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Bulletin No. 19: Inland Wetland Plants of Connecticut

William A. Niering
Connecticut College

Richard H. Goodwin
Connecticut College

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INLAND WETLAND PLANTS OF CONNECTICUT



THE CONNECTICUT ARBORETUM

BULLETIN No. 19

CONNECTICUT COLLEGE

NEW LONDON, CONNECTICUT

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INLAND WETLAND PLANTS OF CONNECTICUT

William A. Niering and Richard H. Goodwin

Connecticut College

illustrated by

Richard M. Brown

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THE FRESH-WATER WETLANDS

Introduction

THE WETLANDS OF CONNECTICUT include both the coastal salt and the inland fresh-water types. The tidal marshes, which play a vital role in supporting our coastal finfish and shellfish productivity, are now coming under the protection of Public Act 695 of 1969. A new piece of legislation, Public Act 155, deals with the problem of the fresh-water wetlands. It defines them as being those sites characterized by poorly drained and alluvial soils, and thus includes the flood plains. Based on soil types there are about 800,000 acres of inland wetlands in Connecticut, covering approximately 25 percent of the land surface (9). Public Act 155 is presently undergoing revision.

The fresh-water wetlands can also be recognized by the kinds of plants that grow in them. The purpose of this publication is to describe and illustrate some forty different kinds of plants that characterize three of our major wetland types—marshes, swamps and bogs. The introductory section defines the wetland types and emphasizes the significant contribution these natural features make toward the quality of our environment. We have attempted to select for illustration the most ecologically important species. The drawings are about one half life size, unless otherwise indicated. Gray's Manual of Botany has been followed for scientific nomenclature (6). It must be emphasized that certain species, such as red maple and highbush blueberry, are not restricted to the wetlands, although they usually reach their greatest abundance in these sites. Additional species associated with the wetlands are listed. Since wetlands are among the floristically richest ecological communities in the world, it has only been possible to include a fraction of the many kinds of plants found in these habitats. The submerged aquatics have been deliberately omitted.

The authors wish to thank Mr. Richard M. Brown of Noank, Connecticut, for his beautiful illustrations.

Wetland Types

Of the twenty different wetland categories recognized by the U.S. Fish and Wildlife Service (11), eight fresh-water types are represented in Connecticut. These are the meadows, the shallow marshes, the deep marshes, shallow open water, wooded swamps, shrub swamps, bogs, and seasonally flooded basins and flats. We have simplified this classification to five major types: the marshes (which include the first four of the Fish and Wildlife Service), the swamps (which combine the next two), bogs, flood plains (on which may be found the seasonally flooded flats), and streambelts. Each of these will be briefly described.

Marshes. These wetlands are characterized by the absence of trees and shrubs. The vegetation is composed of soft-stemmed herbaceous plants. Some grow in moist soil of poorly-drained wet meadows. In wetter situations plants such as cat-tails and pickerel-weed grow with their stems and leaves partly in and partly out of the water (emergents). Others, like water-lilies and duckweed, float on the surface; while still others are completely submerged. In general, the silt and muck-type soils are relatively shallow, the underlying glacial deposits being fairly close to the surface. The water table is at or above the surface throughout most of the year, but seasonal fluctuations are usually encountered. Areas of open water six inches or more in depth are frequent. A somewhat drier phase, the wet meadows, is usually without standing water, but the soil may be more or less water-logged most of the time.

Marshes sometimes originate as a result of the filling of shallow lakes and depressions. Wet meadows become established where impervious soil or hardpan prevents adequate drainage. On flood plains marshes may develop on accumulated silt or alluvial deposits or in old oxbow lakes cut off by the river. Since there is a tendency toward annual accumulation of the organic remains of aquatic plants, marshes may eventually become replaced by other wetland communities. However, we have no evidence of Connecticut's wetlands naturally changing to an upland forest, as suggested by traditional successional theory.

Swamps. Swamps are dominated by wetland trees and shrubs. Red maple is the most characteristic tree of the wooded swamps, with black gum and black ash as frequent associates. A conspicuous shrubby understory of highbush blueberry, spicebush, sweet pepperbush, clammy azalea and other wetland shrubs may develop, and a rich diversity of wildflowers, such as marsh-marigold, skunk-cabbage, jewelweed, violets, and cardinal flower may also be present.

Shrub swamps represent another swamp type, where alders, willows, buttonbush and other shrubs can form relatively pure or mixed stands. Occasionally trees may be associated. However, a high water table often favors certain shrubs, such as buttonbush, over trees.

As in marshes, the underlying deposits are often relatively shallow and usually highly organic. Swamps may develop through the gradual invasion of marshes by woody species or directly, as in poorly drained depressions.

Bogs. These constitute a distinctive wetland type usually characterized by evergreen trees and shrubs, and underlain by peat deposits of considerable depth. Poor drainage normally leads to highly acidic conditions. The typical northern bog is easily recognized by the presence of black spruce and larch. In southern Connecticut the spruce and larch are replaced by southern white cedar or, in some cases, by red maple along with the typical swamp shrubs previously mentioned. In the absence of evergreens the deep underlying organic deposits help to identify a bog.

Bogs have frequently developed in former glacial lakes by the gradual accumulation of organic material falling from beneath a floating mat of vegetation which advances out over the water. Depths of peat deposits of twenty to forty feet are not uncommon.

Bogs are among the most fascinating wetlands botanically. Here one frequently encounters a group of northern species growing several hundred miles south of their normal range. Plants of especial interest include two insectivorous species, the pitcher-plant (see back cover) and sundew, usually growing in sphagnum moss, as well as a distinctive group of evergreen shrubs—leatherleaf, bog laurel, and bog rosemary—that form a bog heath. Rare orchids and other wildflowers are often associated. The underlying deposits may preserve a 15,000-year record of the past vegetation in the form of fossil pollen.

