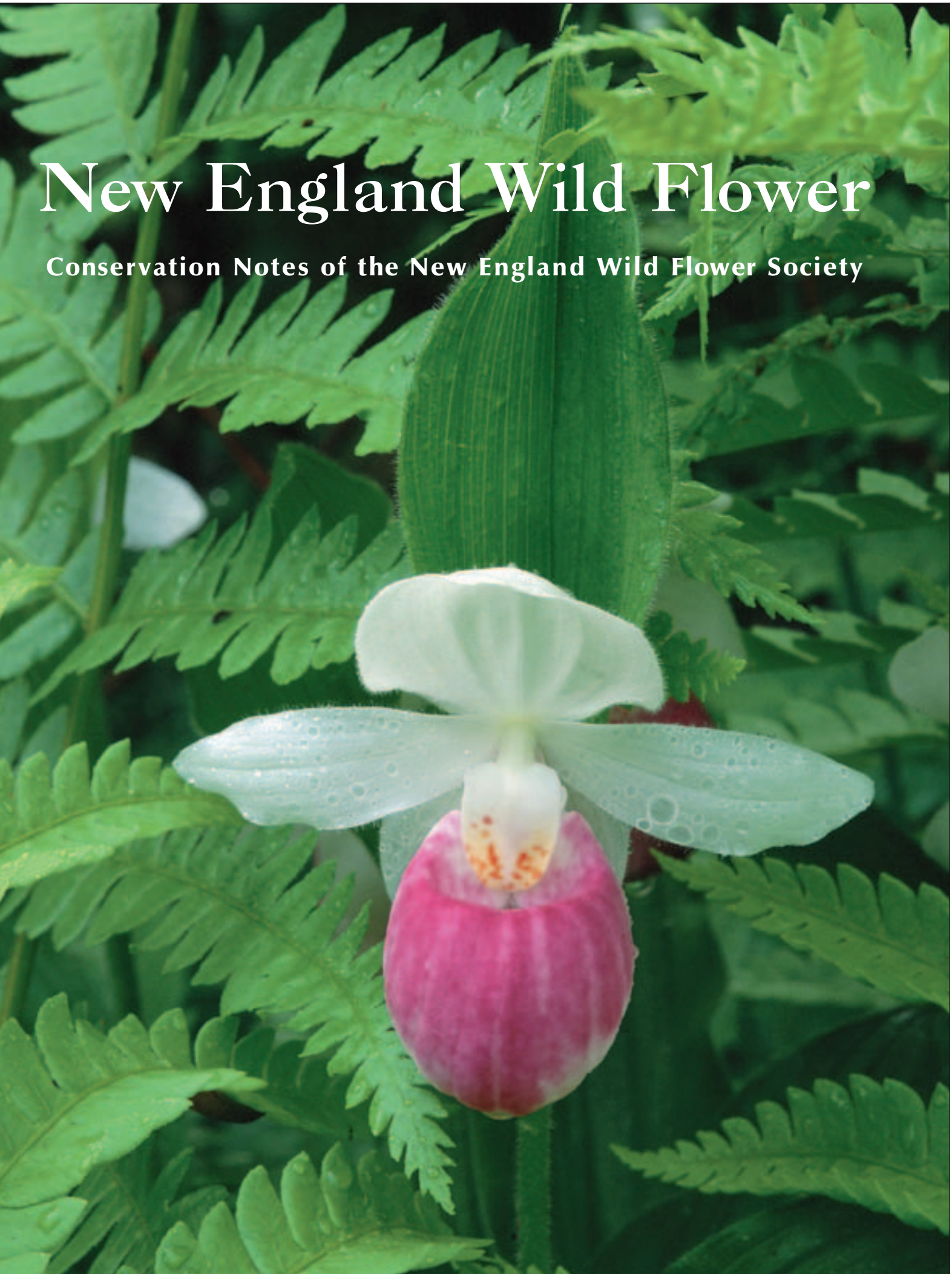

New England Wild Flower

Conservation Notes of the New England Wild Flower Society

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New England Wild Flower
Vol. 1, No. 3 (1997)

Conservation Notes of the New England Wild Flower Society

Featuring: *"Flora Conservanda:* New England — The New England Plant Conservation Program list of plants in need of conservation"

New England Wild Flower is published by the New England Wild Flower Society, an independent, nonprofit, member-supported organization whose purpose is to promote the conservation of temperate North American plants through horticulture, education, research, habitat preservation, and conservation advocacy.

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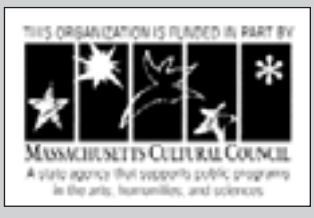

"Flora Conservanda: New England — the list of rare & endangered New England Plants"

A Personal Introduction

William E. Brumback

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In Thanks

In addition to the authors represented in this magazine, most of whom were also major contributors to "*Flora Conservanda:* New England," we would like to thank the more than 100 botanists from around the country who contributed their time and expertise to the original List. In an endeavor the size of the *Flora*, help comes from many sources. We are very grateful for the support given to the List and to this issue of *New England Wild Flower Notes* by the Ellis L. Phillips Foundation. We also thank the Andrew W. Mellon Foundation, the Jessie B. Cox Charitable Trust, the Surdna Foundation, and the Sweetwater Trust for their support of NEPCoP. The beautiful portraits of some of New England's rarest native plants were provided by a dedicated group of gifted photographers who donated their efforts.

To me, botany is the most human of the earth sciences. What can be more human than trying to fit the miraculous evolutionary range of plants into categories, naming those categories in a dead language (Latin), then debating these designations? Humans define plant species and, ultimately, humans decide whether a plant remains in our landscape or vanishes from it forever.

Fortunately, some people in New England care greatly about the fate of rare plant species. I have seen this personal commitment many times, as scientists and volunteers work to preserve our region's botanical heritage and future, but I have never felt it in a more heartening, a more personal, way than while working with my colleagues to produce "*Flora Conservanda*: New England, the New England Plant Conservation Program (NEPCoP) list of plants in need of conservation."

The List was formulated by NEPCoP, a voluntary collaboration of botanists, state agencies, and conservation organizations in each of the New England states whose goal is to "prevent the extirpation and promote the recovery of the endangered flora of the region." When a committee of NEPCoP members met in 1992 to discuss production of a list of endangered species for New England, they began an endeavor that would ultimately span more than four years and hundreds of hours of analysis and review to yield the most comprehensive regional list of New England's rare plants ever published. More than 1300 plant species were considered by the committee, which included representatives from the Natural Heritage Programs of each state, as well as other regional plant experts.

Continued on p. 4

Introduction

continued from p. 3

The Endangered Naturalist

For all the enthusiasm and commitment displayed by the contributors to "*Flora Conservanda:* New England," plant conservation nationally receives less than a tenth of the attention and funding given to the preservation of endangered animals. Though they are the foundation of all life on earth, plants don't seem to move us personally the way animals do. Unlike, for instance, the science and recreation of birding, botany has not fired the interest of a wide range of amateurs. It was not always so; around the turn of the last century early editions of the New England Botanical Club's journal, *Rhodora*, were filled with the exploits and observations of weekend naturalists, as well as professionals, who were out in the field discovering and documenting native plants for the sheer love of the sport. Then, over time, part-time plant enthusiasts gave way to professional naturalists, signaling the decline of amateur botany.

Adding to the problem, the conservation community has become more cautious about revealing the locations of rare plants to the public. While this is a legitimate concern, I think that in the long run it is important to engage the public in hands-on plant conservation and to develop the support needed to protect plants and their habitats.

Return of the Amateur

I hope to see the amateur botanist return as a member of volunteer teams gathered from many organizations. Such dedicated people can survey the rare and common plants of New England throughout the region, help manage their habitats, and create the constituency for plants that is so badly needed.

This issue of *New England Wild Flower Notes*, devoted to New England's rare plants as listed in the *Flora Conservanda*, is a step toward that goal. We might have published the scientific data and left it at that, but the List itself can reach only a limited group, mainly those who already have a background in plant science. In order to promote a wider involvement in plant conservation, we need to do much more. As a community, we need to share the stories of our rare native plants, show them in their natural habitats, and reveal the thoughts and hopes of the people who are working for their survival.

Why Conservation?

Why do we want to protect rare plants in the first place? The reasons are many and very human:

Economic — rare plants adapted to special niches may have genetic, medicinal, agricultural, or other value;

Moral — other species have as much right to survive as we do;

Philosophical — plants, the basis of all life on earth, were here before we were;

Ethical — we have a responsibility to leave at least as much wonderment and diversity for the next generation as we inherited from our parents; and

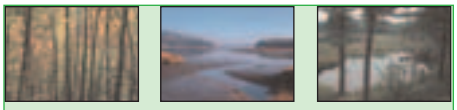
Scientific — rare species help us understand evolution and environmental adaptation.

> The strongest motivation of all is Ecological — we simply do not know the value of an individual species to our ecosystem.

But, for me, the strongest motivation of all is **Ecological** — we simply do not know the value of an individual species to our ecosystem. If a single species is lost, its niche may be filled by another, but an unanswerable question remains: "How many species can we afford to lose and still keep our ecosystem functioning?" To paraphrase Aldo Leopold, the famous prairie conservationist: the first step in intelligent tinkering is to save all the parts.

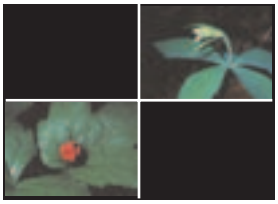
To protect rare plants, we must protect the habitats in which they live. This doctrine has been the driving force behind land preservation by various public and private organizations for many years. Recently, however, plant conservation has begun to recognize a new (and perhaps even greater) challenge: management of rare plants. The New England landscape has long felt the impact of human activity. Although we are also a part of the natural world, our presence has reduced the amount of suitable habitats for rare species and changed the natural processes (fire, water systems, etc.) that maintain these habitats. It is clear that we can no longer simply protect land, we must now also manage the land for rare species and their habitats. In some cases, this management may be as simple and as short-term as removing encroaching vegetation or rerouting a trail, or as complex as prescribed burning. In the long-run, we need to learn how to manage entire habitats, rather than single species, but while we are discovering the best ways to do this, individual plant populations must be maintained.

The 120-page "*Flora Conservanda:* New England" is a snapshot — a portrait in time — of the rare species of New England that will serve as a benchmark against which to judge the health and status of our flora in the future. That future will be far brighter for the personal involvement of many contributors, both professional and amateur naturalists, working to sustain rare plants and their habitats, not only for the sake of the plants, but for all New Englanders.



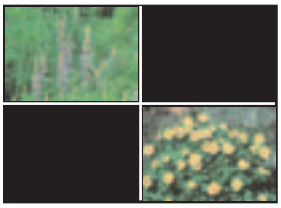
A Note About Habitats

This edition of *New England Wild Flower* is devoted to New England's rare plants and the habitats in which they are found. From alpine summits to seacoasts, to find a rare species you must first find the right habitat. We have grouped the plants of the *Flora Conservanda* into seven categories to give the reader some idea of the most common general habitat in New England for each plant. The habitat descriptions were written for this magazine by the authors of the *Flora Conservanda* itself. Choosing a single habitat for each plant is complicated by the fact that plants do not read botanical manuals and are sometimes found in more than one habitat grouping within their range. By trying to force a plant to fit into only one habitat for the purposes of the present publication, we run the risk of omitting other habitats where the plant might also occur. The habitat categories used here, therefore, should not be considered definitive.



Flora Conservanda: New England

Details of the List



NAME	Div	ME	NH	VT	MA	RI	CT
ASPLENIACEAE							
Asplenium montanum Willd. (11)	2	||||	||||	|1|T|S1|	|3|E|S1|	|1|E|S1|	|6|T|S2|

***"Flora Conservanda:* New England, the New England Plant Conservation Program (NEPCoP) list of plants in need of conservation"** — to give its full title — contains 576 plants divided into five divisions or categories of rarity. The List was derived from data stored by the Natural Heritage Program of each New England state. Packed with information, the List includes synonyms as well as the number of occurrences of a species in each state, state endangerment status, as well as global and state rarity rankings. It is important to note that the List was based on *current* records of occurrences for each plant; ("current" is defined as a plant that has been seen since 1970). Thus, this List shows the known status of rare plants in the wild. It is *not* based on herbarium specimens, which could have been collected from a population that may no longer exist.

How the List is Organized

Above is an example of a listing as it appears in "*Flora Conservanda:* New England." The List is divided into eight columns. The first column contains the name of the plant, the author, and source of the name (number in parentheses). The second column, headed "Div" contains the NEPCoP Division (see "NEPCoP Divisions," at right).

Columns 3–8 contain data for each state listed under the abbreviation for that state, such as "ME" for Maine. Each of these columns is divided into three sections or blocks, separated by vertical bars. If these sections are empty, the taxon is not known to occur in that state. The first block contains the number of current occurrences of the taxon in that state. The second block contains the State endangerment status of the taxon (Endangered [E], Threatened [T], etc.). The third block contains the State Rank (SRank) as defined by the Nature Conservancy. This generalized ranking is based on the number of individual plants, number of occurrences, and other factors contributing to the vulnerability of a taxon within each state — for example, S1 = generally 1–5 occurrences in the state; S2 = generally 6–20 occurrences in the state.

