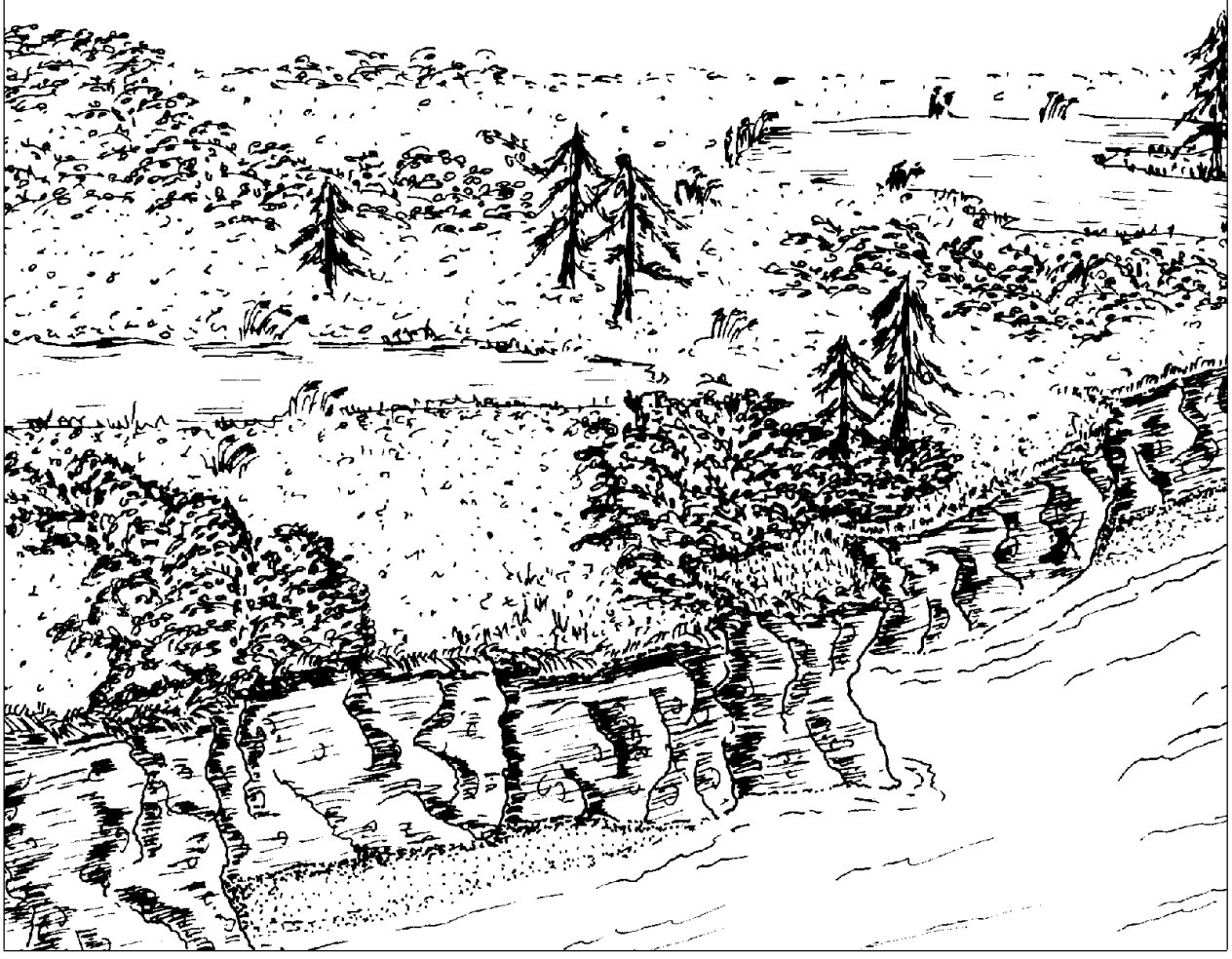
BY THE SEA

A GUIDE TO THE COASTAL ZONE OF ATLANTIC CANADA

MODULE 10: COASTAL BOGS



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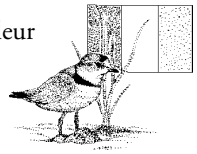