Urban and suburban development of these areas is ecologically unsound. Bogs are especially important for their high water-holding capacity and flood abatement capabilities. Also, due to their deep unconsolidated deposits, their conversion to industrial or residential uses usually results in unanticipated drainage and foundation settling problems.

Flood Plains. These lowlands fringing the watercourses are vital geomorphic features. Their normal function is to handle large volumes of water in times of flood. The periodic overflowing of the banks of a stream builds alluvial soil deposits upon which the flood plain vegetation develops. Flood plains usually support a mosaic of vegetation types, including marshes, swamps and flood plain forests. In the latter black willow, cottonwood and silver maple are especially adapted to withstand flooding and frequently form a series of belts—

the willow along the eroding edge of the river, the cottonwood in an intermediate zone and the silver maple on the older, more stable deposits. Annual plants, such as the nettles, may form a dense undergrowth by the end of the growing season. No attempt has been made to illustrate the flora of the flood plain forest in a separate section, but plants of the marshes and forested swamps, which are often present on the flood plain, have been included under the appropriate headings.

Since flood plains are periodically flooded and are constantly undergoing change, ecologically enlightened communities are restricting land use practices on these sites to agriculture, recreation, and those other activities which permit the river to use this physiographic feature without costly destruction of capital improvements. Any development which restricts the river's flooding potential is undesirable.

Streambelts. Within the State the rivers, streams and their smaller tributaries form a branching pattern. Immediately adjacent to the streams many of the wetland species illustrated may occur as a riparian vegetation belt. Extensive marshes and swamps, as well as the flood plain forests, are often an integral part of the over-all streambelt pattern. Streambelt maps, therefore, are invaluable guides to the important wetlands within a given region. If all towns could adequately protect their streambelts, they would be taking a progressive step toward the preservation of their fresh-water resources.

The Ecological Role of Wetlands

Wetlands make many significant contributions to the maintenance of environmental quality (5, 10, 13). Among these are their role in flood control, in recharging the water table, in pollution filtration, in oxygen production, in various types of productivity, in maintaining a balanced nitrogen cycle, in preserving biological diversity and in providing a place for education and recreation.

Flood Control. Wetlands are of major importance in the hydrologic regime, since they act as storage basins, lower flood crests, minimize erosion and serve to reduce the destructiveness of severe floods.

In urban areas this is especially significant, since development intensifies the speed of run-off. Streets, buildings and parking lots waterproof the land surface thus destroying soak-in areas and concentrating large volumes of rainfall. Hence, run-off is usually rapid and excessive. Wetlands, and especially flood plains, act as catchment areas and thereby tend to lower flood crests and slow the speed of flood waters, thus minimizing damage. The erosive capacity of running water increases as the fifth power of its velocity. The flood plain is a *geomorphic safety valve* and an integral part of the river system. On it has evolved a distinctive flood plain vegetation of marshes and forests well adapted to periodic flooding.

The role of bogs in flood control was dramatically illustrated during the severe flood of 1955 in the Pocono Mountain region of northeastern Pennsylvania. Many bridges were washed out. However, two bridges of the type destroyed elsewhere were still intact below the Cranberry Bog, a Natural Area preserved by The Nature Conservancy. A six-inch rise in water over a ten-acre wetland places more than 1,500,000 gallons of water in storage with no harm to the surrounding biota. By slowing the velocity of flow, wetlands also act as *siltation traps*.

Recharging the Water Table. One of the more subtle but significant aspects of many wetlands, especially those underlain by alluvial deposits, is the potential for recharging the water table. The U.S. Geological Survey has demonstrated this in the Ipswich basin of Massachusetts. On the Yellow River in

North Carolina it has been reported that the water table of the flood plain is hydraulically contiguous with the surface waters of the stream. As we study Connecticut's wetlands further there is little doubt that the importance of their hydrologic role will become better appreciated.

Pollution Filtration. One of the most significant roles of wetlands is their ability to remove pollutants from the water flowing through them. Although it has long been recognized that wetlands have a certain "self cleaning" ability, if not overstressed, recent studies have documented this extremely important role of marshes and swamps. The Tinicum Marshes on the outskirts of Philadelphia comprise a mosaic of highly productive brackish and fresh-water plant communities which receive effluent sewage from nearby sewage facilities. Studies indicated that within three to five hours after the water had moved across the 512 acres of marsh there was a 57% reduction in biological oxygen demand (BOD), 63% reduction in nitrates, 57% in phosphates. This amounted to a reduction of 7.7 tons of BOD, 4.3 tons of ammonia nitrogen, 138 lbs. of nitrate and 4.9 tons of phosphate (7). In Georgia a similar role has been reported along the Flint and Alcovy Rivers where river bottomland swamps occur (14). Along Mountain Creek, a tributary of the Alcovy, extreme pollution due to human sewage and chicken offal has been reported. However, after passing through 2.75 miles of swamp forest along the Alcovy the water was designated as clean and, after moving through seven additional miles of river swamp, water quality had increased to excellent.

The role of Connecticut's wetlands in pollution filtration is yet to be fully documented. However, preliminary observations would suggest that they are playing a significant role. In the Hunt's Brook watershed in Montville, where an estimated million cubic yards of fly ash from the power plant of a major utility has been placed in the streambelt, wetlands downstream have served an important role as a sediment trap. Fine fly ash has been trapped in one depression, where a red maple swamp has been converted into a reed grass (*Phragmites communis*) marsh. Much of the sediment would now be further downstream had it not been caught by this wetland. Utilizing wetlands as pollution filters does not excuse inadequate water pollution controls or irresponsible actions in sound land use. However, Connecticut, like other States, has a large ecological debt to overcome in the years ahead. Reserving the wetlands to assist in getting on the positive side of the ledger seems most prudent at this time. Further wetland destruction can only intensify the difficulty in preserving a high level of environmental quality.