In addition to presenting the current status of over 300 rare plants, the NEPCoP List shows that 55 plants (Division 4) have disappeared from our region as documented by botanical records. More than a guide to plants we should be protecting, the List also reveals the need for more information on over 100 plants for which taxonomy or field status is unclear (Division IND). *Flora Conservanda* shows us that, in one of the most botanized regions of our country, the status of many plants is yet unknown.

To Get a Copy of the List:

To obtain a copy of "*Flora Conservanda:* New England," the full, 120-page list of plants in need of conservation published in "*Rhodora*: the Journal of the New England Botanical Club," send $9.50 to NEPCoP List, New England Wild Flower Society, 180 Hemenway Road, Framingham, MA 01701.

Explanation of NEPCoP's *Flora Conservanda* Divisions

Division 1: Globally Rare Plants occurring in New England (57 plants). Usually only a few occurrences of these plants exist within our region, but New England contains the majority of occurrences for a few of these species.

Division 2: Regionally Rare Plants (273 plants). These plants have fewer than 20 current occurrences (seen since 1970) within New England. This division includes plants that reach the edge of their range in New England. It is important to conserve these edge-of-range species as part of our region's natural heritage, as well as to avoid further shrinkage of their national ranges.

Division 3: Locally Rare Plants (75 plants). These plants may be common in part of New England, but have one or more occurrences of biological, ecological, or (possible) genetic significance. An occurrence could be listed as Div. 3 in a given state if: 1) it is disjunct (separated from other populations by more than 50 miles), suggesting genetic isolation; 2) it represents an ecological anomaly (for example, an acid bog occurrence of a plant that normally grows under calcareous (non-acid) conditions); 3) a significant portion of a plant's range is demonstrably declining within that state.

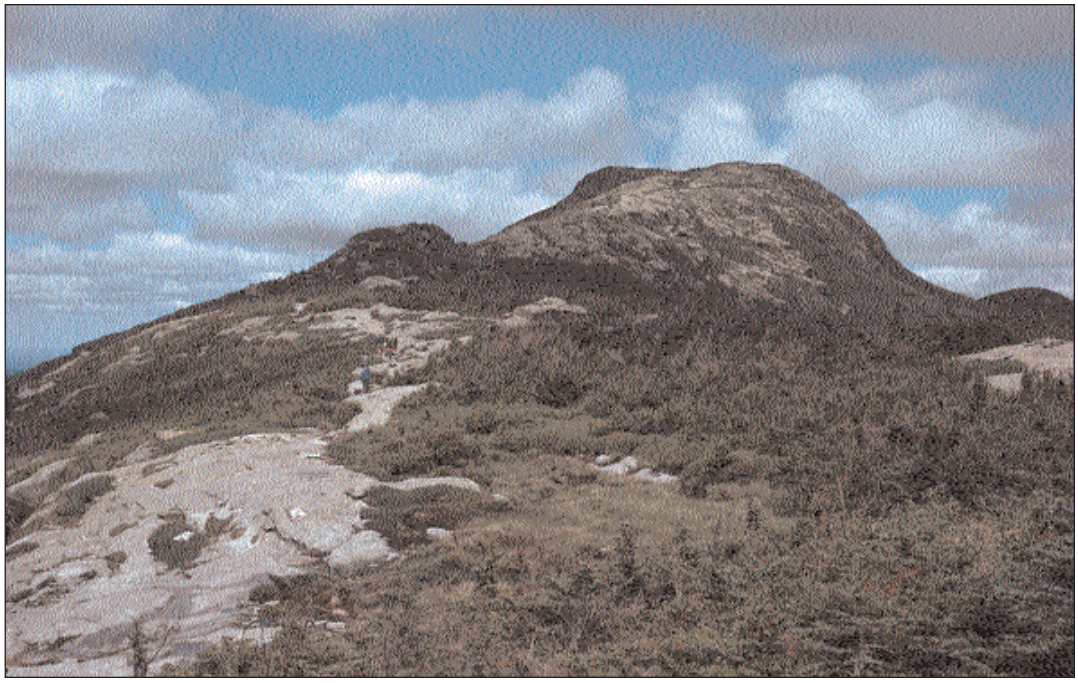
Division 4: Historic Plants (55 plants). Plants that once existed in New England, but have not been seen here since 1970. This division is intended to generate interest in rediscovering these taxa if they still exist here. This division also provides a benchmark to judge the future status of the region's flora.

Division IND.: Indeterminate Plants (116 plants). These plants are under review for inclusion in one of the above divisions, but either their status in the wild is not clearly understood or their taxonomy (at least for New England occurrences) or their nomenclature needs further investigation.

On the following habitat pages, the green type lists the *Flora Conservanda* plants for that habitat and includes the NEPCoP Division information (see sidebar above) for each plant.

Alpine

Daniel D. Sperduto



Achillea borealis
northern yarrow IND.
Agrostis mertensii
boreal bentgrass 2
Arctostaphylos alpina
alpine bearberry 2
Arnica lanceolata
New England arnica 1
Barbarea orthoceras
American winter-cress 2
Betula glandulosa
dwarf birch 2
Betula minor
dwarf white birch 1
Calamagrostis canadensis var. langsdorfii 4
Cardamine bellidifolia
alpine bitter-cress 2
Carex atratiformis
black sedge 2
Carex bigelowii
Bigelow's sedge 3:VT
Carex capillaris
capillary sedge 2
Carex capitata
head-like sedge 2
Carex rariflora
loose-flowered sedge 4
Castilleja septentrionalis
northeastern paintbrush 2(a)
Deschampsia atropurpurea
hairgrass 2
Diapensia lapponica
Lapland diapensia 3:VT
Empetrum nigrum
black crowberry 3:VT
Epilobium anagallidifolium
alpine willow-herb 2
Epilobium hornemannii
Hornemann's willow-herb 2
Euphrasia oakesii
Oakes' eyebright 2

Perched on the shoulders of the region's highest peaks is a land of extremes few forms of life can withstand. The Presidential Range of New Hampshire, Mt. Mansfield in Vermont, Mt. Katahdin in Maine — these are New England's islands of tundra, buffeted regularly by hurricane force winds, where winter arrives early and stays late, where clouds and fog are never distant, and many of the region's rarest plants cling to a thin zone of life between rock and sky. It is a small, harsh world of surprising diversity and beauty.

More than 10,000 years ago, in the wake of receding glaciers, much of New England was covered by tundra vegetation. As the climate warmed and trees and other plants moved back into the region, tundra was relegated to drastically reduced areas high on New England summits. Today treeline occurs near 4800 feet, although it can extend lower on exposed summits and ridges. At least 45 distinct summits are known to harbor alpine vegetation in New England, though the greatest diversity of species and largest acreage can be found on a handful of the larger peaks. Worldwide, treeline is dictated to a great extent by elevation and latitude. With higher elevations or more polar latitudes come colder temperatures, stronger and more persistent winds, late-melting snows, an abbreviated growing season, and a nutrient-poor substrate. It is this combination that conspires to exclude forest plants, and creates just the conditions alpine plants are adapted to survive and thrive in.

A tree's adaptation to grow tall is no advantage on high, where wind and blowing ice and snow prune branches so severely that they cannot gather enough nutrients to keep up with their losses. At the upper limit of tree growth balsam fir and black spruce form thigh-high, bonsai-like clumps called *krummholz*, a German term meaning "twisted wood." Many alpine plants are dwarfed to avoid the pernicious winds and have also adapted in other ways to conserve water and nutrients. For instance, many alpine shrubs are ground-hugging, with thick, small, leathery evergreen leaves that sometimes have curled margins or dense hairs to help reduce the physical abuse and dehydrating effects of alpine winds. The evergreen habit also helps conserve carbohydrates and nutrients by retaining green tissue, and gives plants a head-start on the short growing season. Many alpine plants also have an ability to photosynthesize efficiently at low temperatures and light levels.

New England's alpine vegetation is more like that of the eastern Canadian Arctic hundreds of miles to the north than the extensive forests just hundreds of feet below. About two-thirds of the more than 100 species found here are specific to alpine tundra, although only three species are largely restricted to New England alpine areas. There is a surprising amount of habitat variation within the alpine zone, mostly due to variations in the moisture conditions of the soil, degree of exposure to wind, and length of snow-free period. The most abundant type of tundra is the heath meadow community, which consists of various mixtures of dwarf heath shrubs, Bigelow's sedge, highland rush, and a handful of leafy forbs. Other alpine habitats include heath barrens on the most exposed wind-blown ridges, alpine stream banks, cliffs, and even an occasional bog in depressions of flat ridge tops. Each of these habitats has plants that are well adapted to withstand its challenges.

Tens of thousands of hikers and climbers are

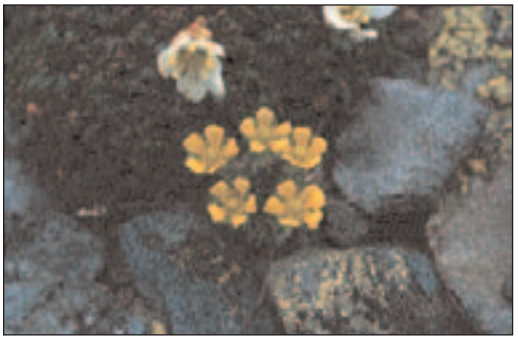
Continued on p. 8

***Rhododendron lapponicum* (Lapland rosebay)** — Blooming in late May to early June with clusters of pink to deep magenta flowers, the Lapland rosebay is colorfully conspicuous on the windswept mountain ledges where it grows. In New England, it is only found on a few high peaks in the White Mountains of New Hampshire and the Katahdin region of Maine. Like all Rhododendron species, the leaves and flowers of Lapland rosebay are poisonous, as is honey made from its nectar.

***Sibbaldia procumbens* (sibbaldia)** — A circumboreal species, this dwarf perennial relative of the rose is common in the alpine zones of northern and western North America, yet it appears as only one small population on Mt. Washington in New England. Why it hasn't spread throughout eastern alpine areas is a bit of a mystery. It produces viable seed, yet doesn't seem to be increasing (or decreasing) its numbers in that location.

***Silene acaulis* (moss campion)** — The rosy pink flowers of this dwarf plant sit atop the shortest of stems, densely seated into a mat of foliage that can reach up to twenty inches in diameter. When not in bloom, the plant resembles coarse moss. *Silene acaulis* reaches the southernmost limit of its range on Mt. Washington in New Hampshire, the only place in New England where it occurs.

***Potentilla robbinsiana* (Robbins' cinquefoil)** — This tiny member of the rose family is a true New England endemic. Highly prized by 19th century plant collectors, a more modern threat to the plant in its isolated mountain refuges is the tremendous increase in recreational hiking. At one time a popular trail on Mt. Washington ran directly through the largest population of this species, until relocation of the path brought relief. Work is underway to increase *Potentilla* populations in their natural habitat through reintroduction of seedlings.



***Diapensia lapponica* (Lapland diapensia)** — A common species in an uncommon habitat in New England, *Diapensia* often colonizes newly disturbed areas in the alpine zone. It can form extensive mats but, as with most alpine species, is easily damaged by foot traffic. The single occurrence in Vermont, widely separated from other populations of this species, is considered worthy of protection under the guidelines of *Flora Conservanda*.

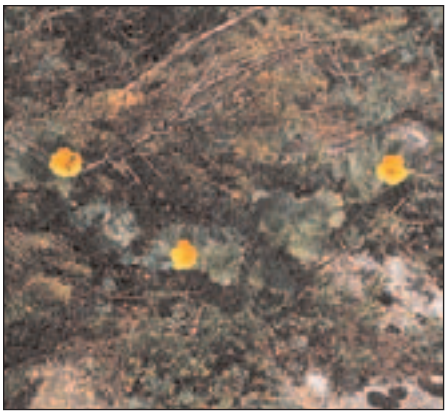
Geum peckii
mountain avens 1
Gnaphalium supinum
mountain cudweed 2
Harrimanella hypnoides
moss bell-heather 2
Hierochloe alpina
alpine holy-grass 2
Huperzia appalachiana
mountain fir-moss IND.
Juncus trifidus
highland rush 3:VT
Loiseleuria procumbens
alpine azalea 2
Luzula confusa
northern woodrush 2
Luzula spicata
spiked woodrush 2
Minuartia groenlandica
mountain sandwort 3:VT
Oxyria digyna
mountain sorrel 2
Phleum alpinum
alpine timothy 2
Phyllodoce caerulea
mountain heath 2
Poa glauca
white bluegrass 2
Poa laxa ssp. fernaldiana
wavy bluegrass 1
Polygonum viviparum
viviparous knotweed 2
Potentilla robbinsiana
Robbins' cinquefoil 1
Prenanthes boottii
Boott's rattlesnake-root 1
Rhododendron lapponicum
Lapland rosebay 2
Salix arctophila
arctic willow 2
Salix argyrocarpa
silver willow 2
Salix herbacea
dwarf willow 2
Salix planifolia
tea-leaved willow 2
Salix uva-ursi
bearberry willow 2
Saxifraga cernua
nodding saxifrage 2
Saxifraga foliolosa
star saxifrage 2
Saxifraga rivularis
alpine brook saxifrage 2
Sibbaldia procumbens
sibbaldia 2
Silene acaulis
moss campion 2
Solidago cutleri
alpine goldenrod 2
Vaccinium boreale
alpine blueberry 1
Veronica wormskjoldii
alpine speedwell 2
Viola palustris
northern marsh violet 2

Alpine

Continued from p. 6

drawn to the alpine zone each year, resulting in the loss of some significant rare species and tundra habitat. To counter these problems, land managers employ a combination of hiker education, on-site signs, summit stewards, revegetation efforts, and trail maintenance methods, with varying degrees of success. Fortunately, most tundra acreage remains intact due to dispersed use on the largest tracts. Ozone damage, climate change, and acid precipitation are other potential threats to tundra vegetation, but these will require further study to understand thoroughly.