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THE MODULES

TABLE OF CONTENTS

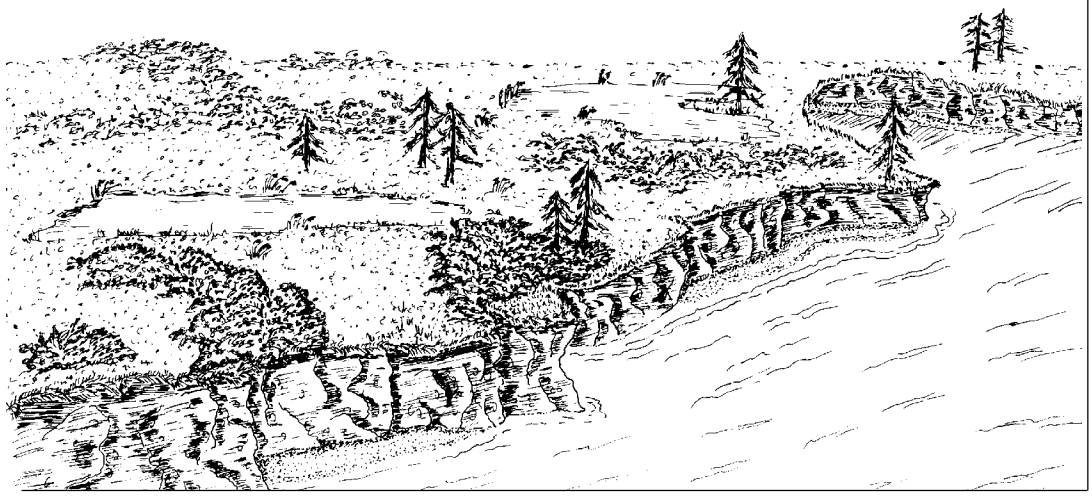
COASTAL BOGS

What is a Coastal Bog?

Bogs are fascinating places to explore. The word 'bog' comes from the Irish meaning 'soft.' If you ever walk in a bog you know that 'soft' is an accurate way to describe the plants that live there. Walking in a bog can be like walking on an enormous wet sponge.

In a bog the rate of decomposition of plant material is slower than the rate of production. In other words, when plants die, it takes a very long time for their remains, which add nutrients to the soil and water, to break down into organic debris. In fact, the rate of decomposition is so slow that the partially decomposed plant material accumulates and forms peat. On top of the peat grows a soft, spongy moss called sphagnum. Just like a sponge, sphagnum has the amazing capacity to absorb water. It can hold up to 15-20% of its dry weight. The cool, moist climate in Atlantic Canada encourages the growth of sphagnum. In the bog together with the moss grow fascinating carnivorous plants and colourful wildflowers that have adapted to the wet, acidic conditions of bog life.

The cool, moist climate in Atlantic Canada encourages the growth of sphagnum moss, which leads to relatively treeless, domed bogs. Salt spray adds nutrients to the narrow, exposed strips along the ocean, favouring the growth of



vegetation types that would otherwise be absent.
Coastal bogs, unlike inland bogs, are exposed to salt spray from the ocean. This adds nutrients that encourage the growth of vegetation that would otherwise be absent. If you walk along some of the coastal bogs of northeastern New Brunswick, you will see brownish-black cliffs made of soft, spongy material. The surface of these bogs is usually covered with low, shrubby vegetation. Water coming out of these places is often very dark, especially when coming from the bottom part of the bog, where the first organic material accumulated. In the cliffs, above the high tide line, Bank Swallows make holes to raise their young.

To some people bogs are mysterious and enchanted places. They are home to a variety of fascinating plants that have adapted to these unique conditions. You can gather berries, hear Song Sparrows, and observe carnivorous plants in action. To others they are forbidding areas of sinking vegetation where swarms of biting insects can drive you mad. However, these seemingly inhospitable lands are prime examples of the forces of nature at work.

Bake-apple

Decomposition and Peat

In most ecosystems the organic matter produced by plants and other organisms decomposes and forms part of next year's soil, releasing nutrients back into the soil. Bacteria, fungi, worms, and other decomposers do this job. In a bog this process also takes place but in a very much reduced form. Because of the acidity and the anaerobic conditions, decomposers are few and the rate of accumulation exceeds that of decomposition. Peat is basically a nutrient-poor substance.

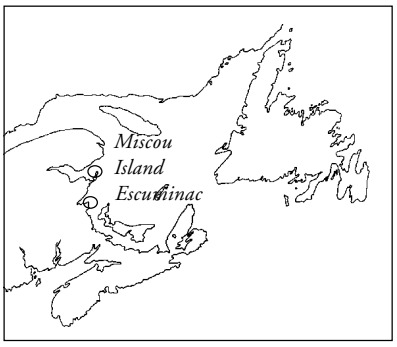
Decomposition is slowed further in waterlogged, stagnant places, where oxygen levels are reduced and micro-organisms needed for decomposition cannot live there. Peatlands that obtain all of their fresh water from the rain or fog are called ombrotrophic.

