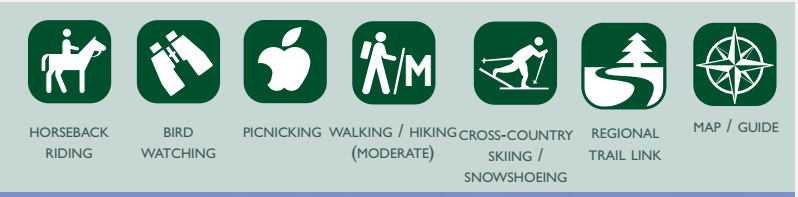
WARD RESERVATION

PINE HOLE BOG NATURE TRAIL

the trustees of reservations

This bog is part of the Charles W. Ward Reservation. The Reservation also encompasses Holt Hill, Shrub Hill, part of Boston Hill, and some of the surrounding lowlands. The area was preserved in 1940 by Mabel B. Ward in memory of her husband Charles W. Ward. The Ward Reservation is owned by The Trustees of Reservations.

PINE HOLE BOG NATURE TRAIL



This short (about 1,100 feet) trail leads to and across a typical northern bog. The gentle approach to the bog and the 700-foot boardwalk across the bog make for easy walking in what would otherwise be very difficult terrain. You return to the starting point by retracing your steps. Look for the numbers that (except for number 1) are placed on the boardwalk itself. Each numbered location is described in this booklet.

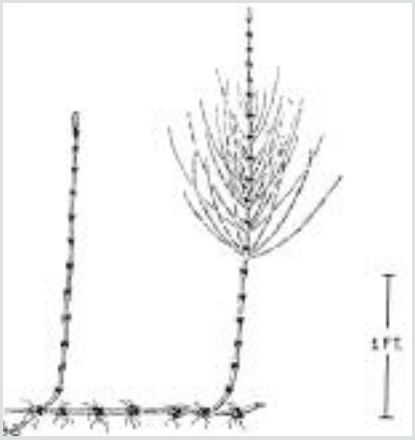
1 As you approach the bog, you are walking through woods dominated by old white pines with some hemlocks and hardwoods mixed in. Note the relative sparseness of vegetation in the deep shade at ground level. In the summer, **indian-pipe** (*Monotropa uniflora*) grows abundantly on either side of the trail. This flowering plant lacks the green pigment chlorophyll and is thus unable to manufacture its own food by photosynthesis. Instead, it secures its food from a nearby tree with the aid of a fungus that connects the roots of both species.

Conspicuous at all seasons are the low-growing **club mosses** (*Lycopodium*). These plants are sometimes called ground pines. Neither name is appropriate as they are neither mosses nor pines but the last descendants of a group of plants that dominated the earth millions of years before pines and flowering plants first appeared. Some of the ancestors of these plants grew as tall as 100 feet. Their partially decayed remains contributed to the formation of coal.

Stepping onto the boardwalk you have left solid ground behind and have started to cross the bog. Underneath you is a mat of vegetation resting on an accumulation of muck. A 19-foot probe was pushed through the mat at this point but failed to reach the bottom of the muck.

2 The area immediately around you is maintained by reguarly removing woody plants to keep it open for sun-loving bog plants.

The plants here include some that are found in all sorts of wet locations and some that are only found in bogs. In the former group are the **swamp horsetails** (*Equisetum fluviatile*) — plants very primitive in structure and lacking true leaves. The ancestors of swamp horsetails grew much larger and their remains also contributed to the formation of the coal that is mined today.

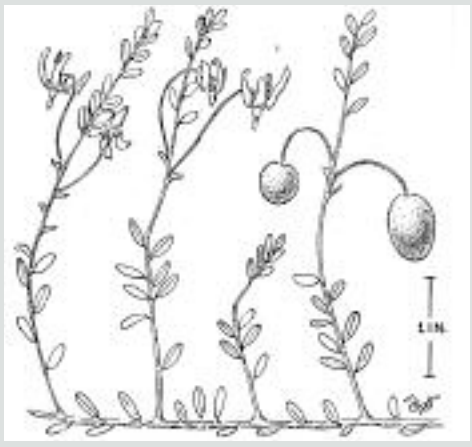


SWAMP HORSETAILS

Cattails (*Typha latifolia*) are common inhabitants of open, marshy locations. The cylindrical brown "head" is a dense mass of tiny fruits — each attached to a parachute.

