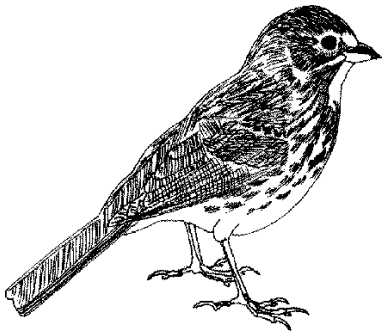
For more information on salt, osmosis, and adaptations please refer to module 1: Introductory module, and module 13: Activities.

Temperature

In areas where the sea-water remains ice free, the temperature tend to be more moderate at island sites that on the mainland (it's cooler in summer and warmer in winter than interior mainland areas). The ocean has a warming effect in winter (because it is much wamrer than the cool winter air). Because of this, islands sometimes provide habitat for uncommon mainland species, such as the Fox Sparrow and the Blackpoll Warbler.

Cooler is better for some species of birds!

The Fox Sparrow and Blackpoll Warbler normally nest in more northerly areas but they are quite content to nest on islands off the cool Atlantic coast, the highlands of Cape Breton, Nova Scotia, and in northwestern New Brunswick. In the latter two areas, there are cooler temperatures because of the higher elevation. The cooler temperatures and constant wind action found on many islands create habitats that are quite different from the mainland. These island habitats are quite similar to those found in northern climates. This allows species common in northern areas to nest on offshore islands.

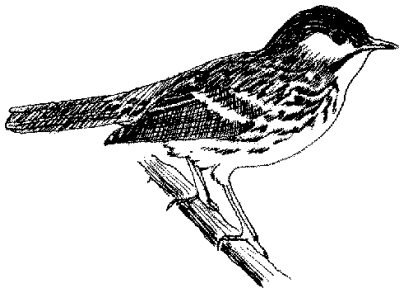


Fox Sparrow

The Fox Sparrow is a large, brown song bird (17-19 cm in length). It is white on the breast with many streaks of 'rusty' brown.

Blackpoll Warbler

The Blackpoll Warbler is smaller (13-14.5 cm) than the Fox Sparrow. This species also frequently nests on coastal islands and areas that are cool (higher elevations). Sexes have differently coloured plumage. Males are black, grey, and white. The females are generally olive-green to grey-green streaked with grey.



Tides

As tides rise and fall, vast amounts of water move across the shores of coastal islands. The tide also may result in some erosion of cliff-faces. Little or no influence is felt on coastal island ecosystems composed of rocks. Shorebirds such as Semipalmated Sandpipers may visit coastal islands to roost (sleep and rest) along the high tide water mark or feed in the intertidal zone during low tide. Of course for either of these activities to occur, sheltered and undisturbed areas must be present.

see activities 4, 14

For more information on tides please refer to module 1: Introductory module and module 13: Activities.

Waves

Coastal islands and cliffs containing erosion-resistant rock are affected very little by waves. However, coastal islands and cliffs composed of unconsolidated soils can be eroded extensively by waves. Storm waves can affect islands by destroying vegetation or causing major erosion.

Wind

The ecosystem of coastal islands and cliffs is one of constant exposure to wind. In this harsh environment, vegetation becomes stunted and deformed. As with precipitation, certain sides of islands and cliffs receive more wind than others. Vegetation communities on the windy side will be quite different from those in sheltered areas. The trees on a windy shore are bent and twisted with branches growing in one direction (inland). This is known as the 'krumholtz' (German for 'twisted wood') effect.

Wind originating from certain directions is associated with particular weather patterns. East and south winds are commonly accompanied by precipitation. North and west winds are common during periods of fine or good weather.

BIOLOGICAL FEATURES

Who Lives Where?

Zonation

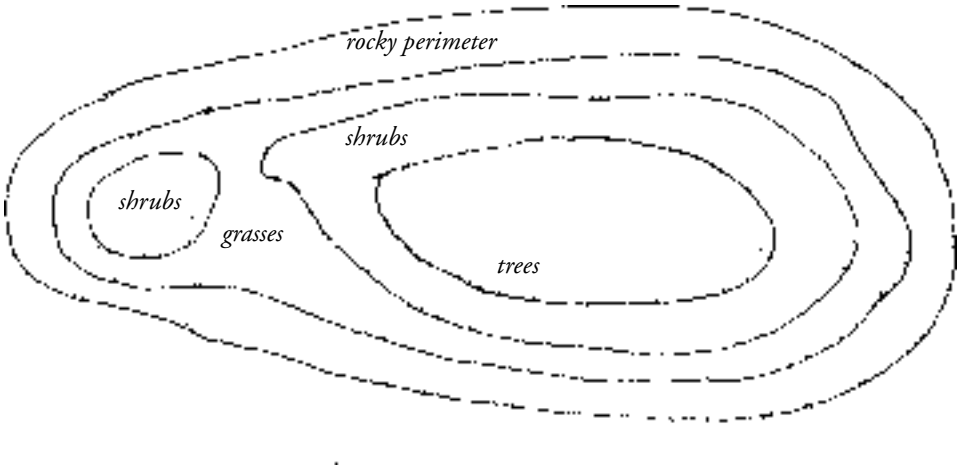
Many islands in Atlantic Canada consist of hard rock substrate, such as granite. Conversely, in certain areas islands are made of sands or 'sand bars.' They contain intertidal habitats identical to those described in module 6: Sandy Beaches and Dunes.

see activity 10

The intertidal zone can be abrupt or lengthy, depending on the slope of the land as it rises from the sea. Please consult module 3: Estuaries for a detailed description of the intertidal zone and the corresponding biotic communities.

The influence of the ocean has a pronounced effect on an island's vegetation. As you move from the shore of the island to farther inland, a zonation of vegetation is evident. Above sea-level along the coast, there is a perimeter made of rocks or sand with no vegetation. Next to this there is an area where soil begins to accumulate and has not been washed away. In this area, plants with a shallow root system, such as grasses, are abundant. These grasses, as well as other plants, can be affected extensively by salt spray in low-lying areas.

Island Zonation



Farther towards the centre of the island, where a deeper layer of soil has accumulated, shrubs begin to colonize, such as raspberry canes and wild roses (collectively known as brambles).

If the island is large enough and a substantial amount of soil is found, small to medium-sized spruce trees will grow there.

Vegetation, such as the White Spruce, may be short and stunted by the prevailing winds blowing onshore. This stunted growth of evergreen trees (also called krumholtz, tuck or tuckamore) may create feeding and nesting areas on islands for certain species of land birds, such as the Fox Sparrow and Blackpoll Warbler.

Plants

Rocks or other barren areas found on islands or cliffs often are covered with 'flaky growths.' These growths are lichens, plants that are able to grow on the surface of rocks. Other low-growing plants and shrubs may colonize barrens. 'Creeping' plants grow horizontally and are less affected by the wind.