Fens are peatlands that are minerotrophic, meaning they receive additional freshwater from other sources such as groundwater or rivers.

The Coastal Bog within the Coastal Zone

When you stroll on a beach in many coastal areas especially in New Brunswick, you can observe peat cliffs. Although these bogs are not really a typical coastal ecosystem as one would expect, they occur commonly in New Brunswick in close relationship with salt marshes, beaches, and estuaries.

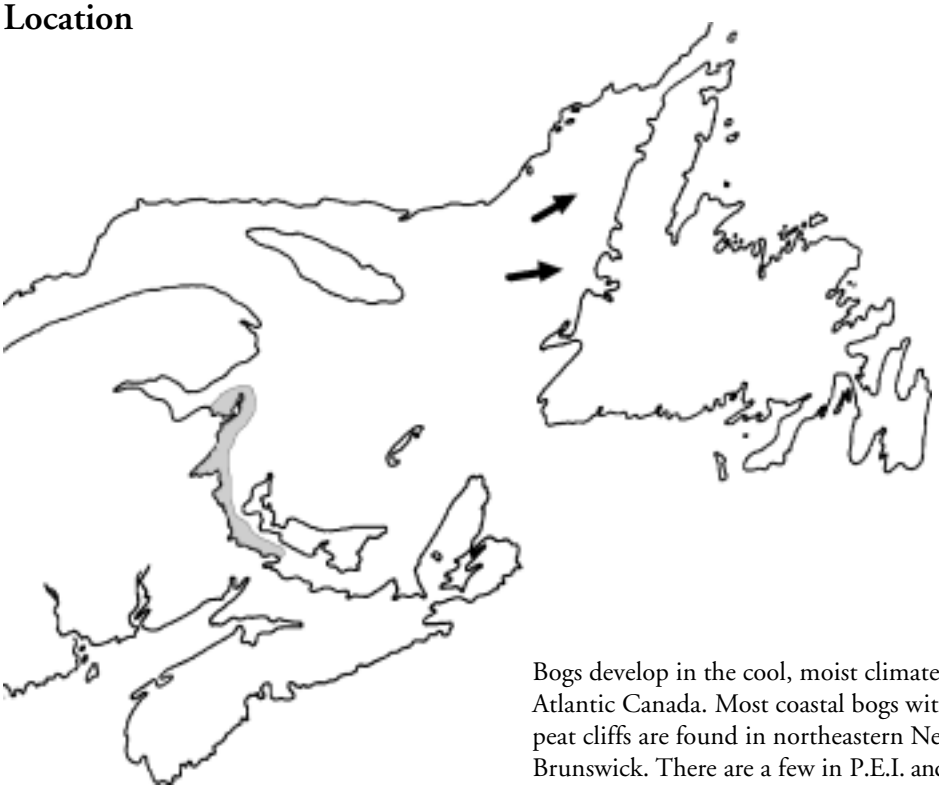
Coastal bogs used to be where the sea is now. Bogs that extended into the sea diminished as the result of gradually rising sea-levels that eroded their shores.



In New Brunswick, at Point Escuminac, peat cliffs have been reported to reach a height of 5 m.

Peat cliffs can also be observed on Miscou Island, New Brunswick.

Location



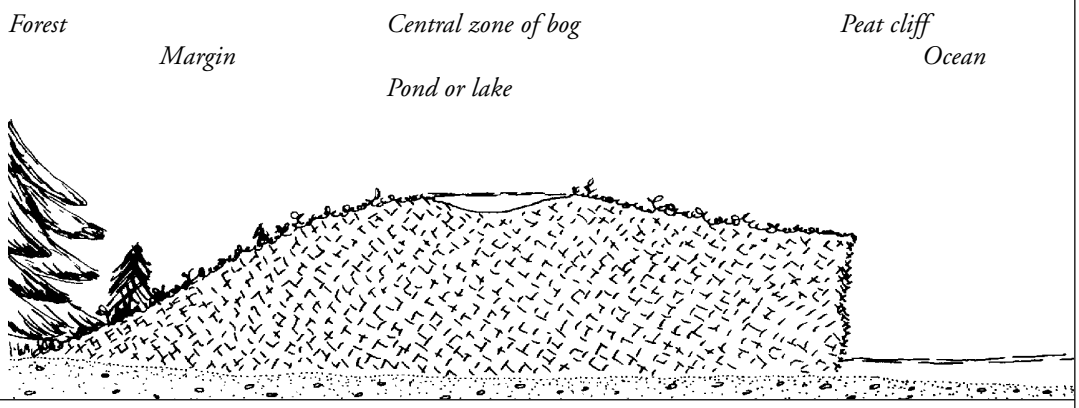
Bogs develop in the cool, moist climates of Atlantic Canada. Most coastal bogs with peat cliffs are found in northeastern New Brunswick. There are a few in P.E.I. and N.S.