CATTAILS

3 The low-growing plant with the small shiny leaves is the **cranberry** (*Vaccinium macrocarpon*). This member of the heath family, like many of the heaths, grows only in bogs. Its large red berries, which ripen in the fall, are used in the sauces and jellies that are an essential part of Thanksgiving dinner.



CRANBERRY

4 The grass-like plant with the cottony tufts (seen in late summer) is **cotton grass** (*Eriophorum*), a member of the sedge family. Sedges, which are not true grasses at all, are common inhabitants of wet locations. If you crouch and look very closely, you will see the tiny insect-eating **sundew** (*Drosera rotundifolia*). Insects that alight on the glistening, sticky hairs of the Sundew's leaves are often trapped. The hairs fold over the insect's body, which is then digested by the plant.

COTTON GRASS

Please do not step off the boardwalk except where indicated (Station #13).

Please do not pick any of the specimens that grow along this trail.

5 You have now entered the area of the bog where woody plants have been allowed to grow normally. Most of the shrubs on your left are **highbush blueberries** (*Vaccinium corymbosum*). They, like cranberries, are members of the heath family and typically are found in bogs and other acid soils. Many of our domestic blueberries have been derived from this species.

Another member of the heath family is **coast pepperbush** (*Clethra alnifolia*), which is growing on your right. Its flowers, which appear in July, are exceedingly fragrant.

6 The shrubs on either side of you are **smooth alders** (*Alnus serrulata*). They are relatives of birches and can easily be identified by their fruits, which are cone-like catkins.

SMOOTH ALDERS

The four tall trees growing on your right, in a row parallel to the path, are **red** or **swamp maples** (*Acer rubrum*). They are common inhabitants of wet locations. In the autumn, the brilliant red and orange foliage of this species gives the bog its brightest aspect of the year.

The small broad-leaved herb so common on either side of the boardwalk as you walk along is the **wild calla** or **water arum** (*Calla palustris*).

WATER ARUM

The tree ahead of you on the left edge of the walk is a **sour-gum** or **black gum** (*Nyssa sylvatica*), a swamp dweller.

7 The luxuriant fern growth on the left is **cinnamon fern** (*Osmunda cinnamomea*). Only the leaves are visible, the stem and the roots grow below the surface of the bog. The plant is dispersed by means of myriad tiny, wind-blown spores produced on the specialized, brown leaves that grow in the center of the cluster.

8 The plant on your right is **arrow arum** (*Peltandra virginica*), an aquatic plant with leaves shaped like arrowheads that can grow up to two feet long.

9 The tall shrubs on your left are **swamp azaleas** (*Rhododendron viscosum*). Their blossoms, which appear in June, are very fragrant. This plant is also called the swamp honeysuckle.

10 **DANGER:** The tall shrub on your right is **poison sumac** (*Rhus vernix*). Do not touch any part of the plant as it is even more dangerous than poison ivy. Fortunately, it is not as widespread as poison ivy, generally being found only in swamps and bogs. It is one of the most abundant plants in this bog, but the specimens close to the boardwalk have been removed for your safety.

POISON SUMAC

11 At this point you are entering a series of zones that are unique to bogs. The trees around you are the **black spruce** (*Picea mariana*) and the **American larch** or **tamarack** (*Larix laricina*). Both are conifers, that is, they produce their seeds in cones. Unlike most conifers, the larch drops all its needles in the fall. While widespread in the far north, in southern New England the black spruce is found only in bogs such as this one. Although small, many of these trees are quite old. One tamarack with a trunk diameter at ground level of 3 inches was cut down recently. A count of its annual rings showed it to be 53 years old. A tamarack of roughly the same age, but four times as tall and with a trunk diameter of 18 inches, grows on the west side of the house at 89 Prospect Road.

BLACK SPRUCE

If you have traveled in the coniferous woods of our northern states or Canada, you will find this zone similar in appearance. The thick accumulation of soggy, slowly decaying organic matter underfoot is called muskeg by the inhabitants of the far north.

AMERICAN LARCH

12 One of the plants chiefly responsible for the physical characteristics of the bog is **sphagnum moss** (*Sphagnum*). This moss is also called peat moss because its decayed remains are the chief ingredient of peat. Sphagnum moss is very spongy. It is, in fact, more absorbent than cotton, and was used as a dressing for wounds during World War I.