Coastal cliff ecosystems are probably one of the most severe areas colonized by plants. A few herbaceous plants can become established, however trees rarely are able to grow here because of the salt spray, lack of soil, and instability of the cliff-face. Few species of plants can permanently live in this ever-changing environment.

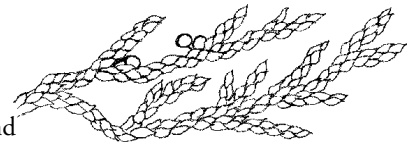
Seaside-Plantain

Seaside-Plantain is a thick-leafed, fleshy plant with a succulent texture. It thrives in exposed areas near the ocean. This species of plantain occurs along shores, cliffs, beaches, and salt marshes. In less favourable areas where Seaside-Plantain may grow, the leaves often are narrow and spikes are shorter than usual.

Roseroot

Roseroot is a succulent plant that lives in moist crevices on ledges.

Creeping Juniper



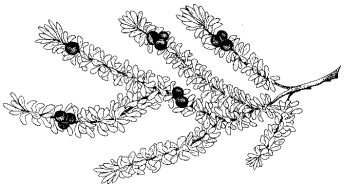
Creeping Juniper is similar to the spruce tree but grows horizontally across the ground. This dark green plant is common on headlands, cliffs, or other exposed areas. Juniper is frequently found in areas exposed to winds. It is commonly intermingled with grasses in areas not yet colonized by trees. Only a small amount of soil has to be present for this plant to grow.

Harebell/Bluebell

The Harebell is a violet-blue flowered plant with bell-shaped flowers. The stem is wiry and hairy. The Harebell often grows in ditches, meadows, or low-lying wet areas, as well as on rocky slopes.

Bayberry

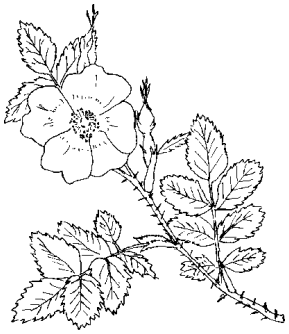
Bayberry is best identified by the clumps of grey, very fragrant berries located on the stem. Bayberry, or Candleberry as it sometimes is called, can be boiled in water to collect a wax to make aromatic candles. When Bayberry grows abundantly, dense thickets often are formed that may be used by nesting birds. Many song birds also eat these berries.



Black Crowberry

Black Crowberry is a mat-forming ground cover that has evergreen leaves and an inconspicuous flower. Fruits or berries are deep purple changing to black as they ripen. It is another creeping shrub similar to Creeping Juniper. This plant also inhabits cliffs, headlands, and barrens.

wild rose



The wild rose is sometimes characteristic of plants growing in unwanted areas (wastelands). This prickly bush has flowers that vary from white to dark red. There are many species of wild roses (upwards of 20) and many species are capable of reproducing with other species.

Succession

Succession is extremely important in the natural process of island colonization. With the various groups of plants colonizing an island, there is a subsequent faunal succession.

A lichen is a special type of organism. It does not neatly fit in with plant or fungal species. It is a combination of both of these organisms existing together symbiotically, with both organisms benefiting from the association.

Lichens secrete carbonic acid that breaks down the rock's surface. The rock gradually is broken into small particles, creating small amounts of soil. Over time, soil accumulates and grasses may start to grow here. As grasses become established, they stabilize the soil, making it less prone to erosion. As grasses grow, die, and decompose they too contribute to soil formation. As the soil content increases, so does the ability of larger grasses and shrubs to grow. With the establishment of shrubs, more soil may accumulate and eventually enough soil will be present to support the growth of a tree.

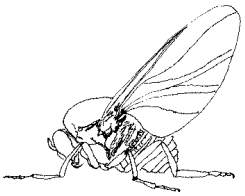
The process whereby lichens through time are replaced by grasses, grasses are replaced with shrubs, and shrubs replaced with trees is known as 'succession.' All natural ecosystems have been created by some type of succession. Natural and unnatural events may revert communities to earlier successional stages. The nesting seabirds produce large amounts of feces or 'guano.' This 'guano' is very strong chemically, containing uric acid or 'urea.' If enough guano coats a tree it will die. When the tree dies, it begins to decay and the birds eventually will move their nests to other nearby trees that are alive. Nutrients from the decomposing tree and guano are returned to the soil and promote the growth of new grasses.

With changes in vegetational succession, there is accompanying faunal succession. Terns nest on grassy islands, Common Eider ducks prefer islands with brambles, and Great Blue Herons and Double-crested Cormorants prefer to nest in mature trees.

Insects

There are few species of insects that typically call islands home. Many flying insects, such as mosquitoes and black flies, which are common on the mainland also are found on islands. Terrestrial insects also could colonize islands through chance events, such as being blown there during storms, or as parasites on some of the island's occupants (such as fleas, ticks, or lice on birds and mammals).

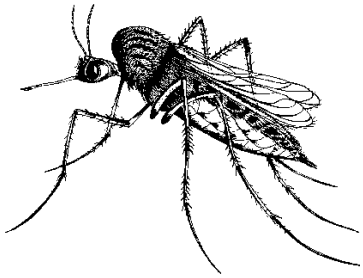
black fly

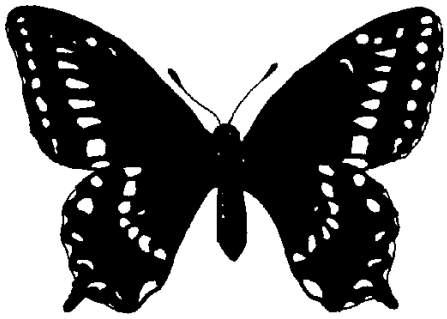


Much like mosquitoes, females are vicious biters whereas males do not bite. Both the mosquito and black fly use blood from their prey as nutrients in order to produce their eggs. Larvae live in the bottom of streams in large numbers. Black fly larvae become food for many aquatic predators, such as trout. The larvae are coconut-tree-shaped with the mouth being near the comblike rakes or leaves of the 'tree.' These structures are used to gather food from the surrounding water.

mosquito

Mosquitoes are the biting insects that we all are familiar with. However, only one sex (the females) is capable of biting (equipped with the appropriate proboscis). Eggs are laid at the surface of standing water (including pools in salt marshes) and are seen as 'wrigglers' at the air-water interface.



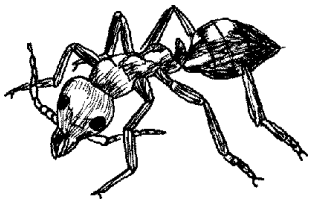


butterfly

Butterflies often have brightly coloured wings that are comprised of thousands of overlapping scales. Young or larval forms of butterflies are called 'caterpillars.' Most caterpillars are harmless to handle but a few species emit a pungent odour when disturbed.

ant

Many ants are wingless all their lives. In particular, those that are referred to as 'workers' never have wings. In contrast, the sexual forms are winged for part of their lives. Males will have wings while they mate, then they die. Females are winged to disperse but then lose their wings after dispersing. During this winged stage they can 'set up a home' and possibly colonize an area, such as a coastal island.