Oxygen Production. In the process of photosynthesis, green plants produce oxygen in excess of what they require for respiration and therefore add this gas to the atmosphere. In recent studies on the Tinicum Marshes it was reported that a net increase of 20 tons of oxygen per day is produced (7). Unfortunately, since this study was made an interchange on interstate highway I-95 has been constructed in the center of the marsh, which has drastically reduced its size. Dr. Edward S. Deevey has pointed out in an intriguing article, "In Defense of Mud," (3) that not all the oxygen produced comes from green plants. In the wetland muds, the reduction of nitrogen and sulfur compounds containing oxygen also involves the production of oxygen. This is an hitherto little-understood role of the wetlands—oxygen production from mud!

Productivity. Fresh-water marshes and swamps are among our most productive biological systems. They compete with the best agricultural land in total production of organic materials. Although we often do not utilize these compounds directly, indirectly they lead to timber or, through the food chain, to wildlife production. Studies reported by Dr. Charles Wharton on the Alcovy

River in Georgia estimate that the value to the taxpayer of the Alcovy River system is \$7,000,000 annually (14). It should be emphasized that these monetary estimates do not include the value of primary production in terms of food for wildlife, or for fur-bearing animals. Furbearers are locally important in Connecticut. On the 750-acre Quinnipiac Marsh in Connecticut, Smith (12) estimated the 1971 population of muskrats at 7,675 individuals. This could yield an annual harvest of 5,700 muskrats, assuming normal winter mortality.

The wetlands have long been recognized as our Nation's duck factories. Those in Connecticut are playing an important role in providing nesting and feeding sites and resting areas for migratory waterfowl along the Atlantic Flyway.

Aid in Maintenance of a Balanced Nitrogen Cycle. Modern man has drastically modified the nitrogen cycle. The annual natural turnover of nitrogen compounds in the U.S. has been calculated to be about 7 or 8 million tons (1). Currently our agricultural fertilizers add another estimated 7 million tons, and nitrogen compounds produced as by-products from our power plants and automobiles, another 2 to 3 million tons. More than doubling the nitrogen input into the biosphere has resulted in a serious deterioration of environmental quality in various parts of the country. Denitrifying bacteria have the ability to take the deleterious nitrogen oxides that are accumulating and convert them back into atmospheric nitrogen of which most of the atmosphere is composed. Most wetlands support vast numbers of these micro-organisms and thus serve to reduce the load of dissolved nitrogen washed into them. With over half of our original tidal marshes already destroyed (8) and with a considerable acreage of the inland wetlands filled or drained, an increased burden is being placed upon the remaining wetlands to help restore the nitrogen balance in the ecosystem.

Maintaining Diversity. The flora and fauna of our wetlands exhibit a rich diversity of species. Among these are rare orchids, unusual insectivorous plants, and wetland birds, including the secretive rails and the spectacular egrets.

Most ecologists agree that diversity tends to stabilize biological systems. A corn field is much less stable ecologically than a marsh or swamp forest. This is not to imply that corn fields are not needed; but man must add considerable energy to them to keep them productive. Such is not the case with the natural wetlands. They represent a set of dynamic self-sustaining biological systems. Marshes, swamps, bogs, flood plains and streambelts lend an important aspect to the biotic diversity of Connecticut. At the present time we do not know how far we can go in simplifying or homogenizing natural landscapes before the entire ecosystem upon which we depend will collapse! Dasmann (2) makes a strong plea for the preservation of natural diversity in the hope that the trend toward uniformity can be arrested and that the world can be kept a fit place in which to live.

Education and Recreation. Wetlands can serve as resource areas for scientific research and also as outdoor educational exhibits—living museums where the dynamics and ecological role of these ecosystems may be taught. Examples of recent data developed on the wetlands have already been cited (1, 3, 7, 12, 14).

In education these outdoor laboratories can be used to emphasize such basic ecological principles as energy flow, the stability of diversity, recycling and limited carrying capacity. All of these are directly related to man and the environmental problems he has created by failing to recognize their applicability to human ecology. A practical example of the educational usefulness of a wetland is made in the Connecticut Arboretum Trail Guide (4). It makes this point along the route: "The swamp below the dam is roughly an acre in size. If flooded to a depth of one foot, it would hold 330,000 gallons of water. Thus whenever a swamp is filled or drained, another large quantity of water is lost

from the underground water supply and made to run off more quickly to aggravate flooding problems downstream."

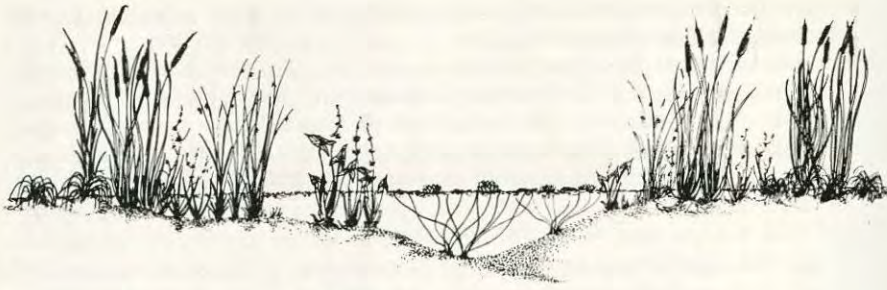
Wetlands also provide a great recreational outlet. Hunting is still an important form of recreation in Connecticut. Others hunt the wetlands with binoculars, where a great diversity of waterfowl and spectacular waterbirds give pleasure and inspiration. Wetlands should be incorporated into the greenbelts of every town, thus becoming a part of the future commitment to open space.