THE PHYSICAL ENVIRONMENT

Formation

Bogs form in cool, wet places. These conditions encourage the growth of sphagnum moss. This moss is well-adapted to the acidic conditions of the bog. As new sphagnum grows on top, moisture and acidity increase. When it dies, it accumulates as peat. The more peat accumulates, the higher the bog becomes. The bog becomes ombrotrophic and sphagnum dominates. The pH stabilizes at 3.2 and moisture levels at 90 to 95%.

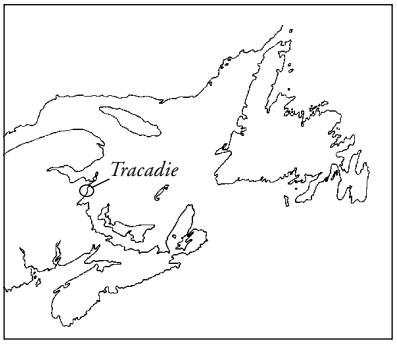
Bog Profile



Age and thickness of bogs

Peat accumulates at a rate of 0.5 to 1.5 mm per year and can be up to nine metres thick but is on average around 3 metres thick. It accumulates fastest in the centre of bogs.

As peat collects, the bogs expands horizontally and vertically.



Bogs of northeastern New Brunswick are very old. A bog at Tracadie, New Brunswick, is 8,500 years old. A bog at Green Point, New Brunswick, is 7,230 years old.

Physical Characteristics

Water

The water level in a bog is directly beneath the surface. It is usually separated from regional groundwater table by impermeable soil conditions at the base of the bog. Bog waters are acidic, generally at a pH of 3.2. Waterlogged mosses (sphagnum sp.) form floating peat mats that are very spongy.

Nutrients

In a coastal bog the only sources of nutrients are precipitation, wind-dust, and ocean spray. In order to adapt to these low nutrient levels, some plants find ingenious ways to complement their food requirements. That is why carnivorous plants, such as sundews, bladderworts, and the Pitcher-plant, are so successful in bogs.

Acidity

The pH (relative acidity/alkalinity) in a bog is usually 3.2, as acidic as a tomato. A bog is acidic because hydrogen (H+) ions are released from the waterlogged peat.

PH levels of some substances

Alkaline		Acidic	
lime	12.4	milk	6.6
Milk of Magnesia	10.5	normal rain	5.6
sea-water	8.3	acid rain less than	5.6
baking soda	8.2	tomato	4.2
blood	7.4	apple	3.0
neutral	7.0	vinegar/lemon	2.0
		soft drinks	2.0 to 4.0

Mammoths and well-preserved humans, known as bog people in Denmark and Ireland, have been found in peat deposits. Preserved humans were also found in Titusville, Florida, in the mid-1980s. The slow rate of decomposition and the tanning effect of the acids can preserve any organisms, though all the bones are often dissolved.

Oxygen

The bog has a low oxygen content due to poor circulation.