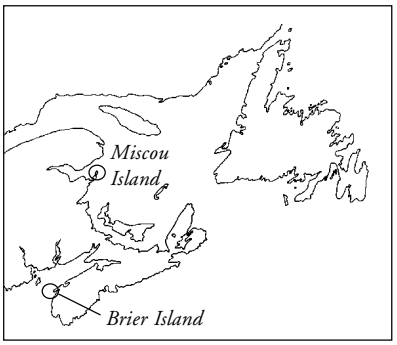


Molluscs, Crustaceans, and Fish

These species, present in the intertidal zone, are explained in detail in other modules, such as module 3: Estuaries, module 7: Rocky Shores, and module 2: To the Horizon - The Nearshore.

Birds

By far the greatest variety and most obvious wildlife found on coastal islands are birds. Many species of birds (mostly marine birds and seabirds) nest on these islands. Of course, there are a few species of small song birds or common land birds thatfrequent islands, such as the Dark-eyed Junco and Blue Jay.



Some coastal islands are important sites for migrating birds because of their geographic location. These islands may be the last land before an extensive flight over a body of water during migration. Brier Island, located at the mouth of the Bay of Fundy, and Miscou Island are important migratory corridors for birds.

Wings designed for a purpose: the aspect ratio of wings

The wings of birds are as variable as are the different species of birds. Some birds have wings that are long and rounded, such as the hawks. Others have long but pointed wings, such as the terns. Each species has evolved a certain type of wing in order to complement their particular way of life. The wings of a Peregrine Falcon, for example, allow the bird to fly at incredibly high speeds, allowing it to easily catch any prey it is pursuing. Some hawks have evolved rounded wings to allow for easy manoeuvering, for example, as they fly between trees in pursuit of prey.

The wing's length in proportion to its breadth is referred to as the 'aspect ratio.' This ratio dictates how often birds have to flap their wings to maintain flight and avoid stalling. Species such as the Black Guillemot have a low aspect ratio and heavy body weight. They must flap their wings at a fast pace to achieve and maintain flight. In contrast, the Herring Gull has a high aspect ratio (long and narrow wings) and light body weight. Therefore, wing beats during flight are not as frequent as for the Black Guillemot, for instance.

A variety of birds find coastal islands to be a suitable nesting location. Coastal islands are preferred for breeding when predators, such as gulls, foxes, and mink, are limited. Because many species nest on islands, each has developed a strategy for nesting in a particular type of ecosystem. Depending on the species, colonial nesting birds will nest on the ground, ledges, cliffs, or trees located on an island.

Who nests where?

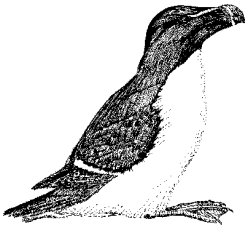
In many species of marine birds, almost their entire life is spent at sea. They only return to land to lay eggs and raise their young. For this short time, islands are very important for nesting seabirds.

Each species of bird has a particular habitat it will use for breeding. Many species, such as Peregrine Falcons, Black Guillemots, and Black-legged Kittiwakes, use the rocky cliffs and ledges for nesting. Others (such as eiders and terns) prefer to nest in the grass, or among prickly shrubs also known as brambles. Still others, such as the Atlantic Puffin and petrels, require unconsolidated and loose soil or burrows so they can nest underground.

Some examples

Razorbills often nest on cliffs to escape from predators. They nest at only a few sites in the Maritimes. Substantial numbers nest in Newfoundland and Labrador. A cormorant colony can be located on coastal islands where food is located nearby. In contrast to the Double-crested Cormorant, the Great Cormorant frequently nests on cliffs instead of trees. Black Guillemots are common in the North Atlantic region (Newfoundland), but occasionally can be found in Nova Scotia breeding at sites such as Margaree Island. Guillemots often nest on cliffs to escape from predators searching for an easy meal. Kittiwakes are common nesters in northern areas of Atlantic Canada. Bank Swallows need unconsolidated soils to build their nests. They prefer to nest in burrows excavated on faces of unconsolidated cliffs or sand dunes. The Peregrine Falcon nests on cliff-feathers during August. During this time, adult birds cannot fly and may look like immature birds. Eiders nest on the ground but in dense thickets of wild roses or raspberries (brambles). Northern Gannets nest on island colonies such as Bonaventure Island in Québec. Puffins nest in burrows or rock crevices on cliff-faces and islands at a few select sites in the southern portion of Atlantic Canada, for example Machias Seal Island. Many more puffins nest in northern Atlantic Canada, in Newfoundland and Labrador. Great Blue Herons use offshore islands in Prince Edward Island. As a result of loss of habitat and human disturbance, they no longer nest on the mainland.

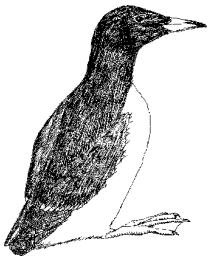
Many land birds live on coastal islands and some species, such as the Dark-eyed Junco and Blue Jay, even nest there. They are not limited to breeding on islands though; they commonly nest on the mainland.



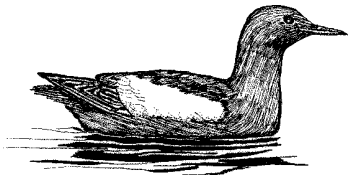
Razorbill

Razorbills are black and white. They measure about 40-47 cm and have a thin bill that has been compressed laterally; hence the name.

Common Murre



The Common Murre nests in large colonies on cliffs or rocky islands. These diving birds are particularly common in Newfoundland and Labrador, and the Québec North Shore. 40-43 cm.

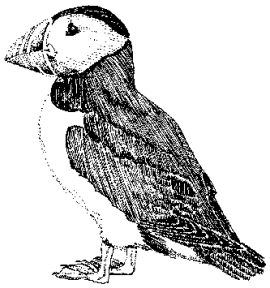


Black Guillemot

Black Guillemots are medium-sized birds that are black and white and have red feet. They are about 30-36 cm in length and are common in bays around certain islands in nesting season.