The climate extremes and rare vegetation of New England's alpine tundra are the persistent relics of our distant glacial history, and remain a unique and fascinating aspect of our natural heritage.



***Geum peckii* (mountain avens)** — Large buttercup-like flowers perch on four-to-eight inch stems above a basal rosette of leaves that turn crimson in autumn. Though often abundant where it can be found, the only occurrences in the world of this endangered plant are on the White Mountains of New Hampshire and on one island in western Nova Scotia. Preferring moist ground along the banks of high altitude lakes and streams, *Geum peckii* usually blooms from early July through August.

A Precarious Perch

It's supposed to be cooler in the mountains on hot New England days. But it was uncomfortably warm the day Liz Harvey and I scrambled to the ledges of East Osceola Mountain above Greeley Pond in search of the tiny silverling (*Paronychia argyrocoma* var. *albimontana*), a rare cliff plant largely restricted in New England to a handful of moderately high elevation cliffs in the White Mountains and two anomalous riverbank populations.

As soon as we plodded off the beaten path, the terrain steepened through old yellow birch and spruce growing on talus boulders at first no bigger than large beach balls. We could see the shimmering ledges far above us as progress slowed over refrigerator- and dump-truck-sized boulders. The granite behemoths were festooned with mosses and rock polypody ferns, and the slope approached the maximum allowed by gravity. To make matters worse, fallen trees were scattered randomly among the jumbled rocks like jack-straws and I wondered at the motivation of F. Goodrich who apparently scrambled over these very boulders to the "painted cliffs" of Osceola to discover the silverling in 1924. When we finally reached the base of the cliff, it wasn't long before Liz spotted a few silver-green tufts of the silverling. I worked my way along the cliff base and noticed a turfy sedge with singular fruiting heads at the top of slender stalks, evidence of the rare sub-alpine scirpus-like sedge (*Carex scirpoidea*). We left reassured that the silverling was still at home on these ledges, and that new discoveries are still within reach, though the way to them may be rocky.

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Roots of Endangerment

The rarest species are generally those that exhibit the highest level of ecological specialization. Plants occupy communities defined by strict physical characteristics of bedrock and surface geology, water chemistry, soil structure and chemistry, and microclimate. In addition, many species have developed complex relationships with other organisms such as pollinators or symbiotic fungi.

Loss of habitat is often identified as the chief cause of endangerment, but habitat loss itself can take many forms. Besides direct conversion, such as filling in a wetland or bulldozing a forest for housing, more subtle disruptions of ecological processes are due to human intervention. For example, where periodic flooding of rivers and streams has been controlled with dams and levees, one may find a reduction in the integrity of floodplain forests, riverine marshes, and gravel bars. Construction of dams at the mouths of rivers impedes inland tidal flow necessary to maintain unique fresh/brackish marshes, the habitat for *Lilaeopsis chinensis*, *Eriocaulon parkeri*, and *Cardamine longii*. Control of wildfires has eliminated the chief mechanism that naturally maintains pitch pine barrens, grasslands, and other communities. Increased use of ground and surface waters for drinking supplies and irrigation affects coastal plain ponds and other aquatic communities.

Development of uplands adjacent to ponds and streams may increase runoff, sedimentation, eutrification, and pollution by herbicides and other chemicals. Alteration of flood and tidal patterns promotes the growth of invasive species (both exotic and native) that form monotypic patches in which one species effectively crowds out other plants. Recreational use of ponds and beaches may have a direct impact on vegetation through trampling and compaction of substrates, and control of aquatic plants by chemical or mechanical means may eliminate rare species in the process.

Such broad alterations of habitat can affect many species, while other threats may contribute to the decline of individual taxa. Removal of plants from the wild for medicinal, ornamental, or other purposes is often seen as a major issue; but a review of *Flora Conservanda* shows that, except in a few

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Rocky Outcrops & Balds

Susan C. Gawler

Rocky outcrops and balds occupy a minuscule portion of New England, but contribute substantially to overall ecological diversity here. Rocky outcrops and balds are the portions of the landscape below treeline where exposed bedrock is the substrate rather than soil. These include anything from the bare summits of hills and low mountains, which can be extensive, to smaller outcrops or cliffs surrounded by forest or other habitat. Lack of soil is the overriding ecological feature of these areas. Water is both hard to get and hard to keep in much of this habitat. Little water is available from the substrate, and what there is can be lost as plants are exposed to drying winds and bright sunlight. These conditions are a challenge for most plants; trees, if present at all, are scattered and stunted. As a result, much more sunlight reaches the ground than in habitats dominated by woody vegetation, offering an advantage for the plants that can withstand such conditions, and helping to explain some of the rarities that occur.

Though they share certain features, the category of rocky outcrops and balds includes an array of different conditions and a plant that is found on one type of rocky outcrop may be entirely unsuited for another type of rocky outcrop. Three major factors — rock type, exposure/orientation, and moisture — act in concert to influence which species a particular outcrop will support.

Most of the hilltop balds in New England are made of igneous, granitic rock producing an acidic substrate. Lowbush blueberries, povertygrass, and three-toothed cinquefoil are common plants that do well on these granitic rocks. Far less common are areas of calcium-bearing rock such as limestones and slates. These sedimentary or metamorphic rocks produce conditions of higher pH that influence nutrient availability. Plants that are more or less restricted to these higher-pH substrates are called "calciphiles" and include several rarities such as *Carex scirpoidea*, *Minuartia rubella*, and *Woodsia alpina*. The rarest type of outcrops are those composed of serpentine, a type of rock that is quite abundant in other parts of North America, but rare in New England. The peculiar mineral content of serpentine (including very high levels of magnesium, a plant micronutrient) renders it almost poisonous to many plants; but there are a few plants that, through evolution, have adapted to serpentine and are able to take advantage of this habitat where it occurs. In New England, these include *Minuartia marcescens* and *Adiantum aleuticum*.

Exposure and orientation interact with water availability to influence which plants can occupy a particular outcrop or bald. North-facing cliffs, or those shaded by nearby trees, tend to be cooler and more moist than south-facing or more exposed cliffs. Though most cliffs and balds are dry, some cliffs may be seepy with trickling water, which brings dissolved nutrients, as well as moisture, to plants. Rare plant species that favor dry, open balds include *Polygonum douglasii* and *Minuartia glabra*, species more southern in their distribution; while the more northern *Asplenium montanum* will only be found where the microclimate is cooler, typically on shady, north-facing cliffs.

Plants need light, water, space, and nutrients to grow. Rocky outcrops and balds provide lots of light and space, but nutrients and water are usually scarce. Exploring these habitats is rewarding, not only to make the acquaintance of certain plants not seen elsewhere, but for an enjoyable (or at least challenging!) hike and a bird's-eye view of the landscape.

Achillea borealis
northern yarrow IND.
Adiantum aleuticum
Aleutian maidenhair 2
Adiantum viridimontanum
Green Mountain maidenhair 1
Anemone multifida
cut-leaved anemone 2
Arabis drummondii
Drummond's rock-cress 3:VT
Arabis laevigata
smooth rock-cress 3:ME
Artemisia campestris ssp. borealis
boreal wormwood 2
Asplenium montanum
mountain spleenwort 2
Asplenium trichomanes-ramosum
green spleenwort 2
Astragalus robbinsii var. minor
Blake's milk-vetch 2
Astragalus robbinsii var. robbinsii
Robbin's milk-vetch 4
Braya humilis
New England rockcress 2
Carex backii **Back's sedge 3:ME**
Carex eburnea **ebony sedge 3:ME**
Carex richardsonii
Richardson's sedge 2
Carex scirpoidea
scirpus-like sedge 2
Cheilanthes lanosa
hairy lip fern 2
Collinsia parviflora
Cordilleran blue-eyed mary 4
Corydalis aurea
golden corydalis 2
Corydalis flavula
yellow corydalis 2
Cryptogramma stelleri
fragile rock-brake 3:ME
Descurainia pinnata var. brachycarpa
short-fruited tansy mustard 2

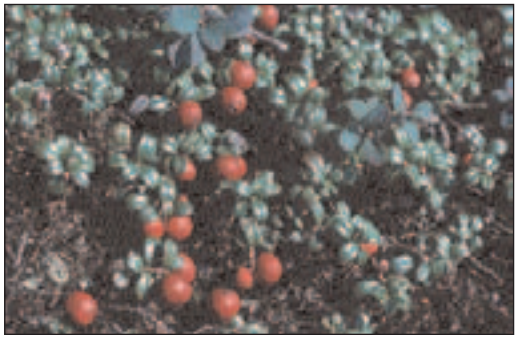
Diphasiastrum sitchense
Sitka club-moss 2
Draba arabisans
rock whitlow-grass 2
Draba cana
lance-leaved draba 2
Draba glabella
smooth draba 2
Draba reptans
whitlow-grass 2
Gymnocarpium jessoense ssp. parvulum
Nahanni oak fern 4
Huperzia selago
northern clubmoss IND.
Juniperus horizontalis
creeping juniper 3:NH,VT
Minuartia glabra
smooth sandwort 2(a)
Minuartia groenlandica
mountain sandwort 3:VT
Minuartia marcescens
serpentine sandwort 1
Minuartia rubella
marble sandwort 2
Moehringia macrophylla
large-leaved sandwort 2
Muhlenbergia capillaris
long-awn hairgrass 2
Paronychia argyrocoma
silverling 2(a)
Pinguicula vulgaris
common butterwort 2
Poa pratensis ssp. alpigena
alpine meadow grass IND.
Polygonum douglasii
Douglas knotweed 2
Potentilla pensylvanica var. bipinnatifida
northern cinquefoil IND.
Rhinanthus crista-galli
yellow rattle IND.
Saxifraga aizoides
yellow mountain saxifrage 2
Saxifraga oppositifolia
purple alpine saxifrage 2
Saxifraga paniculata
livelong saxifrage 2
Scutellaria leonardii
Leonard's skullcap 2
Scutellaria parvula var. parvula
small skullcap 2
Sedum rosea
roseroot 3:VT
Shepherdia canadensis
Canada buffaloberry 3:ME
Solidago simplex ssp. randii var. monticola
Rand's goldenrod 3:NH,MA,NH
Sphenopholis obtusata
prairie wedgegrass IND.
Trichomanes intricatum
appalachian bristle-fern 1
Ulmus thomasi
rock-elm 4
Vaccinium vitis-idaea var. minus
mountain cranberry 3:NH,MA
Woodsia alpina
northern woodsia 2

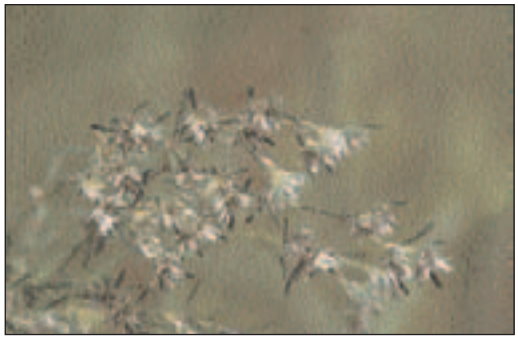
***Solidago simplex* ssp. *randii* var. *monticola* (Rand's goldenrod)** — What was once known simply as *Solidago randii* has been split into three subspecies and become a mouthful. Although the current distribution and status is unclear, this plant appears on *Flora Conservanda* because of disjunct sites in western Massachusetts and southern New Hampshire. Elsewhere in New England, this dwarf rock plant is relatively common at high elevations and alpine areas.

***Cheilanthes lanosa* (hairy lip fern)** — Found on rocky slopes and ledges in prairies and forests of eastern north America, this species reaches its northern limit in Connecticut, which has our only current New England occurrence. It grows on private land at the top of a rocky slope where it is in danger of being overrun by Japanese honeysuckle (*Lonicera japonica*), an exotic invasive species.

***Huperzia (Lycopodium) selago* (northern clubmoss) —** Recent taxonomic study suggests that this clubmoss species is limited to lower elevations while higher elevation plants of this taxon are now named *Huperzia appalachiana*. The species appears in *Flora Conservanda* in Division Indeterminate pending verification of population numbers of both species. Closely allied to ferns, this clubmoss reproduces both by spores and by vegetative buds that can become detached from the plant and grow into new plants.

***Vaccinium vitis idae* var. *minus* (mountain cranberry)** — Found in boreal North America in bogs and on rocks, this species is familiar to most hikers in the mountains of northern New England. It can form extensive mats of evergreen leaves above which red berries are produced. This species appears in *Flora Conservanda* because its populations in western Massachusetts and southern New Hampshire are disjunct from the rest of the range of this species and worthy of conservation.





***Paronychia argyrocoma* (silverling) —** Usually growing on rock outcrops at higher elevations, the silverling can also be found on gravelly river shores in Maine, New Hampshire and Massachusetts. Flowering in June and July, this low-growing tufted plant can form large colonies, but populations have been known to fluctuate dramatically, at times dropping to very few plants. Since small populations are more susceptible to elimination, there is concern that some populations may disappear. This plant is one of those affected by the pressures of recreational hiking.

***Adiantum aleuticum* (Aleutian maidenhair) —** Found mainly in western North America, this fern was once thought to be a dwarf form of the familiar maidenhair, but recently was shown to be a separate species. Ranging along both coasts, and increasingly rare inland, it exists in scattered populations in the east, all growing on serpentine soils. Serpentine, containing high levels of magnesium, is toxic to many plants, reducing competition where it is found for those plants that can tolerate it.