Wind

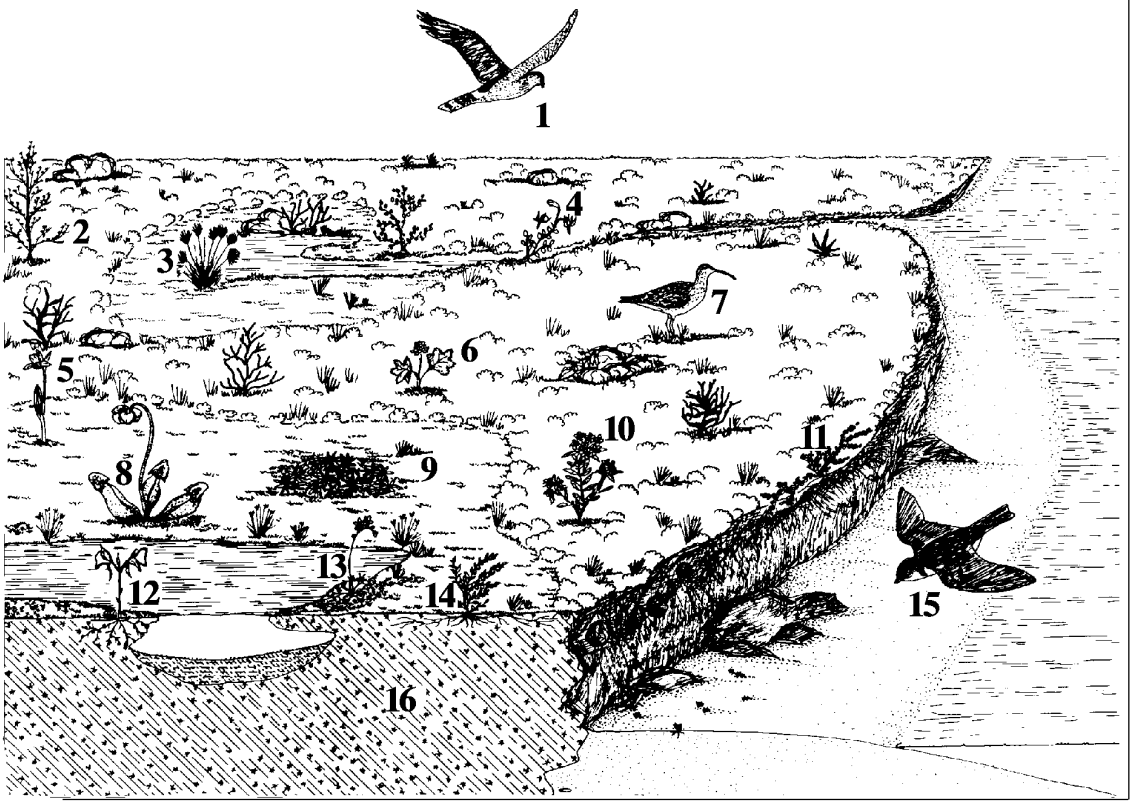
The stunted growth of plants along the shoreline of a coastal bog is caused by the wind and a lack of nutrients.

BIOLOGICAL FEATURES

Who Lives Where?

Fish, molluscs, amphibians, and reptiles use this habitat, but to a limited extent. Some birds find enough trees and shrubs to make a nest, and others come by to feed on the abundant berries.

1	*Northern Harrier*	*2*	*Dwarf Birch*
3	*cotton-grass*	*4*	*cranberry*
5	*Grass-pink*	*6*	*Bake-apple*
7	*Whimbrel*	*8*	*Pitcher-plant*
9	*sphagnum moss*	*10*	*Labrador-tea*
11	*Black Crowberry*	*12*	*Horned Bladderwort*
13	*Round-leafed Sundew*	*14*	*Leather-leaf*
15	*Bank Swallow*	*16*	*peat*



Plants

Plant diversity in a bog is low due to the acidic conditions. Special adaptations are needed to survive in this environment.

Although the conditions for plant growth are not favourable due to the acidity and the waterlogged state of the peat, some plants have adapted to life in the bog. They actually thrive due to the lack of competition in this harsh habitat.

Some plants and their role

Plant	Location	Role
Sundew	in wet places on floating peat mats	carnivorous plant, receives part of its nutrients from insects
Snakemouth	in humid areas among other vegetation	orchid with an extensive but shallow root system, receives some nutrients via a symbiotic relationship with a fungus
Labrador-tea	throughout bogs	shallow, extensive root system brown, fuzzy hairs on underside prevent water loss
Bake-apple	throughout bogs prefers low vegetation	produces large, orange berries, food for other species
Larch	dry areas, periphery of bogs	the few trees present can provide shelter for birds and other organisms

Sphagnum moss

Sphagnum moss is the most important and most common plant in coastal bogs. Once established, this small plant is responsible for creating an acidic environment, thus excluding many other plants that are not adapted to acid conditions. Peat is the partially decomposed plant material of bogs, consisting mainly of decaying sphagnum moss. Look for peat just below the moss.

Sphagnum and peat are like sponges because they retain 15-20 times their own dry weight in water.

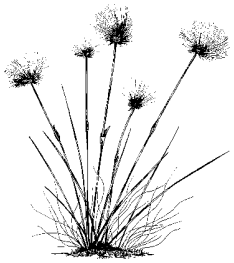
Over 35 different species of sphagnum moss have been identified in New Brunswick.

Grass-pink

The Grass-pink is a delicate orchid that blooms with pink flowers in July.

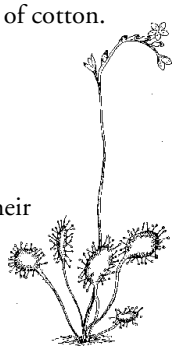
Labrador-tea

Labrador-tea is a shrub that is easy to identify by the brown, fuzzy hairs on the underside of its leaves.



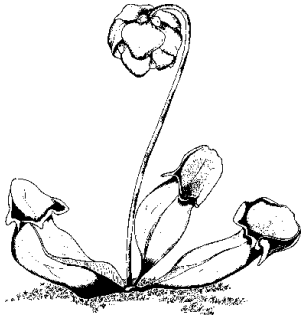
cotton-grass

Cotton-grass is a sedge found in damp places. It's blooms wave in the wind like balls of cotton.