Various bird's preferred nesting site, favourite food, and method of capturing food

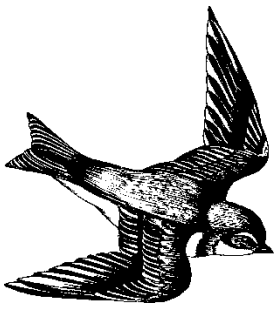
Species	Nest site	Food preference	How they feed
Common Eider	open ground	crustaceans and molluscs	collected while diving
Black Guillemot	cliffs sheltered by overhanging rocks	fish, crustaceans, molluscs	caught in beak while underwater
Razorbill	cliffs on bare ground or rock	fish and shrimp	caught in beak while underwater
Common Murre	ledges on bare ground or rock	fish, molluscs, marine worms, crustaceans	caught in beak while underwater
Thick-billed Murre	ledges on bare ground or rock	fish, squid, crustaceans	caught in beak while under water
Northern Gannet	open cliff-faces	fish	plunging into water from the air



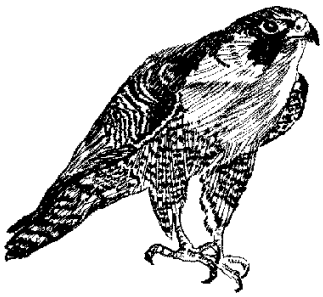
Atlantic Puffin

Atlantic Puffins are black and white with large laterally com pressed bills that are coloured orange, yellow, and white. They are approximately 29-34 cm in length. They feed extensively on small fish captured underwater with their big beaks.

Bank Swallow



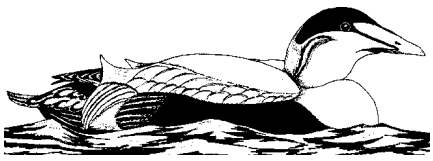
Bank Swallows are small brownish-black and white birds only 13-14 cm long. They are close relatives of the familiar Tree Swallow. They can be seen feeding on insects caught while they fly back and forth through the air.



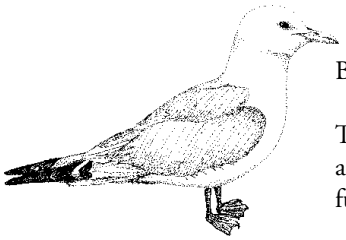
Peregrine Falcon

Endangered Peregrine Falcons are one of the fastest flyers alive and a 'bird of prey.' This means they survive on food they kill, either shorebirds or small forest birds. The falcon is 38-50 cm long and is the size of a crow. It has a greyish-brown face mask referred to as a 'moustache.'

Common Eider



Eiders are large ducks 50-60 cm in length. The two sexes are differently coloured after they become sexually mature. Adult males are black and white and adult females are brown. Immature males are first brown, then moult to varying degrees of mottled black and white. Immature females are brown as well.



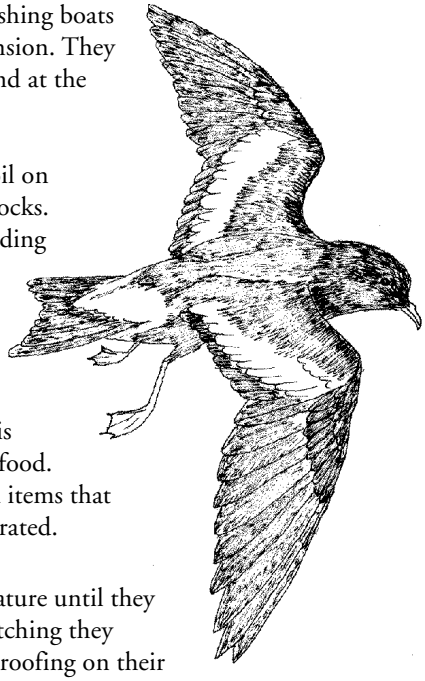
Black-legged Kittiwake

This bird is grey across the dorsal side from wing to wing. Wings are black-tipped, and the feet and tip of the tail also are black, further distinguishing it from other gulls.

Double-crested Cormorant

Double-crested Cormorants are large (74-89 cm in length) black birds often observed roosting on shorelines or rocks with wings spread to allow their feathers to dry. They nest on trees and not on cliffs like the Great Cormorant. They are excellent swimmers and pursue their prey underwater after diving to catch them.

The Leach's Storm-Petrel



These petrels are small black birds (20-23 cm) with a forked tail fan. They frequently follow behind fishing boats feeding on discarded refuse or particles in suspension. They eat mainly plankton, small shrimp, and fish found at the surface of the ocean.

Petrels nest in burrows dug in unconsolidated soil on islands or below ground-level crevices between rocks. They spend the day either in their burrow or feeding at sea. Petrels leave or enter their burrows only at night to avoid avian predators, such as gulls or land predators, such as foxes.

Leach's Storm-Petrels, like some other marine birds, have one tube or nostril on their bill that is used for eliminating excess salt ingested in their food. This adaptation allows for birds to eat salty food items that normally would cause the bird to become dehydrated.

Leach's Storm-Petrels do not become sexually mature until they are five years old. For the first two years after hatching they seldom return to land, so they must have waterproofing on their feathers and be capable of feeding and resting at sea. At three to four years of age, they will return to land only to 'scout out' a potential island for nesting.

Moonlit nights provide for excellent feeding, however they pose a threat for these little birds. During nights with strong moonlight, gulls are a serious predator as petrels readily can be captured while feeding. Petrels feed on zooplankton (krill) which exhibit a vertical diurnal migration in the water column. During periods of daylight, zooplankton are found at the surface while night is spent deep below the ocean's surface. During moonlit nights, zooplankton will often remain at the surface and petrels are able to feed all night.

Lighthouses also are an attractant to these little birds and many can die striking these structures, or be injured and subsequently eaten by predators. Also, owls will roost in trees on breeding islands and kill petrels as they return to nesting burrows.

Mammals

No mammal is found exclusively on coastal islands. In order for small mammals to inhabit coastal islands, there must be a food supply. For instance, insects, berries, or other vegetation must be available for mice such as the Deer Mouse or shrews such as the Masked Shrew to eat.

Some of the larger mammals, such as the Red Fox, depend on insects and berries or food washed ashore from the ocean. Another favourite food is the eggs and young of birds when they are available in the nesting season. River Otter and Mink also may get some food from the aquatic environment.

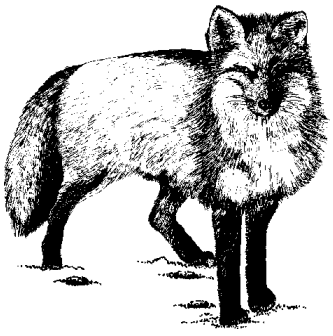
Certain islands, such as Sable Island, provide critical breeding habitats for some mammals as well. Each year in mid to late winter Grey and Harbour Seals congregate at Sable Island to have young or 'pup.'

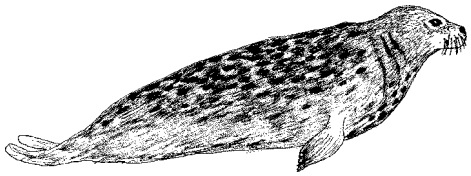
Norway Rat

Norway Rats are brown and approximately 50 cm in length (the tail is about half of the total length). The tail is scaly and does not have fur. These animals pose a serious threat to ground-nesting birds, such as gulls, because rats will feast on eggs.