Relocating *Adiantum aleuticum* in Maine

Aleutian maidenhair fern is one of the rarest plants in New England, known from only one location in Maine and three in Vermont. It is typically found on serpentine rock, which itself is rarely encountered here. In 1979, with the ink still wet on my botany degree, I travelled to a mountain in northwestern Maine with my boss, Hank Tyler, to locate this enigma. I vaguely remember a long day, hours scrounging around the semi-open mountaintop, finally locating the one area, not quite on top of the mountain but on the side, where it occurred. We didn't have much time to gloat since the daylight was fading and we had a long hike down, so we took pictures and marked the spot as closely as we could on an old topographic map.

Fastforward to 1995. As part of the New England Plant Conservation Program, Bill Brumback and the Maine Task Force decided that it was time to check up on *Adiantum aleuticum* — and since I had been there before, I was supposed to know how to get back to it. I was not entirely sure that my memory of sixteen years ago and the very sketchy file notes would serve.

Then, a few weeks before our trip, I heard from a reporter doing a feature on plant conservation in Maine who wanted to come along. We swore him to secrecy on the location and agreed. I hoped he was in good shape

On the day, I navigated and tried to keep my bearings as our truck jostled over miles of gravel and potholes out in the middle of nowhere. At last the mountain appeared to our west, with a small spot of stunted sparse tree growth that looked like the serpentine area.

As we left the northern hardwood forest behind and entered the higher-altitude woods of spruce and fir, I began to doubt the chances of coming out anywhere near where the Aleutian maidenhair fern was growing.

We clambered into an opening above the trees where spruce trees grew only a few feet high, with open patches of rock and reindeer lichens in between. Bill, in the lead, hollered out that he'd found a fern, a little one — I figured there was no way we'd have stumbled on our quarry so easily, so I just glanced down and said "I don't think so." "Hang on partner," he said, "take a look!"

There were a few hundred individuals of Aleutian maidenhair fern scattered here and there across this opening, in the sunny spots among the lichens, rooted in small crevices — a hard place to get a start. Bill collected spores for the NEPCoP seedbank, I took notes on habitat and associated plants, and the reporter took pictures and asked lots of questions. In fact, he asked questions all the way back. I don't think Bill and I stretched our stories of botanical exploration too far for his benefit, but we may have elaborated just a wee bit.

Sue Gawler is a plant ecologist with the Maine Natural Areas Program in the state Department of Conservation. She has been active in plant conservation for many years in Maine and New England, earning her Ph.D. in Botany from the University of Wisconsin-Madison. If pressed to name a favorite botanical spot, it would have to be the St. John River Valley in northern Maine, where she returns regularly to monitor the endangered Furbish's Lousewort. She lives on an old farm in Belgrade, Maine, with her husband, Roy, and children, Jackson and Irina.

Roots

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cases (e.g., *Hydrastis canadensis* — a popular folk medicine), collection is probably a relatively minor threat to New England's rare flora. A greater potential menace exists in the region's burgeoning population of white-tailed deer, whose browsing is suspected in the decline of such plants as orchids, gentians, and lilies.

Plant populations may also be affected indirectly through the decline of symbiotic organisms. Indiscriminate use of nonspecific insecticides, for instance, may reduce or eliminate pollinators as well as pests.

These are challenges we already recognize, but what will be the ultimate impact of global warming? How might the invasion of pest organisms, such as wooly adelgid, which eats hemlocks, alter natural communities and processes? Will new medical discoveries result in over-collection of a particular species? The future surely holds new threats to plant diversity that are currently difficult to assess.

— Richard W. Enser

Open

Richard W. Enser

Agalinis acuta
sandplain gerardia 1
Agrimonia parviflora
small-flowered agrimony 2
Amelanchier nantucketensis
Nantucket shadbush 1
Ammophila champlainensis
Champlain beach grass IND.
Arenaria caroliniana
pine-barren sandwort 4
Aristida basiramea
fork-tip three-awn IND.
Aristida purpurascens
purple needlegrass 2
Aristida tuberculosa
seabeach needlegrass 2
Artemisia campestris
ssp. caudata
tall wormwood 3:VT
Asclepias tuberosa
butterfly weed 3:MA
Aster concolor
eastern silvery aster 2
Aster dumosus
bushy aster 3:ME
Aster praealtus tall aster IND.
Aster sagittifolius
arrow-leaved aster 2
Botrychium lunaria
moonwort 2
Bouteloua curtipendula
side-oats grama-grass 2
Calystegia spithamaea
low bindweed 2
Carex adusta 2
Carex albicans
var. emmonsii 3:VT,VT
Carex bicknellii
Bicknell's sedge IND.
Carex bushii Bush's sedge 2
Carex buxbaumii
Buxbaum's sedge 3:VT

"*Flora Conservanda:* New England" includes a number of species from what is broadly described as "open" habitat. In general, this habitat is dominated by herbaceous plants and cryptogams (mosses and lichens) and is notable for a lack of trees and other woody plants. If present, woody vegetation is usually limited to scattered individuals or patches of dwarf shrubs. Habitat types meeting this general description have often fluctuated, appearing and disappearing in the New England region in response to changing conditions.

The stark landscape that followed the retreat of the last glacial ice mass roughly 10,000 years ago revealed the maximum expanse of open habitats. These barren substrates slowly revegetated with a tundralike assortment of mosses, lichens, grasses and sedges, and a variety of coastal plain species dispersed into the region from the south over the vast span of habitat available to them on the exposed continental shelf. As the climate warmed and sea level rose the northern extension of the coastal plain was flooded, and some plants become isolated on islands and mainland areas primarily in southeastern Massachusetts. Today, although many of the rarer coastal plain species are identified with freshwater pondshores, several occupy open dry uplands including bushy rockrose (*Helianthemum dumosum*) and purple needlegrass (*Aristida purpurascens*).

Revegetation of the New England landscape continued through several successional stages until most of the interior was forested. During this pre-Columbian era plants requiring open habitats were probably restricted primarily to areas near the coast. In this region, a combination of natural and anthropogenic (human-caused) forces supported vegetation types typical of maritime grasslands, pine barrens, heathlands, and sand plains. Woody vegetation was controlled or, in the case of heathlands, kept at a dwarf stature, by the cyclic occurrence of fire or severe storms, and by the effects of a harsh maritime climate. It is likely that scattered patches of open habitat occurred elsewhere in the region during the pre-colonial period but, lacking historical documentation, we can only speculate as to the abundance and distribution of individual species at this time.

Prospects for the flora of open habitats improved with European colonization and the subsequent removal of vast tracts of the primeval forest for building materials and agriculture. Newly cleared land, in the form of meadows and pastures, provided surrogate open habitats for many plants, and by the peak of land clearance in the 1800s, some of these were flourishing. Botanical records from the period indicate that several now-rare species were once widespread in southern New England including painted cup (*Castilleja coccinea*), recorded from more than 18 counties, sandplain gerardia (*Agalinis acuta*), present at more than 25 sites, and yellow-fringed orchid (*Platanthera ciliaris*), estimated at more than 50 sites.

As the nation's agricultural base shifted to the Midwest, the cleared land of New England gradually reverted to forest and populations of field-loving plants began to decline. Today, painted cup has been reduced to only four populations in northwest Connecticut, yellow-fringed orchid to roughly 10 sites in three states, and sandplain

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***Asclepias tuberosa* (butterfly weed)** — Well-known in the nursery trade as a perennial garden plant, this milkweed family member is declining in the wild in Massachusetts (where it is listed as Division 3) and possibly other New England states. Found in open, dry, usually sandy areas, many old locations for this species no longer exist due to habitat destruction and over-collection. Suppression of fire, by allowing woody plants to become established, has also affected this species by shading it out.

***Agalinis acuta* (sandplain gerardia)** — This globally rare, federally-listed, endangered species occurs in about a dozen locations worldwide — one-third of them in south coastal New England. As a semi-parasitic plant, it must get nutrients by attaching its roots to the roots of a host plant. To reproduce, this fall-blooming annual must grow from seed, flower and re-seed itself each year, in poor, sandy soils in full sunlight. Ironically, sandplain gerardia has found refuge in a few old cemeteries, where sunlight, mowing, and soil conditions favor its growth.

***Liatris scariosa* var. *novae-angliae* (northern blazing-star)** — In late summer, the flowers of the northern blazing star form a spectacular purple spike. The only blazing star native to New England, it occurs mostly where land use practices and natural conditions, such as fire and salt spray, inhibit the growth of trees and shrubs. Intolerant of shade and occurring only on poor sandy soils, this species probably flourished in the past when farming and grazing played a more dominant role in the New England landscape.

***Chrysopsis mariana* (Maryland golden aster)** —The Latin *Chrysos*, meaning "gold," is an appropriate name for this attractive species, which adds a burst of yellow to the late summer and autumn landscape. Each of the large yellow flower heads (true asters are either white or shades of purple) can reach up to one inch across and plants may stand two feet tall. Common in dry, sandy forest openings and meadows in much of eastern North America, in New England this species is confined to just two locations in Rhode Island.

Carex polymorpha
variable sedge 1
Carex schweinitzii
Schweinitz's sedge 1
Carex siccata 3:VT,VT
Castilleja coccinea
Indian paintbrush 2
Ceanothus herbaceus
prairie redroot 2
Chenopodium leptophyllum
goosefoot IND.
Chrysopsis mariana
golden aster 2
Cirsium horridulum
yellow thistle IND.
Corydalis aurea
golden corydalis 2
Corydalis flavula
yellow corydalis 2
Crataegus x silvestris IND.
rotonopsis elliptica
elliptical rushfoil 4
Cuphea viscosissima
blue waxweed 4
Cuscuta pentagona
five-angled dodder IND.
Cyperus houghtonii
Houghton's umbrella-sedge 2
Descurainia richardsonii
Richardson's tansy-mustard 4
Desmodium sessilifolium
sessile-leaved tick-trefoil 2
Dracocephalum parviflorum
American dragonhead 2
Eragrostis capillaris
lace-grass IND.
Eupatorium rotundifolium
var. rotundifolium
round-leaved eupatorium IND.
Euphorbia glyptosperma
ridge-seed spurge IND.
Gentiana andrewsii
bottle gentian 2
Gentianella quinquefolia
stiff gentian 2
Gnaphalium purpureum
purple cudweed 2
Helianthemum dumosum
bushy rockrose 1
Hudsonia tomentosa
poverty grass 3:VT
Hypericum stragulum
St. Andrew's cross 2
Juncus torreyi
Torrey's rush 2
Juncus vaseyi
Vasey's rush 2
Lactuca hirsuta
hairy lettuce
Lechea minor
lesser pinweed IND.
Leucophysalis grandiflora
white-flowered ground-cherry 4
Leymus mollis var. mollis
American dunegrass IND
Liatris scariosa var. novae-angliae
northern blazing star 1

Linum medium var. texanum
rigid flax 2
Linum sulcatum
grooved flax 2
Lobelia spicata var. hirtella
spiked lobelia IND.
Lupinus perennis
wild lupine 3:CT,MA,NH,RI,V
Lycopodiella alopecuroides
foxtail bog club-moss 2
Lycopus rubellus
gypsywort 2
Lythrum alatum var. alatum
winged lythrum IND.
Monarda punctata var. villicaulis
horse-mint 2
Oenothera fruticosa
sundrops IND.
Ophioglossum pusillum
adder's tongue 3:MA,RI,CT
Panicum gattingeri
Gattinger's panic grass 2
Panicum stipitatum 4
Paspalum laeve field pasplaum 2
Paspalum setaceum var. psammophilum
bead grass 2
Pedicularis lanceolata
swamp lousewort 2
Physalis longifolia var. subglabrata
longleaf ground-cherry IND.
Pityopsis falcata
sickle-leaved golden aster 1
Platanthera ciliaris
yellow fringed orchid 2
Polygala verticillata
whorled milkwort IND.
Polygonum erectum
erect knotweed IND.
Polygonum tenue
slender knotweed 3:VT
Prenanthes racemosa
glaucous rattlesnake-root 2
Prunus maritima var. gravesii
Graves' beach plum IND.
Pseudolycopodiella caroliniana
slender clubmoss 4
Rhexia mariana
Maryland meadow-beauty 2
Rubus aculiferus IND.
Rubus cuneifolius
wedge sand blackberry 2
Sagina decumbens
trailing pearlwort IND.
Schwalbea americana
American chaffseed 4
Scleria pauciflora
few-flowered nut-rush 2
Scleria triglomerata
tall nut-sedge 2
Scutellaria integrifolia
hyssop skullcap 2
Selaginella eclipes
hidden spike-moss IND.
Senna hebecarpa
northern wild senna 2
Sisyrinchium mucronatum
slender blue-eyed grass 2

Open

Continued from p. 12

gerardia is listed as a federally endangered species with only five depauperate (weakened) populations remaining in New England.

Along with the loss of human-created open habitats throughout New England, human activities have severely reduced the natural communities near the coast, especially sandplains and barrens, due to the spread of development onto these highly desirable sites. The control of wildfires has also eliminated the principal disturbance needed to prevent the invasion of woody species. These two factors have combined to reduce the acreage of New England's pitch pine barrens by an estimated fifty percent since the turn of the century. Consequently, species such as American chaffseed (*Schwalbea americana*) have been extirpated from New England, and others, including wild lupine (*Lupinus perennis*), are in marked decline.