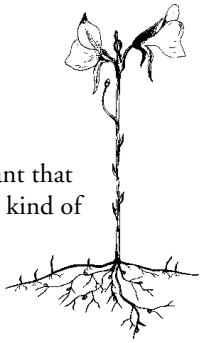
Round-leafed Sundew

Sundews are carnivorous plants that catch insects with their fly paper-like leaves.



Pitcher-plant

The Pitcher-plant is a carnivorous plant that uses its pitcher-like leaves to trap insects.



Horned Bladderwort

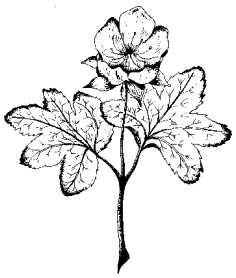
The Horned Bladderwort is a carnivorous plant that catches insects below the water surface with a kind of suction trap.

Larch

The Larch is one of the few trees that grows in bogs. It becomes very visible in the fall when its needles turn yellow.

sphagnum moss

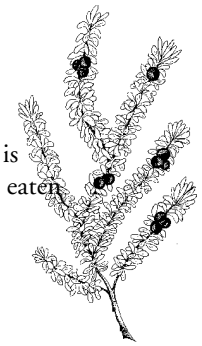
Sphagnum moss occurs in damp places and is mostly green or reddish.



Bake-apple

The Bake-apple is a small member of the raspberry family. It produces large orange berries in the summer.

Black Crowberry

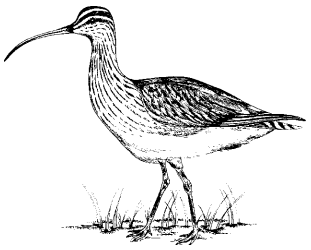


The Black Crowberry is easy to overlook, because it is so low-lying. It produces black berries that are often eaten by birds such as the Whimbrel.

Insects

Bogs often have stagnant bodies of water, where mosquitoes can breed. Deer flies can also become a nuisance in bogs. Dragonflies, on the other hand, consume large amounts of these biting insects.

Birds

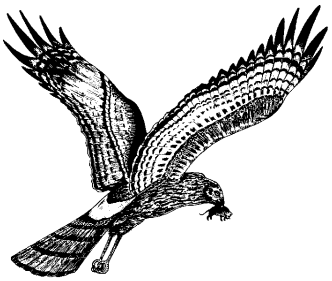


Whimbrel

The Whimbrel is a very large, crow-sized shorebird with a long downward-turning bill. Listen for its short, rapid whistles over coastal ecosystems. 45 cm.

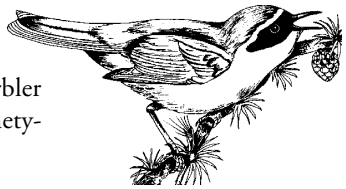
Bank Swallow

The Bank Swallow is the only swallow with a dark breast band that nests in peat cliffs and sand dunes. 13 cm.



Northern Harrier

Watch for a white-rumped hawk hovering over bogs and salt marshes, looking for mice or bog lemmings. To 58 cm.



Common Yellowthroat

The Common Yellowthroat is a yellowish warbler with a blackish mask that calls witchety-witchety-witchety-witch. 13 cm.

Song Sparrow

The Song Sparrow is a vocal sparrow with heavy streaking that joins together to form a central spot on its chest. 16 cm.

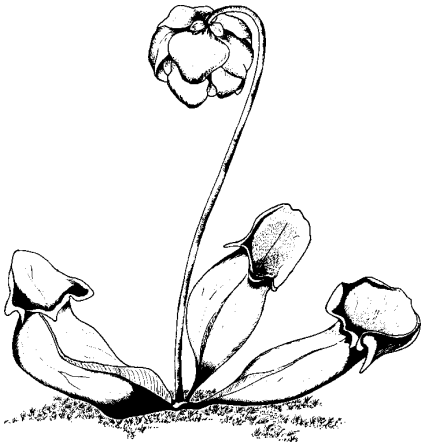
ECOLOGY

Stress and Survival

Life in a bog is difficult and food is scarce. The acidic conditions, low oxygen supply, and low levels of nutrients combined with temperature variations and the high water table necessitate special adaptations. Plants have adapted in numerous ways. They grow more slowly and show stunted forms. Their root systems are extensive and intertwined. To reduce evaporation, their leaves are leathery or covered with hairs. Carnivorous plants supplement their nutrient intake by catching insects. Evergreens conserve energy by not renewing their leaves every year.