In Conclusion

The preservation of environmental quality requires a thoughtful analysis of all aspects of the ecosystem. Only through such an holistic approach will the significance of the wetlands be appreciated. Public Act 155 provides a mechanism through which these liquid assets may be saved for future generations in Connecticut; but implementation will be contingent upon the dedication and initiative of an enlightened citizenry.

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PLANTS OF THE MARSHES

MARSHES are normally covered with shallow water the year around. Typical marsh vegetation is rooted on the bottom and may be totally submerged, float on the surface or emerge above the water (emergents). They develop in shallow ponds or depressions by the gradual accumulation of dead plant remains. However open bodies of water are not uncommon. A somewhat drier phase is the wet meadow where an array of colorful perennials may predominate. These wetlands are highly productive, supporting a diversity of waterfowl and other wildlife.

Bur-reed. *Sparganium americanum* Nutt. This is the commonest of several species of bur-reeds found in Connecticut. An emergent usually growing in shallow water or on muddy shores, up to three feet (1 m) in height. Leaves flat and linear from creeping horizontal stems. Fruits arranged in one to five spherical, bur-like heads.

Cat-tails. *Typha latifolia* L. (Fig. A) and *T. angustifolia* L. (Fig. B). Stout plants from three to eight feet (1-2.7 m) tall, with linear leaves from creeping underground stems, frequently growing in dense stands in shallow water. The broad-leaved species can be distinguished from the narrow by the greater width of the leaves (mostly greater than 0.3 inch (7 mm)), and by the dense cylindrical inflorescence, the terminal staminate portion being contiguous to the lower pistillate portion. In the narrow-leaved species the spike is interrupted (see Fig. B). Inflorescences, $\times 1/3$.*

Arrowhead. *Sagittaria latifolia* Willd. Fleshy emergent with arrow-shaped leaves, the basal lobes often long and tapering; flowers white, borne in whorls of three, July to September; fruits in spherical heads.

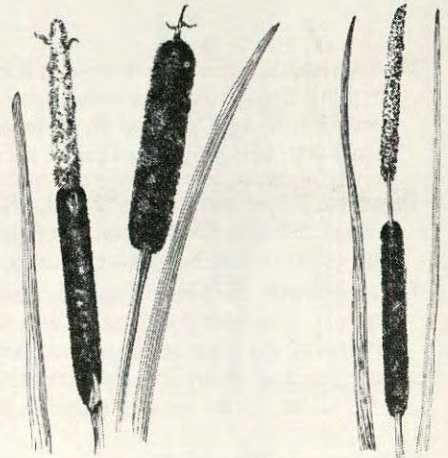
Pickerelweed. *Pontederia cordata* L. Stout, fleshy emergent growing in shallow water or on muddy shores; leaves soft with heart-shaped bases; inflorescence a spike of violet-blue flowers, throughout the summer.

Arrow-arum. *Peltandra virginica* (L.) Schott & Endl. Fleshy emergent with arrow-shaped leaves growing in shallow water or muddy ground; flowers and fruits crowded on a stalk (spadix) and partially enveloped by a leathery, leaf-like spathe, shown at the left.

*Scale of illustration detail is one-third life size.



Bur-reed



A

Cat-tails

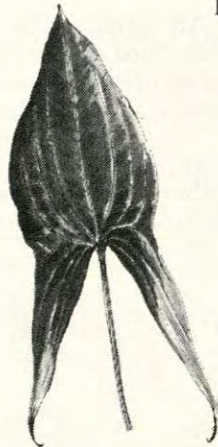
B



Pickerelweed



Arrowhead



Arrow-arum

Wool-grass. *Scirpus cyperinus* (L.) Kunth. Plants of swamps and wet meadows forming dense tussocks with many curving basal leaves; stems three to four feet (1.3 m) tall, topped by a spreading inflorescence composed of a large number of small ovoid spikelets becoming very woolly at maturity. Spikelets, $\times 1$.

Bulrush. *Scirpus atrovirens* Willd. Somewhat similar to the preceding species with dense clusters of small, greenish-brown spikelets. Plants of wet meadows and occasionally bogs. Not figured.

Great Bulrush. Soft-stem Bulrush. *Scirpus validus* Vahl. An emergent sedge of fresh or brackish marshes. Stems stout and rounded in cross-section, up to six feet (2 m) high; inflorescence borne laterally near the end of the stalk and composed of many loosely spreading, tawny or chestnut-brown, ovoid spikelets. Often forms sizable colonies from creeping rootstock. Habitat sketch, $\times 1/20$.

Three-square Bulrush. *Scirpus americanus* Pers. Somewhat similar to the preceding species, with sharply triangular stems and constricted, cone-like inflorescence. Not figured.

Umbrella-sedge, Galingale. *Cyperus strigosus* L. Stem triangular in cross-section, leafy at the base; inflorescence composed of a dense cluster of yellowish spikelets borne above two or more leaf-like bracts. A plant of marshes and wet meadows, occasionally found in bogs. Spikelet, $\times 1.5$.

Tussock Sedge. *Carex stricta* Lam. Grass-like plants with triangular stems and leaves outward arching, forming dense tussocks; fruiting spikes one to four, elongate, overtopping the leaves and about two feet (0.7 m) tall. As illustrated, the narrower male fruiting spikes bearing pollen extend above the broader, seed-bearing spikes. Plants of marshes, wet meadows and open wooded swamps. Habitat sketch, $\times 1/100$. Numerous other species of *Carex* grow in the marshes, swamps and bogs.