Some species continue to survive at sites that mimic natural open habitats. Abandoned sand and gravel operations may support sickle-leaved golden aster (*Pityopsis falcata*) and foxtail clubmoss (*Lycopodiella alopecuroides*). Intensive mowing of roadsides, airports, and cemeteries performs a similar service for butterflyweed (*Asclepias tuberosa*), and northern blazing-star (*Liatris scariosa* var. *novae-angliae*). Although such sites may sustain critically endangered species, these situations are generally unattractive as conservation targets due to the necessity of continuing strict maintenance. Land protection is best directed toward the remaining native habitats, such as the heathlands of Nantucket, the pitch pine barrens of Montague, Massachusetts, and Ossippee, New Hampshire, and the maritime grasslands of Martha's Vineyard and Block Island.

On Familiar Ground

On the heels of the rediscovery of sandplain gerardia (*Agalinis acuta*) in Massachusetts by Bruce Sorrie in the early 1980s, and prior to its listing as a federally endangered species, a great deal of effort was expended to relocate this species in Rhode Island. Natural Heritage Program staff, Chris Raithel of the state Division of Fish and Wildlife, and Caren Caljouw and Tom Rawinski, then with the Nature Conservancy, attacked the problem by first searching for locations of the five historically recorded populations, the most recent of which was reported in 1941. We soon determined that succession had eliminated the formerly open areas required by this species, and the quest shifted to the habitat type in which the Massachusetts plants had been found — cemeteries. The search was narrowed by the use of soil maps and other clues. For example, a cemetery had to be large enough to insure that it was regularly mowed, but not so large that it was routinely manicured and herbicided by an on-site staff. More than 150 cemeteries were searched throughout the state and, finally, in 1988, Chris Raithel found *Agalinis acuta* at a cemetery in Washington County that he had surveyed many times — he passed it on his daily commute.

Strange, but True...

Caren Caljouw often remarked that the specific location for *Agalinis acuta* at one of the Massachusetts cemeteries was identified by the "Hoxie" grave. Although in Rhode Island the plant was initially found in an unused portion of the cemetery, a second cluster of plants was later found on a nearby knoll, at the foot of a gravestone marked "Hoxie."

Richard Enser is the coordinator/botanist of the Rhode Island Natural Heritage Program where he has recently prepared a biodiversity protection plan for the state. He also serves on the board of directors of the Rhode Island Wild Plant Society and Rhode Island Natural History Survey. His botanical interests include coastal plain pondshore communities and he is currently compiling an annotated *Flora* of Block Island.

***Tripsacum dactyloides* (northern gama-grass)** — Ranging from the tropics to southern New England, this grass may have been a factor in the ancient origin of maize. Although it grows in much of the midwest and south in a variety of habitats (usually moist, open areas), in New England it seems to prefer coastal regions, just inland from salt marshes. It can reach a height of eight feet and form large clumps with very sharp leaf edges. There are only about ten occurrences of this species in Massachusetts, Rhode Island, and Connecticut.

***Platanthera ciliaris* (yellow fringed orchid)** — A striking terrestrial orchid of wet thickets and damp meadows, this species has large heads of fringed-lipped flowers in August. (The Latin name means "eyelashes," referring to the fringe on the lip.) Although this species ranges over most of eastern North America, it was once known from Massachusetts, but is currently found only in Connecticut and Rhode Island in New England.

***Lupinus perennis* (wild lupine)** — Wild lupine is the primary food source for the caterpillars of many butterfly species, including the federally endangered Karner Blue, which relies entirely on this plant for food. The preferred habitat of the wild lupine — dry, sandy, well drained soils in full sun – is often targeted for development. This species is declining in all the New England states except Maine, where it no longer occurs. Many lupines seen along roadsides are the non-native garden lupine (*Lupinus polyphyllus*), a species often confused with our native wild lupine.

***Cyperus houghtonii* (Houghton's umbrella-sedge)** — Occurring in sandy open areas in New Hampshire, Vermont, and Massachusetts, the habitat of this species is prime for development. Several of its populations in New England are located under power lines or near the edges of sandpits where dry conditions or disturbance keep the soil open and thus prevent the plants from becoming shaded out. Small population sizes of some occurrences and the effect of ORVs are further cause for concern.

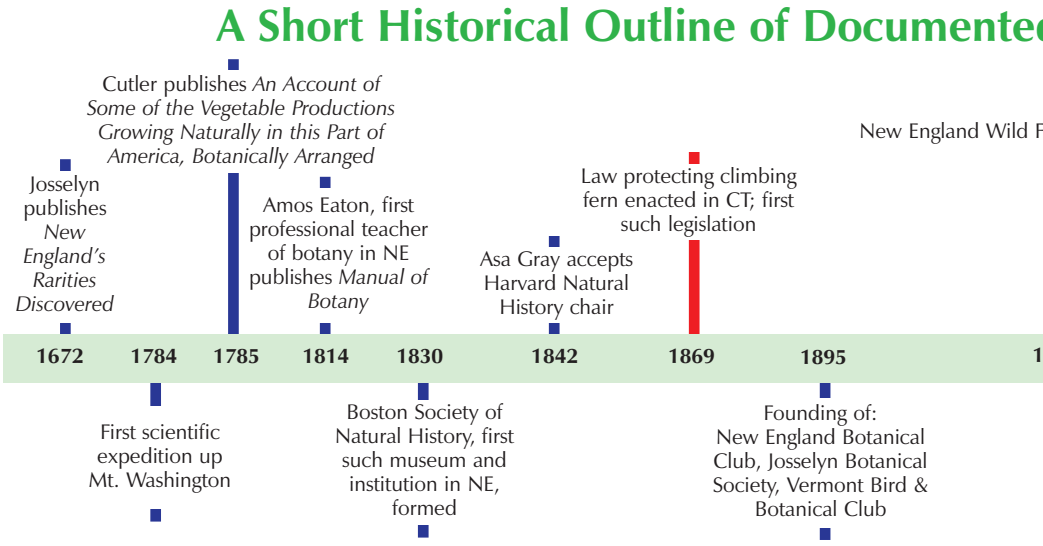
Solidago canadensis* var. *subserrata
elegant goldenrod IND.
Solidago rigida
stiff goldenrod 2
Sorghastrum nutans
Indian grass 3:ME
Sphenopholis pensylvanica
swamp oats 2
Spiranthes casei
Case's lady's-tresses IND.
Spiranthes x intermedia
hybrid lady's-tresses IND.
Sporobolus clandestinus
rough dropseed 4
Sporobolus compositus* var. *compositus
tall dropseed 2
Sporobolus heterolepis
northern dropseed 2
Sporobolus neglectus
small dropseed 2
Strophostyles umbellata
pink wild bean 4
Taraxacum ceratophorum
northern dandelion IND.
Tripsacum dactyloides
northern gama-grass 2
Valerianella radiata
corn-salad 4
Verbena simplex
narrow-leaved vervain 2
Viola brittoniana
coast violet 2
Zizia aptera
heart-leaved golden alexander 2

On the back cover:

***Aster concolor* (eastern silvery aster)**—Occuring along much of the eastern seaboard, this species reaches the northern edge of its range on Nantucket Island in Massachusetts — its only occurrence in New England. Eastern silvery aster derives its common name from a layer of pale hairs that give its leaves a silvery appearance.

History of New England's Rare Plants & Their Conservation

Mary Walker



To understand why some plants are rare in New England one must go back 18,000 years to the last glacial maximum when the continental ice sheet was a mile or two thick over New England and eastern Canada, reaching to Nantucket, Martha's Vineyard, and Long Island. By 12,000 years ago the ice edge had melted back to the St. Lawrence River Valley. The changing conditions over those 6,000 years and the next 6,000 years to the present, led to rarity among some of our plants today. The vegetation that had existed previous to the last ice age was displaced southward by the increasingly colder climate or was killed outright. As the ice front receded, it left much exposed bedrock and great masses of sterile morainal and outwash deposits of sand, gravel, boulders and — where there had formerly been glacial lakes — clays and silts.

Extending nearly across the continent, adjacent to the ice front, was a belt of tundra plants: arctic-alpine grasses, sedges and low shrubs. This low altitude flora contained many calcicoles — calcium-loving — plants. From 12,000 to 10,000 years ago, spruce, migrating from the south, eventually formed dense forests over most of the area and changed the predominant soil to an acid type. This radically altered the ground cover, restricting calcicoles to small areas which still had suitable soil and microclimate, usually near New England's limited outcroppings of limestone or marble.

Thousands of ice blocks were left behind by the ice sheet and covered by glacial till. When they melted, they formed kettle holes which in time became bogs harboring a distinctive flora. In the last 2000 years many bogs have filled in naturally, placing many bog plants on the rare list, especially in southern New England. Tundra plants were left stranded on the highest peaks above timberline as the climate moderated, and the spruce forests covered first the valleys and then the lower and middle slopes of mountains.

Along the New England coast conditions changed drastically too. Following deglaciation sea level rose and flooded the broad coastal plain. Once-widespread populations were reduced in size or became isolated and disjunct from one another.

Experts believe the plants returned northward individually a few meters at a time over thousands of years, and our modern plant communities were not assembled until perhaps 2000 years ago or less. Some plants may still be arriving or extending their ranges in New England, others, like jack pine, kept moving north, leaving behind them only a few relict stands.

Human Causes of Plant Rarity

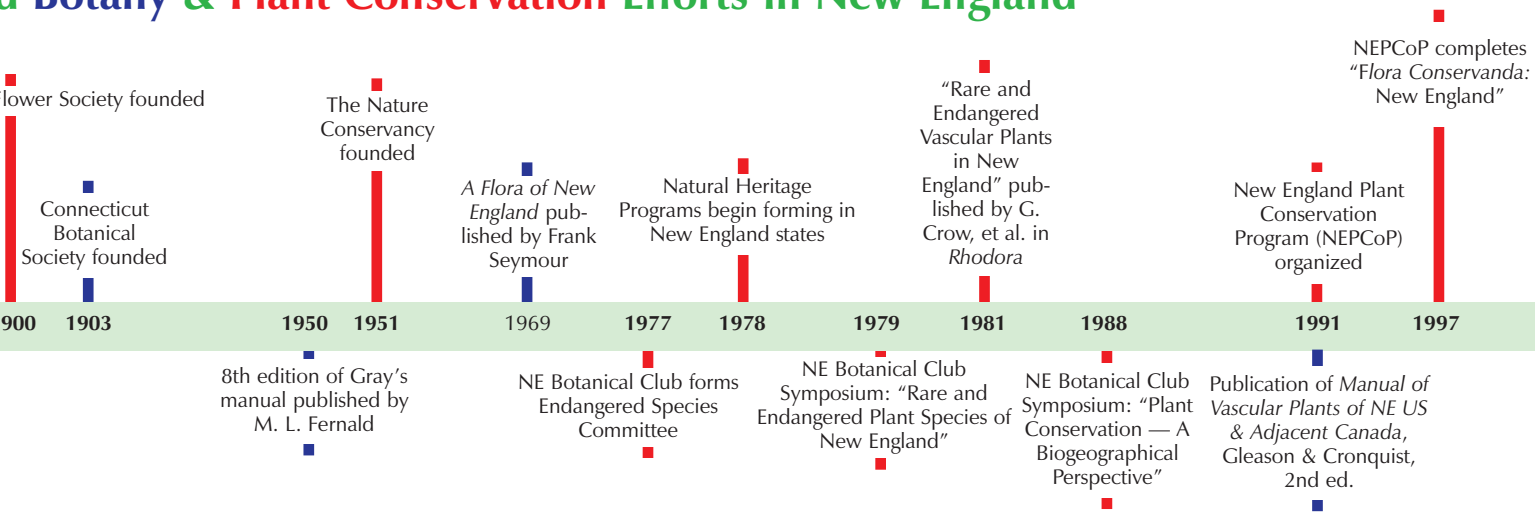
New England and most of the northeast was heavily forested by 2000 years ago. George D. Emerson (1846), in *Trees and Shrubs of Massachusetts,* noted that there were more kinds of trees in that state than in all of Europe.

The first hunter-gatherers arrived perhaps 10,000 years ago. By the time Europeans arrived, these people had already greatly altered the landscape, especially along coastal New England and river valleys inland. They cleared large areas for agriculture and the disturbed ground favored a number of weedy native species, such as aspen, birches and cherries. They burned forest to clear underbrush and create edge effect, which, as they early recognized, increased the quantity of small and large game. In sandy soil regions this favored fire-dependent plant communities of pitch pine and oaks with an understory of blueberries. As firewood became scarce, and the local supply of edible and medicinal plants decreased, the entire village pulled up stakes and moved to a new area.

When Europeans arrived they perceived the natural resources as limitless. Forests provided timber for ships and houses, and fuel for the growing population. By 1700 every New England town had a sawmill. Benjamin Franklin and almost everyone else considered agriculture "the great business of the continent." (Whitney, p. 132) Within two hundred years, our eastern forested landscape was totally altered forever. Thoreau in 1850 deplored the loss of woodland in Concord where the cover was then less than 20 percent. By 1950, about 50 percent of Concord's land was reforested, but in the past two decades houses have become numerous among the trees. Presently, Maine, New Hampshire and Vermont are about 75–90 percent forested, and the southern New England states (MA, RI, CT) are about 60 percent forested, in spite of urbanization.