SPHAGNUM MOSS

As you walk along, look for specimens of that remarkable member of the plant kingdom, the insect-eating **pitcher plant** (*Sarracenia purpurea*). The pitcher-like leaves of the pitcher plant are usually part full of water. Insects that enter the pitcher find downward-pointing bristles blocking their exit. Once they fall in the water they drown and are digested by microorganisms living there. This releases minerals (chiefly nitrogen and phosphorus) for the plant. Curiously, some insects live in the pitchers. If you look closely, perhaps you will see wigglers of the pitcher plant mosquito (*Wyeomyia smithii*).

Wyeomyia smithii has also provided one more piece of evidence of recent global warming (and evolutionary adaptation!). The mosquito larvae remain dormant during the winter and become active again when days reach a certain critical length in the spring. From 1972 to 1996, the mosquitoes shaved 14 minutes off their day-length requirement, presumably because earlier warming permitted the controlling genetic changes to be selected for.

PITCHER PLANT

13 At this point, you may step off the boardwalk directly to your left. Note how springy the mat of vegetation is. Under your weight, the mat may sink somewhat. Try gently and rhythmically bouncing up and down. What happens to the trees and bushes growing around you? This action has given rise to the expression "quaking bog."

The explanation is that you are actually standing on a thin mat of tangled vegetation that has grown over, and is literally floating on, a watery muck. The roots of the trees growing in this area are restricted to the thin mat — not only for their support but also because there is little or no oxygen available to them in the water and muck beneath the mat. This is why swamp and bog trees are so often uprooted during windstorms that do not uproot trees growing on more exposed, hillside locations.

14 The low-growing shrub in a band on either side of you is **leatherleaf** (*Chamaedaphne calyculata*). It is a member of the heath family as is **sheep laurel** (*Kalmia angustifolia*), which is also growing here. Both of these plants have leathery leaves and are evergreen. The sheep laurel leaves grow in whorls of three.

LEATHERLEAF

Thick leathery leaves help reduce water loss by evaporation, and it is something of a puzzle why so many bog inhabitants — living with their roots practically immersed in water — have a feature usually associated with plants growing in arid locations.

Growing in the open water around the entire margin of the pond is a rich stand of **swamp loosestrife** (*Decodon verticillatus*). Note how it grows in clumps. It is these clumps that provide the first foothold for sphagnum moss and start the formation of the floating mat of vegetation. The stems of the swamp loosestrife arch over the water so that their tips often touch the water. When this occurs, roots develop at the tips and new clumps arise. In this way, the mat slowly grows forward and the area of open water gets smaller. Ultimately the pond will be completely covered.

SWAMP LOOSESTRIFE

The water of the open pond does not provide a rich habitat for aquatic life. One reason is that the water is quite acidic. Its pH, a measure of degree of acidity, is 4. This is almost as acid as your morning orange juice! Pure water has a pH of 7, and owners of swimming pools try to keep the pH of their pool water between 7.2 and 7.6.

Why a bog?

Bogs share some features with other soggy habitats but also have features that are unique. Just how these peculiar qualities arise is not yet fully understood. By trying to reconstruct the history of the bog, perhaps we can find some clues.

Geologists tell us that some 12,000 to 14,000 years ago the most recent glacier to cover New England began to recede. As the southern edge of the glacier melted away, huge blocks of ice occasionally were left buried in the ground. When

these blocks melted, deep water-filled basins, which we call glacial kettle holes, were left behind. Such was the origin of this bog. As you approached the boardwalk, you were walking beside the margin of the kettle hole.

Lakes and marshes have a one-way flow of water, that is, water drains in one side and drains out the other. In a kettle hole, such as this one, it is more a matter of a basin filling with rain and melting snow, which finally spills over the edges. In fact, the water in this bog spills over into two different watersheds. Drainage to the north eventually reaches Boston Brook, while drainage to the southwest enters the Skug River.

With the glacier gone, plant life began to recolonize the landscape. Aquatic plants began growing in the kettle hole. As they died, their remains began to accumulate along with plant debris such as pollen and leaves blown in from surrounding areas.