Three-way Sedge. *Dulichium arundinaceum* (L.) Britt. Stems jointed and leafy to the tip; leaves short, flat and linear, arranged in three conspicuous rows; flower spikelets linear, flattened and in two rows. Not figured.

Spike-rush. *Eleocharis* spp. Leafless plants with tufted green stems bearing a small terminal cone-like cluster of scaly florets. A number of species are found in wetlands. Not figured.

Purple Loosestrife. *Lythrum salicaria* L. An aggressive perennial introduced from Europe, spreading through the river flood plains and wet meadows, often replacing the native vegetation. Leaves opposite or sometimes whorled in threes; flowers very showy in terminal, magenta spikes, midsummer to early fall. Flower, $\times 1.5$.

Yellow Loosestrife. *Lysimachia terrestris* (L.) BSP; **Fringed Loosestrife.** *L. ciliata* L. Plants of wet meadows and shores. Flowers yellow; the former with a distinctive "candle" of flowers; the latter with a more diffuse arrangement; June to August. Not figured.



Wool-grass



Great Bulrush



Umbrella-sedge



Purple Loosestrife



Tussock Sedge

Soft Rush. *Juncus effusus* L. Plants forming dense tussocks in open swamps and pastured wetlands; leaves and stems dark green, round in cross-section, ending in a spear-like point; inflorescence developing from one side of the stem as a cluster of small brownish flowers and capsules. Habit sketch, $\times 1/18$. A number of other species of rushes may also be found growing in the fresh-water wetlands.

Rush. *Juncus acuminatus* Michx. One of a number of species having this general appearance. Basal leaves spear-like; inflorescence composed of clusters of small chaffy flowers originating from the attachment of a sharp-pointed involucre leaf. Habitat sketch, $\times 1/20$.

Yellow Pond-lily, Spatter-dock. *Nuphar advena* (Ait.) Ait. f. Leaf blades rounded-oblong, 0.3-1.3 feet (10 to 35 cm) long, emergent or floating; flowers yellow, cup-shaped. A plant of pond margins and marshes. Not figured.

Water-lily, Pond-lily. *Nymphaea odorata* Ait. Leaf blades nearly round, floating two to ten inches (5 to 25 cm) in diameter; flowers white, with many petals, two to six inches (5 to 15 cm) in diameter, very fragrant. A plant of ponds, marshes and bog pools. Flower and leaf, $\times 1/6$.

Reed. *Phragmites communis* Trin. Stout leafy stems forming dense stands up to twelve feet (4 m) high and topped by a plume-like inflorescence. A very conspicuous grass in wetlands that have been subjected to disturbance. Habitat sketch, $\times 1/60$; florets, $\times 1$.

Wild Rice, Water-oats. *Zizania aquatica* L. A tall grass growing up to nine feet (3 m) high in fresh to brackish water of the river marshes; the staminate spikelets hang gracefully from spreading horizontal branches; fruiting spikelets, borne above, fall off promptly. An important wildlife food, which used to be harvested by the Indians in Connecticut. Inflorescence, $\times 1/4$.

Other Species of Marshes and Wet Meadows

Marsh Fern. *Dryopteris thelypteris* (L.) Gray.

Royal Fern. *Osmunda regalis* L.

Sensitive Fern. *Onoclea sensibilis* L.

Water-plantain. *Alisma subcordatum* Raf.

Blue-joint Grass. *Calamagrostis canadensis* (Michx.) Nutt.

Fowl-meadow Grass. *Glyceria striata* (Lam.) Hitchc.

Reed-canary Grass. *Phalaris arundinacea* L.

Rice Cut-grass. *Leersia oryzoides* (L.) Swartz

Beak-rush. *Rhynchospora* spp.

Sweet Flag. *Acorus calamus* L.

Duckweed. *Lemna* spp.

Blue Flag. *Iris versicolor* L.

Smartweeds. *Polygonum* spp.

Meadow Rue. *Thalictrum* spp.

Swamp St. John's-wort. *Hypericum virginicum* L.

Meadow-beauty. *Rhexia virginica* L.

Swamp Milkweed. *Asclepias incarnata* L.

Forget-me-not. *Myosotis* spp.

Water-horehound. *Lycopus virginicus* L.

Turtlehead. *Chelone glabra* L.

Joe-pye-weed. *Eupatorium purpureum* L.

Boneset. *E. perfoliatum* L.

Ironweed. *Vernonia noveboracensis* (L.) Michx.

Bur Marigold. *Bidens* spp.



Soft Rush



Rush



Water-lily



Reed



Wild Rice



PLANTS OF THE SWAMPS

SWAMPS occur where the water table is at or near the surface throughout the year. They are dominated by trees and shrubs. Swamps, such as our typical red maple swamp forests, may be wooded. Within them there is often a distinctive under-growth of shrubs, including those illustrated. In some poorly drained sites trees may be completely absent. In such shrub swamps buttonbush, alder and willow are frequently found. It should be emphasized that transitional wetland types are not uncommon. Some of the plants included in the swamp list may also occur in the marsh and vice versa.

Red Maple, Swamp Maple. *Acer rubrum* L. Leaves three to five sharply toothed lobes separated by V-shaped sinuses, not silvery beneath; foliage usually turns scarlet in early fall; flowers red, appearing in early spring, long before the leaves.

Silver Maple. *Acer saccharinum* L. Leaves more deeply divided than the preceding species and silvery beneath. More commonly found on the flood plains. Not figured.