Red Fox

Red Foxes also have been known to inhabit coastal is lands used by breeding birds. Foxes will eat both the eggs and young of ground-nesting birds. The location of colonies may be influenced by the presence of such predators. Some birds are known to relocate if foxes visit a site regularly.





Grey Seal

Seals may 'haul out' to bask in the sun on partially submerged rocks as the tide begins to ebb. An outcrop of rocks must be located in a sheltered cove for seals to engage in this activity.

ECOLOGY

Stress and Survival

For organisms to survive in any environment, there must be food and fresh water available. Although food and fresh water are not always available for seabirds from islands, birds can get these from the surrounding ecosystems.

Seabirds and the Water

Seabirds, for example various species of gulls, have webbed feet, waterproof feathers, and the ability to swim and propel themselves on the water. Others, such as the Atlantic Puffin, have waterproof feathers and webbed feet but also use their wings to propel themselves underwater in pursuit of prey.

Not only do the webbed feet assist the bird's swimming ability, but the position of the legs on the body also helps. Legs positioned far back towards the tail allow easier swimming and sometimes diving. This also helps in capturing prey. The legs positioned in this way result in difficulties walking on land. Such birds often are clumsy and awkward looking on land but excellent swimmers.

Terns, cormorants, gannets and other seabirds have larger salt glands than land birds. This allows them to excreet excess salt.

How birds keep the water out of their feathers

An oil gland is located at the base of the tail feathers under the contour feathers on the dorsal side of the bird. The gland secretes wax, fats, and fatty acids that are smeared on feathers as the bird grooms itself or 'preens,' making them waterproof. This gland also is called the preen gland or uropygial gland. As the feathers are preened with the bill, secretions are collected from the short feathers protruding out of the opening of the uropygial gland. The water repellent is applied to the feathers by the bill. This also keeps the surface of the bill moisturized and keeps the outer layers of the bill from cracking and shedding off.

Many birds that do not frequent the water also have these glands although they do not swim. This does, however, keep rain or other forms of precipitation from penetrating the feathers. It has been thought by some that cormorants lack this gland and must dry their feathers after being in the water. They often spread and flap their wings while roosting on abandoned docks, pilings, rock outcrops, and headlands.

Seabirds and Food

Many island-dwelling birds depend on the ocean for food, except for the land birds that eat vegetation and insects. Sea and marine birds feed on plankton, tiny crustaceans, and fish from the ocean.

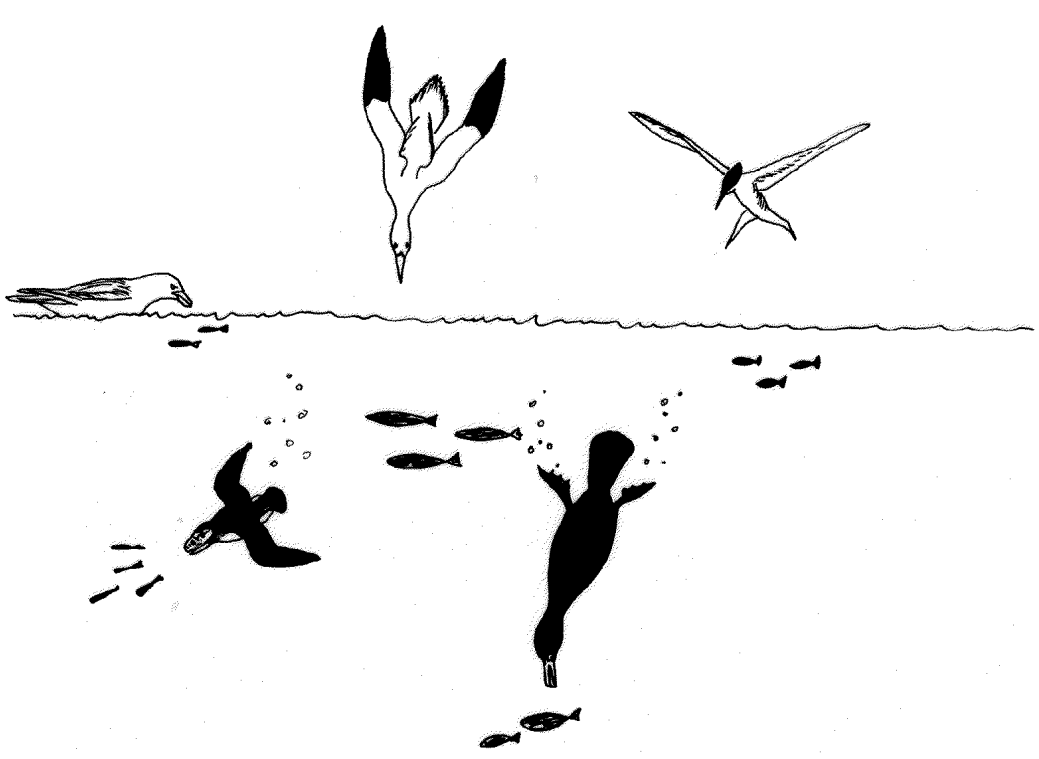
Seabirds gather food in many different ways. Some, such as the Northern Gannet, soar at a high elevation and plunge into the water to capture food. Gannets have 'built-in air bags' in the breast area to absorb the shock of hitting the water's surface at high speeds.

Terns will search clear water for small fish near the surface.

Cormorants, murres, and Razorbills use their feet or wings for propulsion to dive below the surface in pursuit of fish and other marine life.

Yet others, such as gulls, feed while sitting on the surface. And still others, such as petrels, 'skim' the surface of the water collecting zooplankton, undigested food particles from whale excrement that is oily and floating on the surface, or edible refuse from ships.

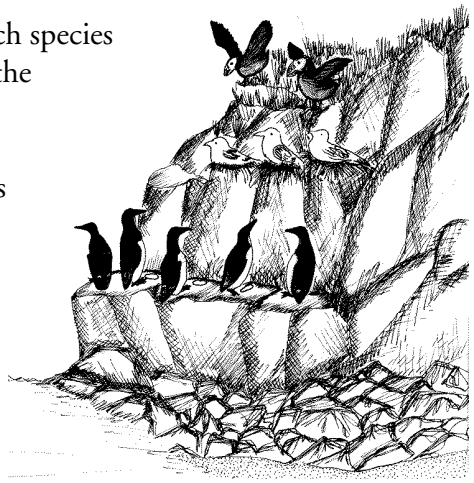
Food gathering methods of birds



Seabird Strategies

Seabirds have developed additional biological strategies for nesting in colonies. As seabirds visit and leave colonies, adaptations have evolved to avoid mid-air crashes between entering and exiting birds. Takeoffs (exit) and landings (entrance) on an island colony are from opposite directions depending, of course, on the direction and strength of prevailing winds. Northern Gannets leave the colonies in one direction and come back approaching from the opposite way.