Decay in a bog is extremely slow. The stagnant water is deficient in oxygen, thus inhibiting the development of the microorganisms responsible for decay. The low temperatures of the bog also inhibit decay. The natural depression of this bog forms a frost pocket. Furthermore, the peat of the bog is a good insulator and warms up very slowly in the spring. For example, on April 15, 1969, six days after the ice had melted, the soil temperatures in the bog averaged 40°F, 10°F below those on the upland areas surrounding the bog.

The plants in the bog are correspondingly delayed in resuming their growth in the spring. The needles on the tamaracks on the upland areas nearby had grown to half an inch by April 20, 1969, while in the bog, growth was just beginning. Not until May 15, 25 days later, did the needles on the bog tamaracks reach a length of half an inch.

With a shortened growing season in the bog, it is perhaps not surprising to find species, such as the black spruce, that now live chiefly at higher latitudes. These plants are probably the descendants of species that grew throughout this area in early post-glacial times, but were eventually supplanted as the climate got warmer. In the bog, however, they have been able to survive.

Curiously enough, these relics of the Ice Age share the bog with a number of plant species of southern origins. The pitcher plant and sundew, as well as several members of the orchid family that grow in the bog, are examples. What possible explanation could there be for such an association of northern and southern species?

Plants living in the coniferous forest of the north and in the rain forest of the tropics do share one problem. In both locations, the soil is deficient in minerals and often soggy. With its granite rocks and abundant rainfall, New England does not have soils that are very fertile either.

The situation is especially severe in the bog because what minerals do wash in, are quickly absorbed by the organic matter, chiefly peat, and become inaccessible to the plants.

With the abundance of organic matter, one might expect nitrogen, at least, to be plentiful — but such is not the case. The microorganisms responsible for the release and recycling of nitrogen from dead plant material are unable to function effectively under acid conditions and with the low levels of oxygen available.

The severe shortage of nitrogen in the bog may perhaps account for the insect-eating plants found here. By digesting insects that enter their traps, both the pitcher plant and sundew acquire nitrogen compounds for their own growth.

With dead plant remains accumulating faster than they decay, a thick deposit of organic matter has formed in the bog. In some parts of the world, such bog deposits are removed, dried, and used as a fuel — peat. Peat represents the first stage in the formation of coal. Peat deposits such as this one have also produced a great deal of information about fluctuations in climate and surrounding plant communities in the past. Boring into the layers of peat reveals pollen grains and other ancient plant remains in remarkably well-preserved condition. Scientists studying such peat samples have been able to reconstruct detailed histories of bogs such as this one.

Although no borings have been done on this bog, you can recreate some of its history as you retrace your steps along the boardwalk.

Behind you is an area of open water, the last remnant of a pond that once extended all the way to the start of the boardwalk. Surrounding this is a zone of plants that can grow right in the water, and which provide a foothold for hardy species such as leatherleaf and sphagnum moss. Their growth provides, in turn, sufficient support for such northern-type conifers as the black spruce and tamarack. With the mat growing thicker, red maples, alders, and blueberries became the dominant species. Even some white pines have begun to grow in the bog, although most of them die at a relatively young age.

Thus, as you walk from the water's edge back to dry land, you pass through distinct plant communities. These recreate in space the sequence of events that have taken place in time during the inexorable process of filling in the bog. Such a sequence, in which the development of one plant community sets the stage for its own replacement by another, is known as succession. Although succession has been occurring in this location for more than 10,000 years, the process is not yet over. How many more years will it be before the open water, sphagnum moss, pitcher plants, and black spruces have disappeared and a red maple forest is all that remains?

References

1. Thomson, Betty F., *The Changing Face of New England*, Macmillan, New York, 1958. A brief, easy-to-read, account of the geography, geology, and ecology of New England. Chapter 1 includes a discussion of the analysis of pollen deposits in bogs, and Chapter 6 discusses the special conditions that occur in bogs.

2. Watts, May T., *Reading the Landscape*, Macmillan, New York, 1957. A delightfully written account of how the landscape reveals to the alert eye the physical and biological forces that have shaped it. Chapter 4 deals with bogs.

3. Zink, George E., *Geology of the Charles W. Ward Reservation*, The Trustees of Reservations, Boston, 1955.

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The Trustees of Reservations are 100,000 people like you who want to protect the special places we love, or who simply like to be outdoors.

Together we can save and share the landmarks and landscapes across our state that make all of our lives more fulfilling, rewarding, and fun.

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