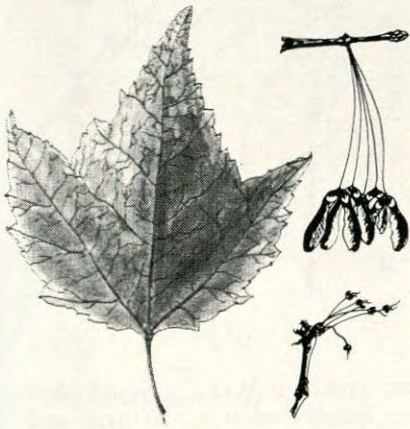
Poison Sumac. *Rhus vernix* L. A coarse shrub or small tree up to twenty feet tall; bark gray and smooth; leaves compound, with 7 to 13 untoothed leaflets; inflorescence spreading; flowers, May to July; fruit a gray berry, August to November. Twigs, foliage, flowers and fruits very poisonous to the touch.

Black Ash. *Fraxinus nigra* Marsh. A small to medium-sized tree with opposite, compound leaves (single leaf illustrated); fruit with an elongate, flattened wing. Leaf and fruit, $\times 1/3$.

Large Pussy-willow. *Salix discolor* Muhl. (Fig. A). Leaves elliptic with rounded teeth; silky masses of flowers appearing in early spring before the leaves; a large shrub of swamps and thickets.

Silky Willow. *Salix sericea* Marsh. (Fig. B). Leaves finely toothed, tapering at each end and lustrous beneath with silky hairs; a shrub of swamps and stream banks.

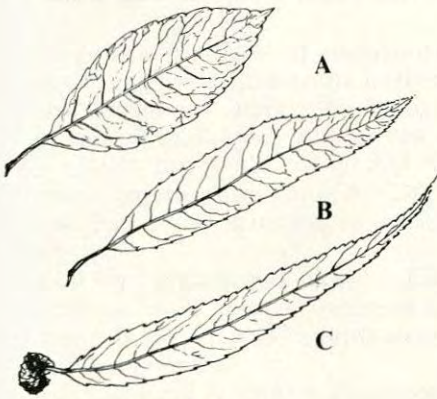
Black Willow. *Salix nigra* Marsh. (Fig. C). Leaves long and tapering, with stipules. A shrub or medium-sized tree of flood plains, shores and swampy woodlands.



Red Maple



Poison Sumac



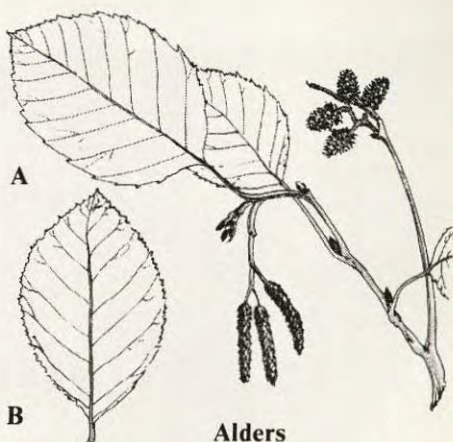
Willows



Black Ash



Black Gum



Alders

Black Gum, Tupelo, Pepperidge. *Nyssa sylvatica* Marsh. Small or middle-sized tree, with horizontal branches; leaves somewhat leathery and shiny with an abrupt tip, turning deep red in the fall and dropping early; fruits black, about 0.5 inch (12 mm) long. Often growing in swamps and at the edges of lakes, sometimes on the upland.

Alders. *Alnus rugosa* (DuRoi) Spreng. (Fig. A) and *A. serrulata* (Ait.) Willd. (Fig. B). The alders are common shrubs of swamps and stream margins, often forming extensive thickets up to 15 feet (5 m) high. They may usually be distinguished by the clusters of small, woody, cone-like fruits, that persist through the second growing season, and the elongated catkins (male flower clusters) conspicuously present in the winter condition. Both fruits and catkins illustrated.

Highbush Blueberry. *Vaccinium corymbosum* L. A common shrub of swamps, but by no means confined to wetland situations, growing in clumps about six to ten feet (2 to 3 m) in height; flowers white, urn-shaped; fruit a blue to blue-black edible berry, July and August; fall foliage turning a brilliant red in open sunny sites. Branch, $\times 1/3$; flower, $\times 1/2$; bud, $\times 2.5$.

Maleberry. *Lyonia ligustrina* (L.) DC. A shrub to be distinguished from the blueberry by the presence of clusters of persistent brown capsules. Flower and capsule, $\times 1/2$.

Sweet Pepperbush. *Clethra alnifolia* L. Shrub four to eight feet (1.3 to 2.7 m) high; flowers white, fragrant, in terminal racemes in midsummer; fruit a brown, persistent capsule. A common shrub of swamps, but also found on the upland.

Clammy Azalea. *Rhododendron viscosum* (L.) Torr. A branching shrub about eight feet (2.7 m) tall; twigs appearing in a whorled arrangement at the ends of the branches; mid-summer flowers usually white, occasionally pink or rose-purple, up to 1.5 inches (4 cm) long, sticky and very fragrant; capsule cylindrical.



Highbush Blueberry



Maleberry



Clammy Azalea



Sweet Pepperbush

- Black Alder, Winterberry.** *Ilex verticillata* (L.) Gray. A common shrub of swamps usually about six to eight feet (2 to 3 m) tall; white flowers small and inconspicuous; female shrubs with bright red fruits about 0.25 inch (6 mm) in diameter borne along the twigs, showy in late fall and early winter.
- Spicebush.** *Lindera benzoin* (L.) Blume. A spreading shrub from six to twelve feet (2 to 4 m) high; small greenish-yellow flowers appearing in early spring before the leaves; leaves and red fruits spicy aromatic. Common in swamps and damp woods and along brooksides. Twig with bud, $\times 3.5$.
- Buttonbush.** *Cephalanthus occidentalis* L. Straggling, brittle shrub with opposite leaves; white flowers densely aggregated into spherical heads in mid-summer. Frequently forms pure stands in shrub swamps. Flower, $\times 3$.
- Marsh-marigold, Cowslip.** *Caltha palustris* L. An herb of swamps and wet meadows. Leaves roundish to kidney-shaped with the margin toothed; flowers deep yellow, April to June.
- Skunk-cabbage.** *Symplocarpus foetidus* (L.) Nutt. A common herb of swampy woodlands; large fleshy leaves somewhat heart-shaped, with a rank odor of skunk when bruised; a globular mass of flowers borne in the earliest spring within a fleshy, purple-spotted, enveloping, leaf-like structure (spathe). Plant, $\times 1/3$.