The effect upon native plants was varied and often complex. A number of our woodland early spring wildflowers may have declined as a result of deforestation. As soon as the Erie Canal was built, northern New England farmlands were abandoned for more favorable land in the midwest. Some species of open fields and meadows became rare as invading shrubs and trees shaded them out. Livestock, grazing in rough pastures, avoided eating plants such as mints, arums, milkweeds, bracken fern, and sedges, favoring their growth, and the grazers also encouraged the development of old field populations of spruce, white pine and red cedar in northern, central and southern parts of the region respectively (Whitney). Suppression of forest fires has caused the decline of fire-dependent plant communities. In Concord, Massachusetts, before settlement in mid-1600s, there were extensive pitch pine, scrub-oak, and white oak woodlands on sandy soil sites, probably originat-

d Botany & Plant Conservation Efforts in New England



ed and maintained by human-initiated burning over many decades. Pitch pine was common still in Thoreau's time. Now these areas are gradually succeeding to a woodland of white pines, red, and black oaks and hickory, and pitch pine is uncommon.

Forests and woodlands are usually managed not with rare plants in mind but for sportsman. High deer population and consequent overbrowsing is now a serious threat to many plant species.

Draining of wetlands for agriculture and urban development has been and continues to be intense. By 1980, overall losses in New England were estimated at 25 percent. In Connecticut, 55 percent of Atlantic white cedar bogs have been destroyed, part of a total wetland loss of some 74 percent (Whitney). Though legislation has finally given some protection to wetlands, dredging, ditching and diking of more than half of our coastal salt marshes to provide new land for development has destroyed the habitat of native species and benefitted the spread of an alien reed, *Phragmites australis*.

In fact, human-caused land disturbance of the past two or three hundred years has greatly encouraged the spread of native and alien "weed" species that often displace our native flora. Evidence of this is seen in the many swamps and river bottomlands blanketed by purple loosestrife. Plants from abroad, first introduced for food, medicinal or ornamental purposes, escaped to become familiar roadside flowers. The increase in introduced species can be traced through our first written plant reports and floras. In 1672, John Josselyn reported 40 species of weeds; Manassah Cutler noted 66 in 1785. Bigelow's *Florula Bostonensis*, first edition (1814) listed 83 species; in the third edition of 1840 there were 140. By 1905, Fernald listed some 600 recently introduced weeds and Seymour, in his *Flora of New England* (1969), reports 877 species or nearly one third of our flora as introduced. (Whitney)

In 1900, in a speech to the American Association for the Advancement of Science, Dr. William Trelease, director of the Missouri Botanical Garden asked for "...the protection and preservation in every way possible of our native and natural vegetation." Ninety-seven years later, we are challenged to preserve not just individual rare species but a few whole ecosystems, before they are forever gone.

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Mary Walker has been a librarian at NEWFS since 1974. She is a past president of the New England Botanical Club, was an Appalachian Mountain Club hut naturalist in the White Mountains for 20 years, and currently is studying the flora of the island of Anguilla. Her interest in plants is life-long and comes from both parents.

The Importance of Keeping Historic Records

Gilbert Van Ingen is important in the floristic annals of New England for one thing: he was the first person to collect *Cheilanthes lanosa* here. On October 23, 1892, he decided to climb the face of West Rock Ridge in New Haven, Connecticut, where, for some reason, he got stuck and had to be rescued. While waiting, he collected a small fern and later took the specimen to Yale's Daniel Cady Eaton, an authority on pteridophytes. Eaton determined it to be *Cheilanthes lanosa* (then *C. vestita*), a southern and western fern not then known from New England. Eaton made an herbarium specimen of Van Ingen's find.

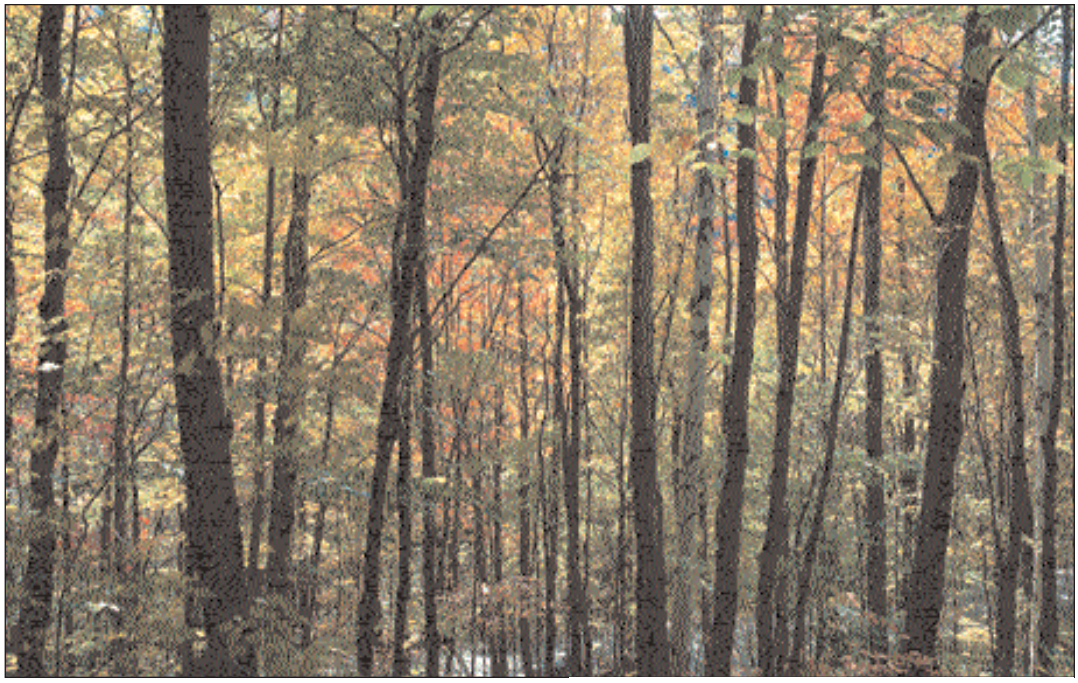
For almost a century, this collection was the sole documentation of the species in New England. By 1975, when the Connecticut Geological and Natural History Survey started its inventory of the state's rare plants, *Cheilanthes lanosa* was acknowledged as extinct in the region. Searches for it around West Rock always proved fruitless. In 1977 however, a geology student from Stamford University found another population of *Cheilanthes lanosa* in a similar habitat a couple of towns away from Van Ingen's station. After a hiatus of almost a hundred years, this taxon could once again be added to the roster of New England rarities.

This story highlights two very important reasons for including historic records in "*Flora Conservanda:*

Continued on p. 21

Woodlands & Forests

Leslie J. Mehrhoff



Agastache nepetoides yellow giant hyssop 2
Agastache scrophulariifolia purple giant hyssop 2
Amerorchis rotundifolia small round-leaved orchis 2
Angelica venenosa hairy angelica 4
Aplectrum hyemale puttyroot 2
Arabis missouriensis Missouri rock-cress IND.
Aristolochia serpentaria Virginia snakeroot 2
Asclepias purpurascens purple milkweed 2
Asclepias variegata white milkweed 2
Asclepias viridiflora green milkweed 4
Aster infirmus cornel-leaved aster 2
Aster prenanthoides crooked-stem aster 2
Aureolaria virginica downy foxglove 3:VT
Blephilia ciliata downy wood-mint 2
Blephilia hirsuta hairy wood-mint 2
Blephilia hirsuta var. glabrata IND.
Botrychium minganense Mingan moonwort IND.
Botrychium rugulosum St. Lawrence grapefern IND.
Botrychium oneidense blunt-lobed moonwort IND.
Calypso bulbosa fairy slipper 3:VT
Cardamine concatenata cut-leaved toothwort 3:ME
Cardamine douglassii pink spring-cress 2
Cardamine x incisa IND.
Cardamine x maxima great toothwort IND.
Carex arcta contracted sedge 3:VT
Carex barrattii Barratt's sedge 2
Carex collinsii Collins's sedge 2
Carex davisii Davis's sedge 2
Carex glaucodea glaucescent sedge 2

New England has three main forest types: boreal, eastern deciduous, and small areas of coastal plain forest. These broad general categories include many subdivisions and intergradations. Our forests are a study in diversity, with surficial geology, bedrock moisture, and local climate influencing the plant communities that exist within them. Rare and imperiled species in New England often have small ranges and special habitat requirements and may be restricted to one or a few kinds of these plant communities.

In northern Vermont, New Hampshire, and across much of Maine, one finds boreal forests, characterized by a predominance of conifers, including *Picea glauca* (white spruce), *Abies balsamea* (balsam fir), *Pinus* spp. (pines), and *Thuja occidentalis (*northern white cedar), often in association with hardwoods such as *Betula papyrifera* (paper birch). Many of the herbaceous and shrubby species found in the boreal forests of the region are more common farther north, reaching the southern limit of their ranges here in New England.

To the south, most of the forests of New England are described as eastern deciduous. Near the northern limit of this forest type as it approaches the boreal forest, transition forests occur. There is a strong latitudinal gradient across the region. On drier hilltops in southern New England one encounters oak-hickory forests, while in northern areas on rich mesic (moist) sites one finds examples of sugar maple and white ash forests. *Tsuga canadensis* (eastern hemlock) occurs in the valleys and on cooler, north-facing slopes. Little of the eastern deciduous forest in New England has escaped clearing or other human activity since the area was settled. *Pinus strobus* (eastern white pine) comes in after abandonment of a cleared area in the northern regions of this forest type and *Juniperus virginiana* (eastern red cedar) is the major tree component after abandonment in the southern extremes of New England.

A small area of Atlantic coastal plain forest occurs in southeastern Massachusetts and coastal Rhode Island. These forests are dominated by *Pinus rigida* (pitch pine), and oaks, including *Quercus coccinea* (scarlet oak) or *Quercus ilicifolia* (scrub oak). *Ilex opaca* (American holly) occurs in association with these species. Native grasslands are likely to have occurred within this forest type sometime in the past. This kind of forest has felt the heavy impact of human activity.

Among the many rare species in our forests, a good example of a plant with very narrow habitat requirements is the three-birds orchid (*Triphora trianthophora)*, which seems inextricably tied to mature forests that also contain beech (*Fagus grandifolia*) as a common component. In New England, at least, this orchid is always found in association with this particular tree. Some of these occurrences are doing poorly, which may in part be due to deterioration of the hardwood forests in which the plant grows. Other upland forest species show similar associations. *Cypripedium parviflorum*, the yellow lady's-slipper, seems always to be associated with rich woodlands. Another orchid, the crane-fly (*Tipularia discolor*) occurs, in New England, in coastal forests with oaks, pines, and American holly nearby.

Yet some species defy our attempts to place them in a particular type of habitat. Another orchid, the small whorled pogonia, *Isotria medeoloides,* does not appear to be specific to any given

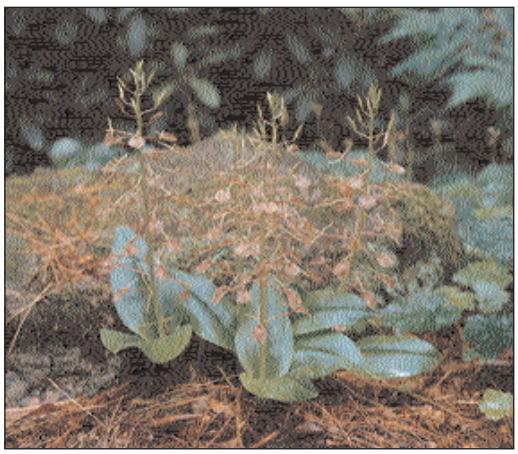
Continued on p. 20

***Viburnum prunifolium* (blackhaw)** — This shrub or small tree is most often found growing in low moist woods. Its bluish-black fruit has been used for preserves since colonial times, and is a favorite of fox, bobwhite and several species of songbirds. Research suggests that a tea made from the stems or bark may prevent miscarriages and ease spasms after childbirth. More common further south, smooth blackhaw reaches the northern edge of its range in Connecticut, where it is found in only a few locations.

***Hydrastis canadensis* (goldenseal)** — For centuries goldenseal has been used as an herbal remedy to treat sore throats, nasal congestion and stomach ulcers. Over-collection of this plant has been largely responsible for its disappearance from many areas. Ranging from western New England to Minnesota and south to North Carolina, it is rare in many states, including Connecticut, Massachusetts and Vermont. Goldenseal does not thrive in the highly acidic soil conditions that predominate in New England.

***Dryopteris felix-mas* (male fern)** — Common in Europe, this fern of the world's northern regions is very rare in New England, occurring in only a few locations in Vermont and Maine. The male fern prefers the rich limestone soils of glades and ravines. Targeted by plant collectors because of its beauty and rarity, this species is now declining in much of its North American range. The greatest cause for the rarity of the male fern in New England is a lack of suitable habitat.

***Liparis liliifolia* (lily-leaved twayblade)** — One of the most unusual of the terrestrial orchids, this species appears to be dwindling in New England. Difficult to detect even when in full bloom, each flower bears a purplish translucent lip which serves as a landing pad for pollinators. Always considered rare in our region, recent searches have failed to find plants at a number of previous sites. An orchid of rich woodlands and shaded ravines, this species has been known as an early colonizer of second growth woods, waning, probably because of increased shade, as the forest matures.