Some people suggest that bogs are similar to deserts, because some of the same adaptations are found in both ecosystems.

Carnivorous plants



The Pitcher-plant is named after its modified leaves, which resemble a pitcher. This plant uses a pitfall trap to catch insects. Nectar glands and bright leaf veins attract insects to the lip of the pitcher, where hundreds of downward-pointing hairs encourage descent into the receptacle (as well as making an upward climb difficult or impossible).

To complicate matters for insects, just below the hairs are special plant cells, layered like shingles on a roof. These cells are both sticky and loose, and attach easily to an insect's foot. Insects accumulate heavy, sticky globs of cells, and even winged insects have trouble flying out through the narrow opening of the leaf. Eventually, exhausted, they fall into the pool of rainwater at the bottom of the leaf and drown. Especially adapted invertebrates feed on these drowned insects. Their wastes provide the nutrients for the Pitcher-plant. Unlike the sundew and bladderwort, the Pitcher-plant does not produce digestive enzymes.

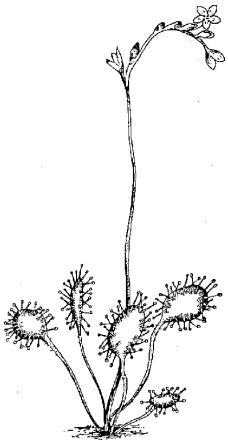
Productivity

In contrast to other coastal ecosystems, coastal bogs have a low rate of decomposition and thus productivity. Since plant matter takes so long to decompose, and there are so few nutrients easily available, growth of plants is not encouraged.

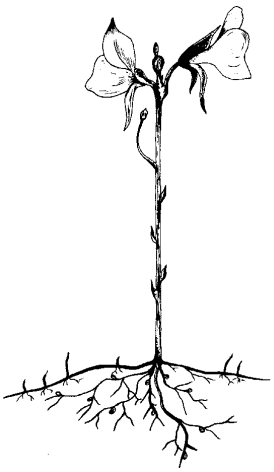
Coastal bogs are more of a land ecosystem than any of the others. Their formation is greatly influenced by the ocean climate.

Carnivorous plants

The sundew is a small plant, whose spine-covered leaves sparkle with sweet, sticky droplets. Insects are attracted to this sticky dew and become stuck on the fly-paper-like leaves. Then, slowly, the leaf spines wrap around the insect, taking between 20 minutes and several hours to finish the job. The plant hurries the job only if the insect struggles to escape.



The bladderwort prefers shallow water. Its name comes from the tiny sacs, resembling bladders, found on its underwater stems. The bladders, once thought to help the plant float and obtain oxygen, are really miniature animal traps. They hold and digest food, but are more than 'little stomachs,' because they also capture the food they eat. The capture begins when an outer guard hair of the bladder is touched. This motion breaks a vacuum seal, sucking water and prey inside past a one-way door, taking only one 500th of a second to work. The bladder then gets to work digesting the meal, using its own enzymes as well as cooperative bacteria, taking no more than two hours. After the meal, special cells in the sac pump out the water to restore the vacuum trap.



COASTAL BOGS AND US

Peat has many uses.

In early times, vikings extracted iron from bogs to make nails and tools. In fact, most early Iron age civilization was based on the extraction of bog-iron. Peat was also used as insulation material. Sphagnum was formerly used by native people as diapers, and as a wound dressing. It was also used in the Second World War for dressing wounds.

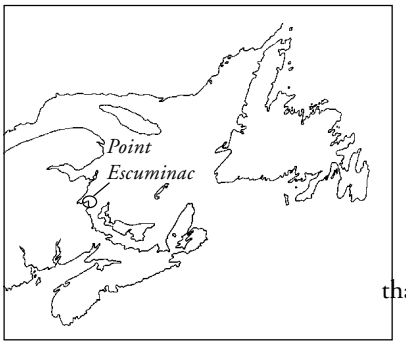
Today, peat mining is an important economic activity, especially in New Brunswick. Peat is mined for use in horticulture, as garden mulch, as fuel, and for sewage treatment. Dried sphagnum is also used in some menstrual pads.

Many of the berries in a bog are edible. You can collect blueberries, huckleberries, or Bake-apples.

Some bog plants are indicator species for pollutants collecting in our environment. Mosses and lichens trap airborne pollutants such as mercury. Scientists study the levels of pollutants in these plants. They also study pollen and seeds trapped in bogs to learn about past climatic conditions.