Other Species of Swamp Plants

- Cinnamon Fern.** *Osmunda cinnamomea* L.
- Interrupted Fern.** *O. claytoniana* L.
- Wood Reedgrass.** *Cinna arundinacea* L.
- Indian Poke.** *Veratrum viride* Ait.
- Goldthread.** *Coptis groenlandica* (Oeder) Fern.
- Bitter Cress.** *Cardamine pensylvanica* Muhl.
- Water-carpet.** *Chrysosplenium americanum* Schwein.
- Steeple-bush.** *Spiraea tomentosa* L.
- Meadow-sweet.** *S. latifolia* (Ait.) Burkh.
- Swamp Rose.** *Rosa palustris* Marsh.
- Trailing Swamp Blackberry.** *Rubus hispidus* L.
- Jewelweed.** *Impatiens capensis* Meerb.
- Violets.** *Viola* spp.
- Golden Alexanders.** *Zizia aurea* (L.) W.D.J. Koch.
- Water-hemlock.** *Cicuta maculata* L.
- Water Parsnip.** *Sium suave* Walt.
- Water-pennywort.** *Hydrocotyle americana* L.
- Silky Dogwood.** *Cornus amomum* Mill.
- Red-osier Dogwood.** *Cornus stolonifera* Michx.
- Rhodora.** *Rhododendron canadense* (L.) Torr.
- Skullcap.** *Scutellaria* spp.
- Arrow-wood.** *Viburnum recognitum* Fern.
- Witherod.** *V. cassinoides* L.
- Elder.** *Sambucus canadensis* L.
- Cardinal Flower.** *Lobelia cardinalis* L.



Black Alder



Spicebush



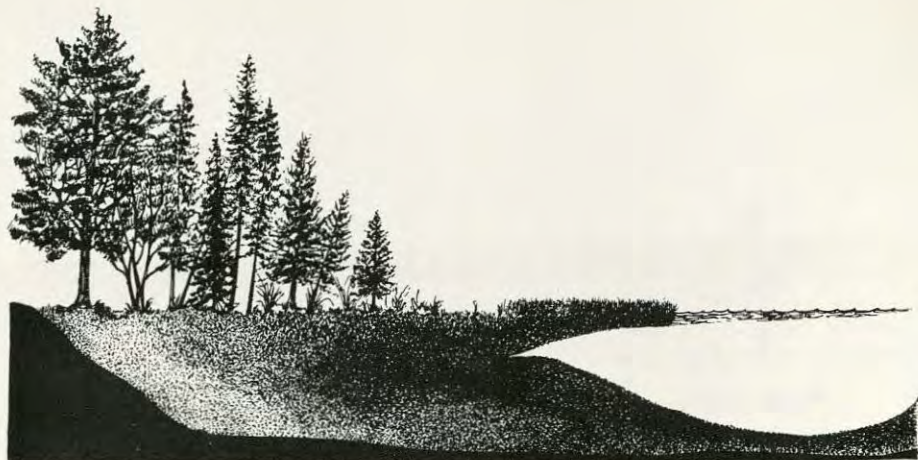
Buttonbush



Marsh-marigold



Skunk-cabbage



PLANTS OF THE BOGS

BOGS usually develop in undrained glacial depressions with no outlet or where outflow is drastically impeded. Organic matter accumulates as peat, because normal decay is extremely slow. The water is cold, usually strongly acid and practically devoid of oxygen and available nutrients. Bogs harbor a distinctive group of plants that include members of the heath family as well as insectivorous plants and bog orchids. Typical trees of the bog are larch and black spruce, although they are replaced southward in Connecticut by southern white cedar. Sometimes deciduous species may completely replace the conifers. Under foot sphagnum moss with a high water-holding capacity is usually encountered.

Larch, Tamarack. *Larix laricina* (DuRoi) K. Koch. A small coniferous tree of the bogs. The deciduous needles rather soft, light green, borne in circular clusters at the ends of short woody spurs, turning yellow in the autumn before shedding; bare twigs have a knobby appearance.

Southern White Cedar. *Chamaecyparis thyoides* (L.) BSP. This is an evergreen characteristic of our coastal bogs and swamps, becoming a large tree at maturity. Leaves minute and scale-like; cone small and globose, $\times 1$.

Black Spruce. *Picea mariana* (Mill.) BSP. This is the needle-leaved evergreen tree usually growing in bogs; rather dwarfed in southern New England. Trees three feet (1 m) in height may be over forty years old.

Water-willow, Swamp-loosestrife. *Decodon verticillatus* (L.) Ell. A slightly shrubby plant typically invading open water by rooting at the tips of the arching branches, which become spongy thickened at the tips where they enter the water; leaves opposite or in whorls of three, with clusters of magenta flowers at their bases. Habit sketches, $\times 1/50$.