Carex gracilescens
slender woodland sedge 2
Carex nigromarginata
black-edge sedge 4
Carex oligocarpa eastern
few-fruited sedge 2
Carex praticola
northern meadow sedge 4
Carex sparganioides
bur sedge 3:ME
Carex striatula 2
Carex willdenowii
Willdenow's sedge 4
Carex woodii pretty sedge 4
Cercis canadensis redbud 4
Chamaelirium luteum
devil's bit 2
Chenopodium foggii
Fogg's goosefoot IND.
Chenopodium standleyanum
woodland goosefoot IND.
Corallorhiza odontorhiza
autumn coralroot 3:ME,NH
Cornus florida
flowering dogwood 3:VT
Corydalis flavula
yellow corydalis 2
Crataegus mollis pon
reed-grass IND.
Cynoglossum virginianum var. boreale
northern wild comfrey 1
Cynoglossum virginianum var. virginianum
wild comfrey 4
Cypripedium arietinum
ram's-head lady-slipper 1
Cypripedium parviflorum var. parviflorum
southern small yellow lady's-slipper IND
Cypripedium parviflorum var. pubescens
large yellow lady's slipper IND.
Desmodium canescens
hoary tick-trefoil 2
Desmodium cuspidatum
large-bracted tick-trefoil 2
Desmodium glabellum
Dillen's tick-trefoil 2
Desmodium humifusum
spreading tick-trefoil 1
Dicentra canadensis
squirrel corn 3:ME
Diospyros virginiana
persimmon 2
Dryopteris filix-mas male fern 2
Eupatorium album
white thoroughwort 2
Eupatorium aromaticum
small-leaved white snakeroot 2
Eupatorium sessilifolium
upland boneset 3:VT
Floerkea proserpinacoides
false mermaid-weed 2
Galearis spectabilis
showy orchis 3:ME
Galium kamtschaticum
alpine bedstraw IND.
Geum vernum spring avens 4
Gnaphalium helleri
heller's everlasting IND.
Gnaphalium sylvaticum
woodland cudweed IND.

Goodyera oblongifolia
giant rattlesnake-plantain 2
Hackelia deflexa var. americana
beggar's-lice 2
Hybanthus concolor
green violet 2
Hydrastis canadensis goldenseal 2
Hydrophyllum canadense
broad waterleaf 2
Ilex ambigua var. montana
mountain winterberry 2
Isotria medeoloides
small whorled pogonia 1
Juglans cinerea butternut IND.
Krigia biflora
orange dwarf-dandelion 4
Lespedeza repens
creeping bush-clover 2
Lespedeza stuevei
velvety lespedeza IND.
Liparis liliifolia
lily-leaved twayblade 2
Liquidambar styraciflua
sweet gum 2
Listera auriculata
auricled twayblade 1
Listera australis
southern twayblade 2
Listera cordata
heartleaf twayblade 3:MA
Lonicera dioica
mountain honeysuckle 3:ME
Lonicera hirsuta
hairy honeysuckle 2
Lonicera sempervirens
trumpet honeysuckle IND.
Lygodium palmatum
climbing fern 3:CT,VT
Lyonia mariana staggerbush 4
Magnolia virginiana
sweetbay magnolia 2
Malaxis bayardii
Bayard's malaxis 1
Melampyrum lineare var. latifolium
cow-wheat IND.
Melampyrum lineare var. lineare
cow-wheat IND.
Melampyrum lineare var. pectinata
cow-wheat IND.
Melanthium hybridum
broad-leaved bunchflower 4
Montia fontana blinks 2
Morus rubra red mulberry 2
Muhlenbergia sobolifera
cliff muhly 3:ME
Onosmodium virginianum
false gromwell 2
Oryzopsis canadensis
Canadian mountain-rice 4
Osmorhiza chilensis
tapering sweet cicely 2
Osmorhiza depauperata
blunt sweet cicely 4
Oxalis violacea
violet wood-sorrel 2
Panicum mattamuskeetense
Mattamuskeet panic-grass IND.
Panicum polyanthes IND.
Panicum scabriusculum 2
Paronychia canadensis
smooth-forked chickweed 3:VT
Paronychia fastigiata
forked chickweed IND.
Phaseolus polystachios
wild kidney bean 4

Woodlands

Continued from p. 19

plant community. Forest is the common denominator, but the associated plant species within the community change from north to south. Although this orchid has a wide range in the eastern United States, two New England states, Maine and New Hampshire, have the majority of occurrences, with some populations being quite large.

Plant geography is also important to the understanding of rare plant distribution in New England forests. Some plants, such as *Asclepias variegata* (white milkweed) and *Symphoricarpus albus* (snowberry) are rare in the region because they are at the edge of their natural ranges. Many of the *Flora Conservanda* species fall into this category. These peripheral populations may contain genes that will allow the species to adapt to environmental change.

One of the most vexing problems for plant conservationists is determining the reasons behind the decline of species. Sometimes this is obvious, as when habitats have been destroyed by human activity. In other cases, the cause of decline has eluded biologists and these species may be the ones most urgently in need of conservation. Most conservationists agree that the best way to preserve imperiled species is to protect them *in situ*, in their natural habitats.

***Isotria medeoloides* (small whorled pogonia)** — Growing in acidic soils on the wooded slopes of mixed hardwood forests, small whorled pogonia is found in relatively few locations, despite acres of apparently suitable habitat. Of these limited populations, the greatest concentrations of this species in the world occur in New Hampshire and Maine. The reasons for the decline of this orchid are unknown, but reforestation — and increasing shade — in New England's maturing forests appear to be a significant factor.

***Blephilia ciliata* (downy wood-mint)** — Found in both moist and dry woodlands, usually on the edge of open woods or clearings, this species reaches its northern limit in New England in Massachusetts. Only one population, located near an abandoned quarry, remains of the nine or so populations formerly known to exist in the state. It is not extant in Vermont and Connecticut, probably due to forest succession.

***Lonicera hirsuta* (hairy honeysuckle)** — This shrub is known from calcareous habitats, usually in light to full shade. It produces yellow or orange two-lipped flowers characteristic of the genus. The young stems of this plant are glandular or "hairy," giving rise to the common names. Although its range includes the northeastern quadrant of the United States, in New England it is found only in Massachusetts and Vermont. Its rarity is probably due to loss of habitat through forest succession and the relative rarity of suitable calcareous habitats in New England.

Records

Continued from p. 17

New England." The first is that listing taxa that are presumed extirpated from the region gives a more accurate analysis of the New England flora. An inference of what is happening to our native flora may be drawn from what has disappeared from the region, with one caveat: if no one has tried to relocate the population, its listing as extirpated may be a false indictment of declining environmental quality.

The second reason is that by listing a taxon, attention is called to it. Field biologists in search of imperiled species use historic records as a primary ingredient for setting their field itinerary. Because *Cheilanthes lanosa* was looked for and found, rather than being discounted as long-gone, the population could be brought under protection. The new Connecticut station was registered as a privately owned area of special concern by the state DEP and The Nature Conservancy.

The challenge of finding something presumed lost long ago appeals to our sense of discovery. Historic records can be like pieces of a puzzle. For years after starting our field work on Connecticut's rare and endangered species, another fern, the narrow-leaved glade fern, *Diplazium pycnocarpon*, eluded us. One day I noticed that some of the old herbarium sheets had been collected on a ridge in central Connecticut, west of Hartford. By comparing the historic records, I was able to pinpoint a ravine that looked promising. Entering the ravine, I found several plants of the glade fern. It had been collected here in 1902 and by 1993, thanks to the historic records and some botanical sleuthing, spores had been collected for the NEPCoP seed bank. If the records had not been maintained, this site might not have been rediscovered.

—Leslie J. Mehrhoff

Help Wanted — Part-time

In 1978, when I started full-time work for the Connecticut Geological and Natural History Survey, no extant populations of the elusive orchid called small whorled pogonia (*Isotria medeoloides)* were known in the state of Connecticut. Concerned, I struck a deal with Steve Grant, a friend who writes nature pieces for the Hartford Courant. He, a Courant photographer, and I would go on an *Isotria* hunt. If we found it, he got the story but could not publish the exact locality; if we didn't find it (and we didn't) he would publish an illustration of the plant and ask his readers for help.

Lots of people saw the article and responded that they had seen this plant. I spent countless hours following up on leads from the helpful public; usually they were talking about some other plant. A few, however, must have been reading the description straight out of a wildflower guide! In any case, all the leads were false. One landowner, after showing me false Solomon's seal and hearing my encouraging, but negative, response, quickly pointed to another plant, apparently at random, and asked, "Well, is *this* it?"

The value of enlisting the press finally revealed itself when someone brought me a photo of flowering *Isotria medeoloides* that he had taken the previous summer. At the time, he didn't know the identity of the plant he photographed in one of our state forests.

The epilogue, however, was bittersweet. The photographer led me to the site where we found four healthy plants, two in flower. But right in the middle of the stand was a square-sided hole, about eight inches across and maybe six inches deep. No wild animal makes a square-sided hole. Some ignorant person had removed one fifth of the only known Connecticut population of this rare and federally protected species.

Les Mehrhoff is Curator of the George Safford Torrey Herbarium in the Ecology and Evolutionary Biology Department at the University of Connecticut. Previously, he was Supervising Biologist of the Connecticut Geological and Natural History Survey. His doctoral dissertation was on the phytogeography of Connecticut flora. He is a past president of the New England Botanical Club, on the boards of both the Connecticut Botanical Society and the Josselyn Botanical Society of Maine, a member of NEPCoP's Regional Advisory Council and chair of its Listing Committee.

Platanthera cristata
crested yellow orchis 2
Podophyllum peltatum
mayapple 2
Polemonium van-bruntiae
eastern Jacob's-ladder 1
Polygala senega
Seneca snakeroot 2
Polymnia canadensis
white-flowered leafcup 2
Prenanthes serpentaria
lion's foot 2
Prenanthes x mainensis
hybrid rattlesnake-root IND.
Prunus alleghaniensis
Alleghany plum 4
Pterospora andromedea
pine-drops 2
Pycnanthemum clinopodioides
basil mountain-mint IND.
Pycnanthemum torrei
Torrey mountain-mint IND.
Pyrola minor lesser pyrola IND.
Ranunculus allegheniensis
Allegheny crowfoot 2
Ranunculus hispidus
hispid buttercup IND.
Ranunculus lapponicus
Lapland buttercup 2
Ranunculus micranthus
tiny-flowered buttercup 2
Rhododendron maximum
great laurel 3:ME,VT
Ribes rotundifolium
wild currant IND.
Sanicula canadensis
Canada sanicle 2
***Silene stellata* starry campion 2**
Smilax tamnoides
bristly greenbriar 4
Solidago x calcicola
rock goldenrod 4
Sphenopholis nitida
shining wedgegrass 2
Symphoricarpos albus var. albus
snowberry 3:MA
Taenidia integerrima
yellow pimpernel 2
***Tipularia discolor* cranefly orchid 2**
Trichostema brachiatum
false pennyroyal 2
Triosteum angustifolium
narrow-leaved horse gentian 4
Triosteum aurantiacum
wild coffee 3:ME
Triosteum perfoliatum
broad tinker's-weed 2
Triphora trianthophora
three-birds orchid 2(a)
Veronicastrum virginicum
Culver's root IND.
***Viburnum prunifolium* black haw 2**
Viburnum rafinesquianum
downy arrow-wood 3:NH
Viola hirsutula
southern wood violet 4
***Viola palmata* palmate violet IND.**
Viola striata cream violet IND.
Viola subsinuata IND.
Waldsteinia fragarioides
barren strawberry 3:ME

Lakes, Ponds, Bogs & Fens

Robert G. Popp

Amphicarpum purshii annual peanutgrass 2
Arethusa bulbosa arethusa 3:CT,MA,RI,VT
Betula pumila swamp birch 3:NH
Carex baileyi Bailey's sedge 3:ME
Calamagrostis stricta ssp. inexpansa neglected reed bent-grass 2
Callitriche hermaphroditica 4
Carex buxbaumii Buxbaum's sedge 3:VT
Carex chordorrhiza creeping sedge 3:MA,VT
Carex gynocrates northern bog sedge IND.
Carex livida pale sedge 2
Carex prairea prairie sedge 3:ME
Carex sterilis dioecious sedge 2
Carex striata var. brevis Walter's sedge 2
Carex tenuiflora sparse-flowered sedge 2
Carex tetanica fen sedge 2(a)
Carex trichocarpa hairy-fruited sedge 2
Carex wiegandii Wiegand's sedge 1
Ceratophyllum echinatum hornwort 3:ME
Coleogeton filiformis ssp. alpinus northern slender-pondweed 2
Coleogeton filiformis ssp. occidentalis slender pondweed 2
Cypripedium parviflorum var. *makasin* northern small yellow lady's slipper IND.
Cypripedium reginae showy lady's slipper 3:CT,MA
Drosera anglica English sundew 2

Although they blanket much of northern Canada and Siberia and are most abundant in northern lands, peatlands, also referred to as bogs, fens, moorland, heath, or muskeg, are worldwide in distribution.

Natural communities whose soils are peat — the partially- or non-decomposed remains of dead plants — can accumulate under diverse conditions, creating the many different types of peatland indicated by the various names. When water is impeded in some way, its oxygen content is reduced, inhibiting decomposition. Low temperatures and acidic conditions slow decomposition further and enhance the accumulation of peat. The type of peatland, however, is largely determined by the source and characteristics of the water.

Bogs occur where there is minimal surface or groundwater input, so nutrients are supplied primarily by rainwater. Oxygen here is in very short supply, and the already limited plant nutrients are made even less available by the acidic conditions. In contrast, a fen community receives significant groundwater input, which not only provides additional nutrients and dissolved oxygen, but also removes some acids and decayed material. For these reasons, peat accumulation in fens is generally slower than in bogs. Fens also tend to be smaller than bogs since they are dependent upon groundwater; in fact, they are often included within a larger bog system.