In order for eggs and young to survive, each species has developed special skills for increasing the chance of reproducing successfully.



Guillemots and murres nest on bare ledges with no nest bowl. The eggs are shaped so they will roll in a circle if disturbed and they will not fall off the ledge.

Nesting on islands has increased the chance of young surviving by excluding many terrestrial predators. In much the same way, cliff nesters have further decreased the chance of nesting failure by constructing nests where predators cannot gain access. Others, such as the Atlantic Puffin, nest in burrows dug in unconsolidated soil or underground crevices.

Productivity

Coastal islands and cliffs are productive ecosystems although their productivity is very different from the productivity of salt marshes, the nearshore or estuaries.

Land birds often will eat either seeds, or insects that feed on plants. However, very mobile organisms like birds with special adaptations, can collect their food from the ocean. For these seabirds, the importance of certain sites for nesting is linked very closely to the production of food in the ocean!

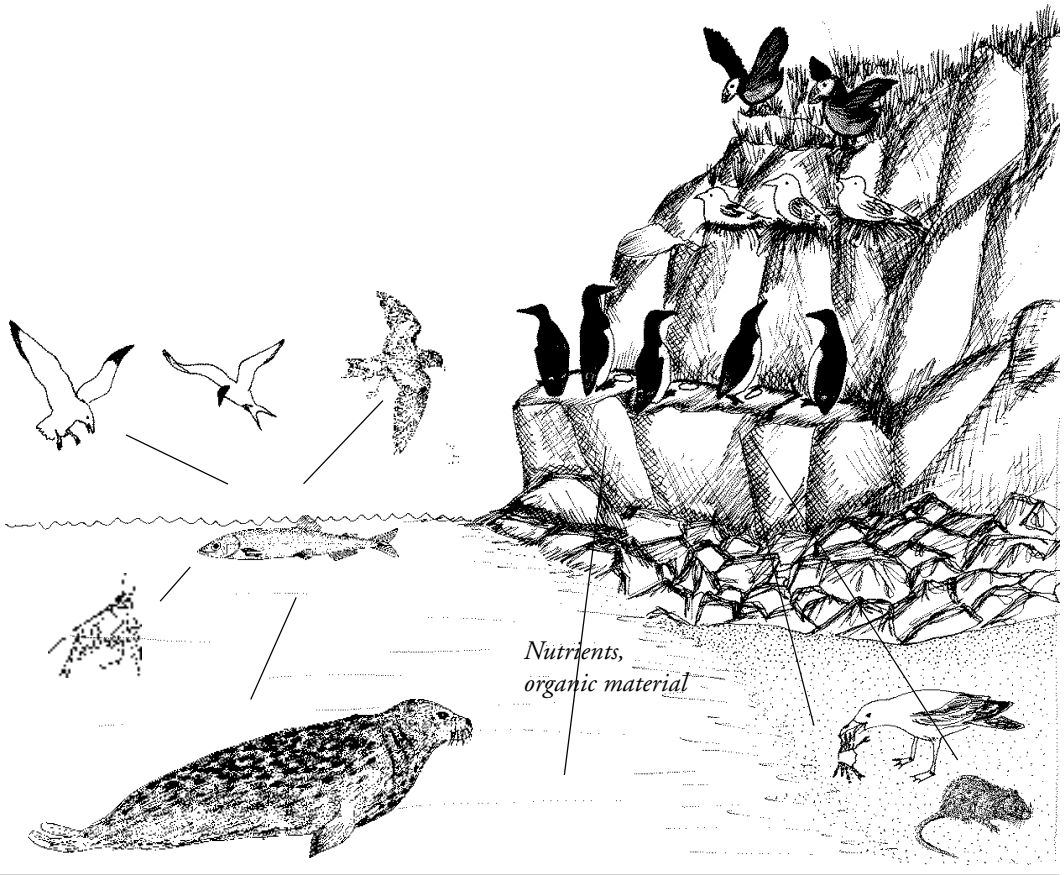
Seabirds frequent nearby productive ecosystems to gather food. These include: estuaries where terns may hunt, offshore areas with upwellings where gannets and puffins may hunt, and nearshore areas where gulls may forage.

Food Web

Phytoplankton produced in the ocean is eaten by zooplankton. Phytoplankton production is greatest in upwelling areas (see module 1: Introductory module). The zooplankton are eaten by Krill and fish. The Krill or fish are eaten by many different organisms, including colonial nesting seabirds (which often carry this food back to their young), larger fish, or marine mammals (whales and seals).

Bird eggs, young, and adults may become food for other birds or some of the larger island-dwelling species of mammals. Nutrients are eventually returned to the ocean by decomposers when these organisms either defecate or die. The cycle is repeated continually, fuelled by these 'recycled' nutrients and the sun.

Some feeding relationships around an island



COASTAL ISLANDS AND CLIFFS AND US

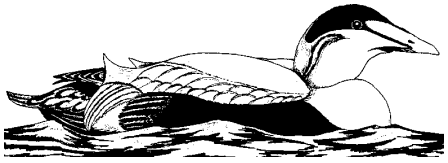
There are many examples of people using birds that nest in colonies. Egg and down collecting are two examples.

Eggs laid by nesting birds on coastal islands were once an important food resource for people in small communities along the coast, and until recently this was the case on the coast of Québec, Labrador, and Newfoundland.

Hunting of colonial nesting birds for human consumption is well documented.

The collection of down from Common Eider duck nests occurs in some places where these birds nest in Atlantic Canada, particularly in Newfoundland and Labrador. Although this activity takes place during the breeding season, it is closely monitored and regulated by permit from the federal government. Collectors operate under guidelines regarding how and when this activity will take place. Collection of eider down must occur before eggs begin hatching and young need constant care. This timing not only minimizes disturbance of young but enhances the quality of the down by ensuring it is clean and unsoiled.

Common Eider



Recently, island exploration has become a pastime enjoyed by many Atlantic Canadians. Mountain climbing also is becoming a pastime for many people.

As interest in the environment and nature increases, ecotourism will grow.

Problems in the Ecosystem

It is illegal to remove nest materials (sticks, grass, feathers, etc.), eggs, or young from any migratory bird's nest. Nonetheless, egg poaching continues to be a serious problem in certain locations.

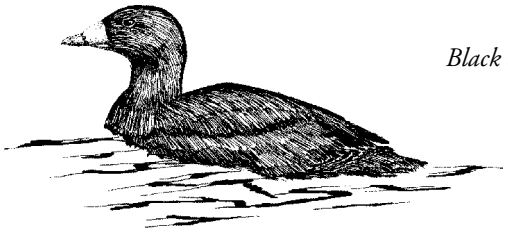
Illegal spring hunt in northeastern New Brunswick

Off northeastern New Brunswick, there is an unfortunate spring tradition. As ducks migrate north to breeding grounds, there is a 'spring hunt.'