Pollen Records

Bogs are a kind of time capsule due to their slow decomposition rate. In the peat, pollen grains are preserved for thousands of years. By analysing these ancient pollen grains, we can look into the past and discover what the climate and vegetation were like thousands of years ago.



At Point Escuminac, New Brunswick, scientists have studied pollen found in different layers of peat. The study of pollen is used to reconstruct the different types of ecosystems that existed over the last 11,000 years, since the end of the last ice age. With the help of this method, scientists are also able to reconstruct the different types of vegetation that have grown over the past 11,000 years.

Problems in the Ecosystem

Natural Agents of Change

Rising sea-levels lead to erosion of peat cliffs and gradual loss of peatland habitat.

Fire can destroy the surface vegetation and affect the bog's growth pattern.

Human-caused Changes

People can also change bogs.

We mine peat from bogs, which destroys the original habitat for plants and animals. It also creates peat dust. If the peat mining is done in proximity to settlements, blowing peat dust from developed peatlands can affect people with respiratory problems such as asthma, bronchitis, and certain allergies. Blowing peat can also suffocate organisms. In some areas peat dust has caused estuaries to become so clogged with peat that filter feeders such as oysters can no longer grow there.

We also drain peatlands for development. When this happens, the drainage waters can change the quality of streams flowing out of bogs, thus affecting fish and invertebrates downstream. Drainage waters often contain organic matter from the bog. This matter has to be broken down. Oxygen demand increases because exposed decomposing peat needs oxygen, thereby reducing the amount available in the water. Many fish species are sensitive to changes in oxygen content. Lower oxygen levels can affect their survival.

When we drive in bogs, we seriously alter the ecosystem. Vehicle traffic in bogs destroys the vegetation, causing long-lasting scars on the surface.

Protection of the Ecosystem

Coastal bogs are an important part of our coastal zone in some regions of Atlantic Canada. We need to conserve and protect this unique ecosystem for many reasons.

Bogs are fascinating places to explore and they provide a home for unique species of plants. They contain information that helps us understand past climatic conditions and the evolution of the landscape. They also play an important part in the lives and culture of those who live close by. Bogs provide an economic base not only when they are mined but also for tourism, as more and more people become interested in these areas for bird watching and nature study.

In New Brunswick, only a small portion of coastal bog habitat has been protected, in Kouchibouguac National Park. In this province, policies to lessen impacts from peat mining operations are in place. These policies include using proper operational techniques such as sedimentation ponds; using special air filters on the equipment; covering stockpiled peat in the field; and restoring a mined peatland to some sort of functional wetland after mining ceases.

But we need to do more. We need to study the interrelationships of coastal bogs with other ecosystems.

The best way to appreciate coastal bogs is to explore them. Take the time to observe carnivorous Pitcher-plants, delicate orchids, and brightly coloured damselflies. Listen for the calls of Song Sparrows and Bank Swallows. Watch for Northern Harriers as they hover overhead searching for mice or bog lemmings. And feel the spongy sphagnum moss that is growing underfoot. But step lightly on the bog. Not only is it a waterlogged environment, but it's a fragile ecosystem needing your understanding and protection.

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 the bog. There are also great regional and local variations, and we realize the difficulty in accommodating all of these.

Plants

Grass-pink	Calopogon tuberosus
Arethusa/Swamp Pink	*Arethusa bulbosa*
Snakemouth/Rose Pogonia	*Pogonia ophioglossoides*
Bog-rosemary	*Andromeda polifolia*
Leather-leaf	*Chamaedaphne calyculata*
Rhododendron	*Rhododendron canadense*
Bog Laurel	*Kalmia polifolia*
Sheep-Laurel	*Kalmia angustifolia*
Labrador-tea	*Ledum groenlandicum*
Sweet Gale	*Myrica gale*
cotton-grass	*Eriophorum vaginatum*
sedges	*Carex sp.*
Round-leaved Sundew	*Drosera rotundifolia*
Narrow-leaved Sundew	*Drosera intermedia*
Pitcher-plant	*Sarracenia purpurea*
Horned Bladderwort	*Utricularia cornuta*
Larch	*Larix laricina*
Dwarf Birch	*Betula pumila*
Bake-apple	*Rubus chamaemorus*
cranberry, blueberry	*Vaccinium sp.*
Black Crowberry	*Empetrum nigrum*
huckleberry	*Gaylussacia sp.*
sphagnum moss	*Sphagnum sp.*

Birds

Whimbrel*	*Numenius phaeopus*
Northern Harrier	*Circus cyaneus*
Bank Swallow	*Riparia riparia*
Common Yellowthroat	*Geothlypis trichas*
Song Sparrow	*Melospiza melodia*

* The Whimbrel is a migrant species that nests in the Arctic.