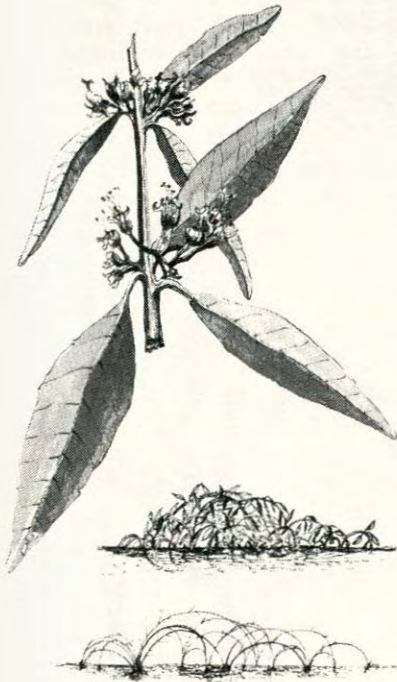
Sundew. *Drosera rotundifolia* L. and *D. intermedia* Hayne. Plants with small rosettes of leaves clothed with reddish, sticky, gland-bearing hairs that ensnare and digest insects; few to numerous small white flowers scattered along a slender erect flowering stalk about six inches (15 cm) high. Usually found growing in damp sphagnum moss in open sunny situations. Leaf tip of *D. intermedia*, $\times 1$.



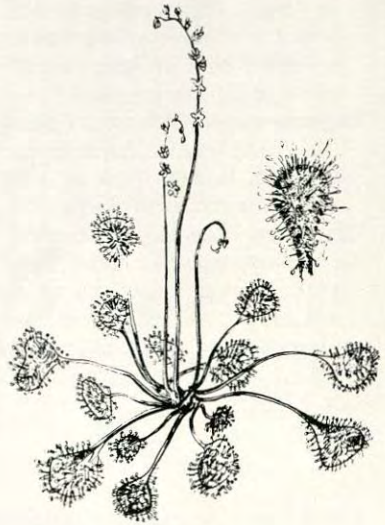
Larch



Black Spruce



Water-willow



Sundew



Southern White Cedar

- Pitcher-plant.** *Sarracenia purpurea* L. A rosette of pitcher-shaped leaves often suffused or veined with purple or red and partly filled with water; flower bronzy, borne on an erect stalk about twice the length of the leaves, June to August. This is an insectivorous plant. Insects caught and drowned in the pitchers are digested, and the nutrients absorbed. Figure on the back cover, $\times 3/5$.
- Leather-leaf.** *Chamaedaphne calyculata* (L.) Moench. A common bog shrub, often forming a dense shrub cover (heath) about two feet (0.8 m) high; leaves leathery and semi-evergreen with a roughened texture, characteristically tapering in size toward the tips of the branches; flowers white, urn-shaped, along one side of the stem tips, April to July; fruit a capsule. Flower bud, $\times 5$.
- Sweet Gale.** *Myrica gale* L. Shrub growing to about 4.5 feet (1.5 m) high; leaves somewhat leathery and toothed toward the tip, aromatic; fruiting clusters cone-like. A shrub of boggy shores and swamps. Bud, $\times 2.5$.
- Bog-laurel.** *Kalmia polifolia* Wang. Slender shrub about one to two feet (0.5 m) in height; leaves opposite, lustrous-green above and whitened beneath, often with the edges inrolled; flowers about 0.5 inches (1.4 cm) broad, deep pink to crimson, with anthers caught in little pockets in the corolla (petals); fruit a globose capsule on slender, erect stalks. Flower and leaf, $\times 1$.
- Bog-rosemary.** *Andromeda glaucophylla* Link. Low shrub about one to two feet (0.5 m) in height; leaves alternate, narrow, whitened beneath with the margins inrolled; flowers pink or white, urn-shaped; fruit a capsule with a whitish bloom on recurved stalks.
- Cranberry.** *Vaccinium oxycoccos* L. and *V. macrocarpon* Ait. Plants with a creeping, vine-like habit, characteristic of the acid sphagnum bogs; flowers pink; fruit globose, red at maturity from September, holding through the winter. *V. macrocarpon* can be distinguished from *V. oxycoccos* by the larger fruits, which exceed 0.4 inches (1 cm) in diameter, and larger leaves which are (over 0.25 inch) (6 mm) in length. Flower $\times 1$; habit sketch, $\times 1/10$.

Other Species of Bog Plants

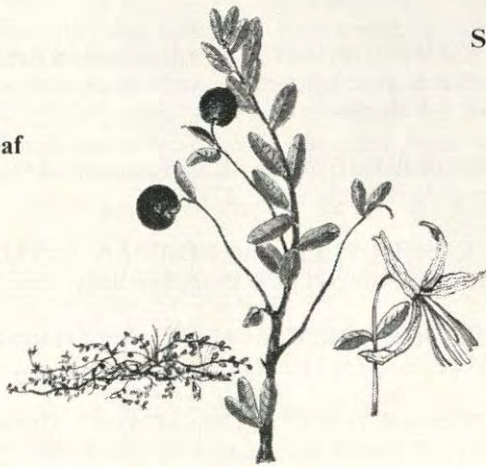
- Chain Fern.** *Woodwardia virginica* (L.) Sm.
Cotton-grass. *Eriophorum* spp.
Wild Calla. *Calla palustris* L.
Yellow-eyed Grass. *Xyris* spp.
Common Ladies'-tresses. *Spiranthes cernua* (L.)
Grass Pink. *Calopogon pulchellus* (Salisb.) R. Br.
Rose Pogonia. *Pogonia ophioglossoides* (L.) Ker.
Swamp-pink. *Arethusa bulbosa* L.
Labrador Tea. *Ledum groenlandicum* Oeder.
Rhododendron, Rosebay. *Rhododendron maximum* L.
Bog Bean. *Menyanthes trifoliata* L.
Bladderwort. *Utricularia* spp.
Bedstraw. *Galium* spp.



Leather-leaf



Sweet Gale



Cranberry



Bog-rosemary



Bog-laurel

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