The three species of scoters (Black, White-winged, and Surf) common in the area are the target of the hunters. The ducks migrate north in the spring along the coast of northeastern New Brunswick preparing for their overland trip to breeding grounds in the north near Hudson Bay, Ontario. They move along the coast until they encounter pack ice and migration is slowed. The large concentration of birds is tempting to some hunters...who take birds illegally.

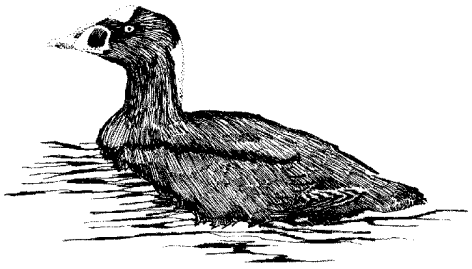
As these birds already have experienced a legal harvest in the autumn, additional mortality from humans should be avoided. The birds that are killed at this time of year are the breeding population. A kill of birds in the spring is undoubtedly increased in significance when the young that could have been produced are considered. The illegal hunting cannot continue without having a profound negative impact on seaduck populations.

Fortunately, attitudes toward 'spring hunting' are slowly changing. It is less of a problem now than it was just a few years ago. As ideas change and people respect nature more, bird populations may begin to rebuild to numbers observed in the past.

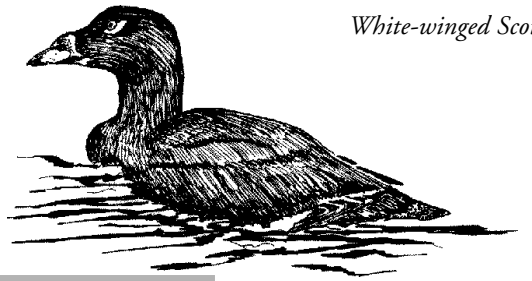


Black Scoter

Surf Scoter



White-winged Scoter



Declining seabird populations

Regional breeding populations of some seabirds are declining. In many instances, food or appropriate breeding habitat have become limiting factors. Both of these factors have been affected by natural and unnatural (human-induced) influences.

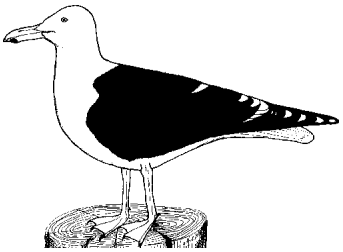
'Egging' by humans in the past has been recognized as a contributing factor in the demise of local breeding populations. Similar to the extinct Great Auk, gannets lay only one egg per year and they do not re-nest if the nest or egg is destroyed. The removal of a single egg will result in no offspring produced from that breeding pair of gannets that year. Northern Gannets in the past (nineteenth century) nested at an area referred to as 'The Gannet Rocks,' Yarmouth County, Nova Scotia. The colony was eliminated because of egging over a period of time. Now, only migrants are sighted off southern Nova Scotia. The birds still breed at Cape Saint Mary's, Baccalieu and Funk Islands, Newfoundland, and Percé, Québec.

Another group of colonial nesters, the terns (Common, Arctic, and Roseate) all have experienced decreases in their local breeding populations. These declines have been caused by a depressed food supply, loss of good breeding habitat, disturbance fromhumans, and competition from the more dominant species of gulls (Herring, Great Black-backed, and Ring-billed).

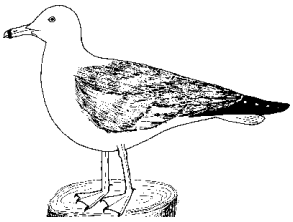
Of particular interest is the competition from gulls. Both Great Black-backed and Herring Gulls have displaced breeding terns and are recognized as a limiting factor in breeding populations on Sable Island, Nova Scotia.

There is even greater concern over the increasing Ring-billed Gull population. This species of gull is very dominant. In fact, although this species is smaller than Herring Gulls, they dominate for nest site selection. The much smaller terns also are threatened with nest site competition from the more assertive Ring-billed Gull.

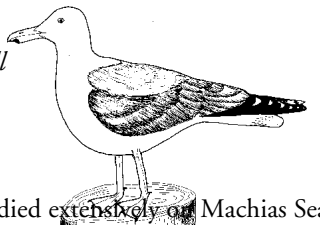
Great Black-backed Gull



Ring-billed Gull



Herring Gull



Arctic Terns have been studied extensively on Machias Seal Island. The availability of food has been shown to affect growth rates and subsequent survival to fledging of tern chicks. As juvenile Herring is a preferred food, there are potential conflicts with humans who also catch the small herring. Focus of fishing efforts on fish such as herring and overfishing may create a problem of food scarcity.

Populations of Atlantic Puffins also have declined near settled areas, probably from the impact of human disturbance while breeding.

Human disturbance can result in any of the following: 1) nesting adults might

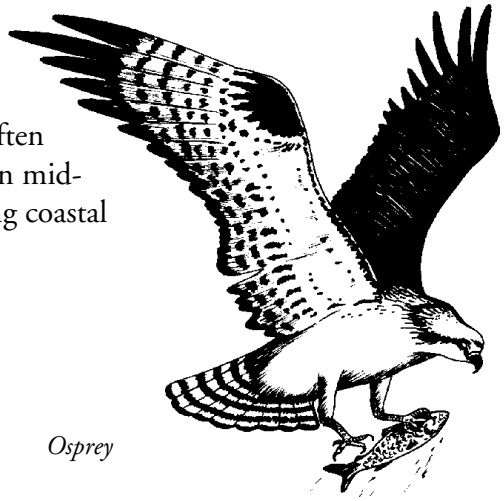
abandon eggs; 2) eggs temporarily abandoned by adults are more susceptible to predation by egg-nest too long; 5) unleashed pets (specifically dogs) may eat eggs, injure, chase, or worst of all, kill young or adults; or 6) less noticeably, this can cause both young and adults to expend energy to escape from humans that otherwise could be used for feeding, preening, and learning to fly.

The use of cliffs for mountain climbing is not detrimental in most instances. However, one of our endangered species, the Peregrine Falcon, nests on cliffs. Ecotourism may negatively impact the birds nesting on coastal islands during the breeding season.

Storms can be disastrous. Nests, eggs, or even young can be washed out to sea and rain on eggs and young can kill them by exposure to cold.

Substances from the land may eventually find their way to coastal islands and cliffs. Pollutants are not only trouble where they are applied, but affect the whole environment, including coastal island and cliff inhabitants.

At one point in the past, Ospreys were adversely affected by the amount of pesticides that were being used. The shells of Osprey eggs were thinned as a result of eating fish containing DDT, a chemical used for pest control. Now that the use of DDT has been eliminated in Canada, the Osprey is making a comeback and this bird can often be observed looking for fish (hovering in mid-air) in the waters of sheltered coves along coastal island shores.



Osprey

Sometimes commercial fishers lose fishing gear in storms. Some of the lost gear can become a fatal trap for mammals and birds. Retrieval at the wrong time can disturb the nesting birds.

Coastal islands might see some pressure for cottage and resort developments, and the influx of tourists and subsequent heightened activity near breeding islands could destroy these important ecosystems.

SEE ACTIVITIES 42, 43

Global warming and sea-level rise could result in further loss of colonial nesting

habitat as sea-levels rise and islands are submerged.

Oil spills can be deadly for all marine life, not seabirds alone! Just a little oil on feathers and the birds become unable to fly, and they loose the ability to insulate themselves from cold or heat.

Protection of the Ecosystem

Both the federal and provincial governments and non-government organizations are striving to protect islands and cliffs as critical esosytems for colonial nesting birds and other wildlife.

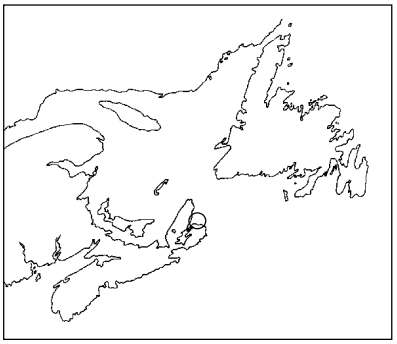
To protect the birds themselves, legislation such as the Migratory Bird Convention Act and The Canada Wildlife Act exists. Migratory Bird Sanctuaries offer legal protection to migratory birds, their nests, and eggs.

Habitat is protected through the establishment of Wildlife Management Areas, Natural Areas (P.E.I.) and National Wildlife Areas. Areas that are essential to certain populations of birds have been recognized through the establishment of Ramsar sites or wetlands of international importance. This provides a moral obligation for continued efforts to protect the wetlands.

Coastal islands that are being used for nesting by birds should not be disturbed from early spring (April 1) until midsummer (August 15). The least harmful way to observe nesting colonies of breeding birds is via a boat along the shore of an island.

In order for these areas to be protected and recognized as essential ecosystems, many federal, provincial, and non-government organizations have been involved in developing conservation strategies for important ecosystems.

The Bird Islands (Hertford and Ciboux Islands) are



located 2.5 km off Cape Dauphin, Victoria County, Cape Breton, Nova Scotia. The islands are important nesting sites for a variety of seabirds. Among the common nesting species are the Leach's Storm-Petrel, Great Cormorant, Razorbill, Black Guillemot, and Atlantic Puffin. Populations of birds breeding on the 154 acre island are now protected as this area is owned by the Nova Scotia Bird Society. In the past, both islands were im pacted negatively by the activity of humans. Sheep were placed on the island and this limited available nesting sites for breeding birds. Fishers also used both eggs and birds as sources of food. During this time, seabird populations decreased because of human activities. Now the only human activity near these islands is tour boats carrying visitors to observe the breeding birds from a safe distance.

REMEMBER

You can do your part too! If seals basking in the sun on partially submerged rocks dive back into the water, you are too close to the island during the critical breeding period. Birds may not appear alarmed but your presence may cause stress to adults or young and adults may abandon nests.

SPECIES LISTS

The following lists are by no means a complete account of the organisms living in this ecosystem. They were chosen as representative species, ones that would most likely be observed when visiting coastal islands and cliffs. There are also great regional and local variations, and we realize the difficulty in accommodating all of these.

Plants

wild rose	*Rosa sp.*
wild raspberry	*Rubus sp.*
Black Spruce	*Picea mariana*
Creeping Juniper	*Juniperus horizontalis*
Harebell/Bluebell	*Campanula rotundifolia*
Seaside-Plantain	*Plantago maritima*
Silverweed	*Potentilla anserina*
Three-toothed Cinquefoil	*Potentilla tridentata*
Scotch Lovage	*Ligusticum scothicum*
Knotted Pearlwort	*Sagina nodosa*
Sea Rocket	*Cakile edentula*
Bayberry	*Myrica pensylvanica*
White/Cat Spruce	*Picea glauca*
Black Crowberry	*Empetrum nigrum*
Roseroot	*Sedum rosea*

Molluscs

Razor Clam	*Ensis directus*
Northern Quahaug	*Mercenaria mercenaria*
Soft-shelled Clam	*Mya arenaria*
Surf Clam	*Spisula solidissima*

Insects

ants, bees, and wasps	*Order Hymenoptera*
flies	*Order Diptera*
fleas	*Order Siphonaptera*
springtails	*Order Collembola*
beetles	*Order Coleoptera*
moths and butterflies	*Order Lepidoptera*

Crustaceans

Green Crab	*Carcinus maenas*
Rock Crab	*Cancer irroratus*
Sand Shrimp	*Crangon septemspinosa*

Fish

American Sand Lance	*Ammodytes americanus*
Winter Flounder	*Pseudopleuronectes americanus*
Smooth Flounder	*Liopsetta putnami*
Atlantic Silverside	*Menidia menidia*
Capelin	*Mallotus villosus*

Birds

Peregrine Falcon	*Falco peregrinus*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Cormorant	*Phalacrocorax carbo*
Black Guillemot	*Cepphus grylle*
Great Blue Heron	*Ardea herodias*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*
Razorbill	*Alca torda*
Arctic Tern	*Sterna paradisaea*
Common Tern	*Sterna hirundo*
Bank Swallow	*Riparia riparia*
Herring Gull	*Larus argentatus*
Ring-billed Gull	*Larus delawarensis*
Great Black-backed Gull	*Larus marinus*
Fox Sparrow	*Passerella iliaca*
Osprey	*Pandion haliaetus*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Northern Gannet	*Sula bassanus*
Common Eider	*Someteria mollissima*
Bald Eagle	*Haliaeetus leucocephalus*
Black-legged Kittiwake	*Rissa tridactyla*
Atlantic Puffin	*Fratercula arctica*
Common Murre	*Uria aalge*
Thick-billed Murre	*Uria lomvia*
Dark-eyed Junco	*Junco hyemalis*
Blue Jay	*Cyanocitta cristata*
Semipalmated Sandpiper	*Calidris pusilla*
Blackpoll Warbler	*Dendroica striata*

Mammals

Red Fox	*Vulpes vulpes*
Short-tailed Shrew	*Blarina brevicauda*
Masked Shrew	*Sorex cinereus*
Harbour Seal	*Phoca vitulina*
Grey Seal	*Halichoerus grypus*
Short-tailed Weasel	*Mustela erminea*
Mink	*Mustela vison*
Norway Rat	*Rattus norvegicus*
River Otter	*Lutra canadensis*