The source of groundwater determines the type of fen. Where the water passes through limy bedrock as in western Connecticut, Massachusetts, and Vermont, rich fens tend to form. The water is "rich" in dissolved minerals, especially calcium and magnesium, and these nourish the plant life as well as making conditions more alkaline. In areas of acidic bedrock, poor fens are established. Here the groundwater is "poor" in dissolved minerals and conditions remain fairly acidic. Poor fens are transitional between bogs and rich fens.

Differences in vegetation correspond to differences in water chemistry and peat depth. Bogs are typically dominated by peat mosses (*Sphagnum* spp.) and shrubs, especially those in the heath family such as leatherleaf, bog and sheep laurel, Labrador tea, and cranberry. On higher hummocks, stunted black spruce, tamarack, and red maple may be found. Rich fens are dominated by sedges, forbs, and non-*Sphagnum* mosses; the occasional tree is likely to be northern white cedar or tamarack. As one might expect, poor fens are vegetationally transitional between the other two peatland types. Although peat mosses and heath shrubs generally predominate, they are intermingled with non-*Sphagnum* mosses and sedges.

Peatlands may be found in association with lakes or ponds, but the distinction is a difficult one. We tend to think of ponds as being smaller and shallower than lakes and this is generally true, but the primary criteria is that ponds have rooted aquatic plants all the way across, while in lakes such plants are limited to the edges. Although all lakes and ponds may appear superficially similar, there is actually much variation depending upon water chemistry and nutrient status.

Lakes and ponds can have soft water and low productivity typical of higher elevations in New England. Some of these may fit the image of cold, clear mountain lakes; others, however, may be tea colored, a result of tannins released from plants by the acidic conditions. Still other

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***Platanthera leucophaea* v. *leucophaea* (eastern prairie fringed orchid)** — At dusk the delightful fragrance from the blossoms of this lovely orchid permeates large areas attracting many pollinators — small moths as well as the larger Sphinx Moth. Although the eastern prairie fringed orchid is predominantly a prairie species, it occasionally grows in fens, wet meadows and lake shore situations. In New England it is very rare, growing only in a few locations in northern Maine.

***Scirpus ancistrochaetus* (northern bulrush)** — Officially described as a species in 1962, this plant is federally-listed as endangered. Located in New England in Vermont, Massachusetts, and New Hampshire, the plant prefers fresh-water ponds, water impoundments, and other wet depressions with seasonally variable water levels. The plant may not flower every year, making it difficult to locate, nevertheless several new populations have recently been found in New England wetlands and beaver ponds. The species closely resembles some of the other common bulrushes, but is distinguished by flowers with bristles armed with downward facing barbs.

***Arethusa bulbosa* (dragon's mouth)** — This orchid species is found in peaty wetlands and bogs throughout the northeastern United States. It appears in *Flora Conservanda* as a Division 3 plant because of its documented decline in four of out of the six New England states. Suitable wetland habitat is threatened both by destruction and by ecological succession of bogs and meadows to red maple swamps. Although it can persist in the shade of shrubs, it will gradually disappear if competition or shade becomes too intense. Its botanical name derives from the mythological Greek river nymph, *Arethusa*, and its common name "dragon's mouth," from the flower's brightly colored, pendulous lip.

***Rhynchospora inundata* (inundated horned sedge)** — An 8-to-24-inch smooth stem with a triangular cross-section is topped by starry clusters of spikelets, each holding a small nut with a "beak" or "horn". The stem and leaves arise from a base that exhibits long runners. It is found from eastern Massachusetts, Long Island and New Jersey to Florida in swampy, muddy, inundated areas. All states but Florida consider it uncommon. Like other pondshore plants, it is highly adapted to changes in water levels, germinating only in dry years.

Drosera linearis
linear-leaf sundew 2
Elatine americana
American waterwort IND.
Eleocharis tricostata
three-angled spike-rush 2
Eleocharis nitida
spike-rush IND.
Galium labradoricum
Labrador Bedstraw 3:MA,VT
Geocaulon lividum
northern comandra 2
Heteranthera reniformis
kidneyleaf mud plantain 4
Hippuris vulgaris
mare's-tail 2
Isoetes acadiensis
Acadian quillwort 1
Isoetes lacustris
lake quillwort IND.
Isoetes prototypus
prototype quillwort 1
Isoetes x foveolata
pitted quillwort IND.
Juncus stygius var. americanus
moor rush 2
Lemna valdiviana
duckweed IND.
Myriophyllum pinnatum
pinnate water-milfoil IND.
Myriophyllum verticillatum
comb water-milfoil IND.
Najas guadalupensis
southern water-nymph IND.
Platanthera leucophaea var. leucophaea
prairie white-fringed orchid 1
Potamogeton confervoides
alga pondweed 1
Potamogeton ogdenii
Ogden's pondweed 1
Potamogeton strictifolius
straight-leaved pondweed IND.
Potamogeton vaseyi
Vasey's pondweed 2
Ranunculus ambigens
spearwort 2
Rhynchospora capillacea
hair-like beak-rush 2
Rhynchospora inundata
inundated horned rush 2
Rhynchospora torreyana
Torrey's beak-rush 2
Salix candida
hoary willow 3:ME
Schoenoplectus etuberculatus
untuberculed bulrush 1
Scirpus ancistrochaetus
northern bulrush 1
Sclerolepis uniflora sclerolepis 2
Utricularia biflora
two-flowered bladderwort 2
Utricularia fibrosa
fibrous bladderwort 2
Utricularia inflata IND.
Utricularia resupinata
resupinate bladderwort 2(a)
Utricularia subulata
subulate bladderwort 2
Wolffiella gladiata 2
Zosterella dubia
water stargrass 3:ME

Lakes

Continued from p. 22

lakes and ponds have hard water and high productivity. These occur throughout the Champlain Valley and western Massachusetts and Connecticut. The hard water results from the limy bedrock which releases minerals into the water. The high productivity is partly a result of increased nutrient availability, but also results from human activities. Coastal plain ponds tend to have soft water, but are still often highly productive because of human-introduced nutrients.

The aquatic plant community varies dramatically with productivity level but especially with water chemistry. Although generalists abound, most aquatic plants tolerate only a certain range of acidity or alkalinity. A skilled botanist can guess the pH of a lake fairly accurately by observing the plants that occupy it, just as he or she can categorize a peatland as a bog, or a rich or poor fen, by noting the vegetation.

***Betula pumila* (swamp birch)** — This small shrub is common in limestone swamps in New England, but appears in *Flora Conservanda* because of one New Hampshire location in an acidic fen. Reached by crossing a nearly impenetrable swamp, this occurrence is cited because it is an ecological anomaly in this habitat.

Found Memories

On an early August day, I took a landowner to see the federally endangered northeastern bulrush at Vermont's most recently discovered site. We drove in along a woods road and then continued on foot when that became impassable. Finally, we reached the open marsh where the bulrush grew. Our progress was quite slow, in part because of the rough terrain, but mostly because my companion was 87 years old. He had grown up on the property, and he insisted on seeing this rare plant that "all the fuss was about." Unfortunately, he was not overly impressed when I showed him the pale brown sedge. His only apparent interest concerned the species' usefulness.

Upon returning to my vehicle, however, he gestured towards another woods road and told me of a similar marsh about a mile away. I had other appointments that day, but I made a mental note to check it out. About a month later, I happened to be in the vicinity and remembered the gentleman's lead. After following the woods road for about a mile, I came to another open marsh just as he had described. What he had not told me, and had no way of knowing, was that the northeastern bulrush was the dominant species throughout much of this marsh. His information led to the discovery of by far the largest population in both Vermont and New England for this federally-endangered plant.

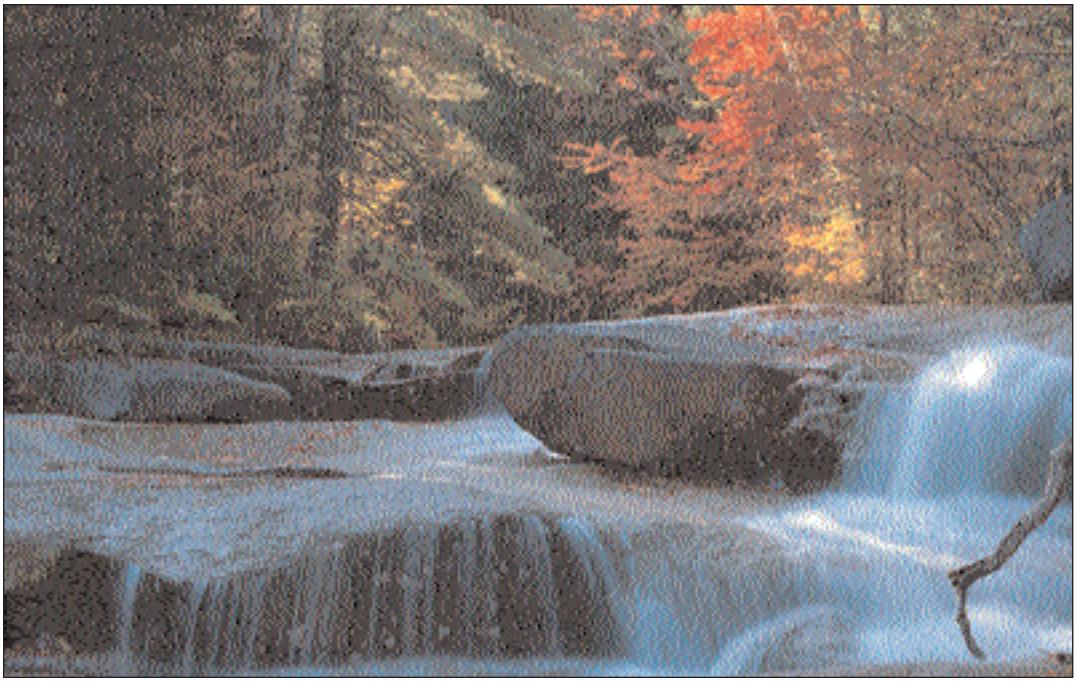
Bob Popp is the botanist for the Vermont Nongame and Natural Heritage Program, a position he has held for seven years. Bob received his Botany degree from SUNY College of Forestry and his Masters in Plant Ecology at Colorado State. He lives in Marshfield, Vermont, with his wife and two young sons. Bob enjoys birding and, while botanizing, often has his ears attuned to the birds singing nearby.

Identifying the Invaders

Japanese knotweed, a bamboo-like plant once used in landscaping, has colonized the shores around Plymouth Rock more rapidly than the Pilgrims. It can be found along roadsides, streambanks, and encroaching on wetlands throughout much of New England, joining a growing list of invasive plant species. Other well-known plants considered invasive in one or more New England states are purple loosestrife, Eurasian milfoil, multiflora rose, glossy buckthorn, Morrow's honeysuckle, and Japanese barberry. Kudzu, the creeping menace of the southeast, now occurs in southeastern Massachusetts. A thorny vine known as "mile-a-minute," last reported to be about a mile from the Connecticut border, and a prolific grass known as Japanese stiltgrass, which has already invaded Connecticut, are both likely to keep moving northward. Water chestnut, an aquatic Eurasian annual with large spiny fruits that stick to the feathers of waterfowl, seems to be beginning a major invasion of New England waters.

Approximately one-third of the flora of Massachusetts is made up of non-indigenous species. Thus, close to a thousand plant species that were not part of the state's landscape when the Pilgrims landed are now competing with native plants for space and survival. But extinctions do occur naturally; isn't that just "survival of the fittest?" The problem is that extinction of native species is happening faster than at any time in the past, due to the great increase in global transportation, and because the introduced species are often at a selective advantage. The invaded ecosystems lack natural defenses such as appropriate predators, herbivores, parasites, or diseases. The native plants, along with a host of interrelated species that have slowly co-evolved with them over eons, are suddenly imperiled by invaders whose growth is almost unimpeded. Fewer than 100 such alien species have caused more than 100 billion dollars in direct economic loss in the United States this century, to say nothing of the impact on the natural ecosystems and the thousands of affected species with no obvious direct value to the human economy. It has been estimated, for instance, that non-indigenous species have been implicated in the decline of 42% of the federally listed threatened or endangered species in the United States.

—Paul Somers



Rivers, Streams, Swamps & Marshes

Paul Somers

"Untamed, raging rivers," "dark, snaky swamps," and "mosquito-infested marshes" are phrases that for generations have been used to describe wetland types prevalent in the New England landscape. With such simplistic stereotypes in mind, it became all too easy to justify damming free-flowing rivers, timbering swamps, or draining marshlands. Floodplains, after all, have highly productive and easily tilled soils and, because of their flatness and proximity to rivers for transport and commerce, were prime for construction. Now, as a result of public and private efforts, many of our rivers are regulated by one or more dams, and many associated wetlands have been drained and converted to other purposes. Nationally, conversion to agriculture has been responsible for about 87% of the wetlands lost, with development taking most of the remainder. In 22 of the 48 contiguous states, 50% or more of the wetland habitat that existed in 1780 is gone. In New England, however, only Connecticut, which is estimated to have lost 74% of its wetlands, falls into this category.

What distinguishes the riverine, swamp and marsh habitats, and what is their significance in terms of biodiversity and rare plant habitat in particular? Riverine habitats — those with flowing water within a channel — vary tremendously, depending on water flow, pH, nutrient levels, temperature, bedrock geology, surrounding soils and vegetation, salinity (in the case of tidal estuaries), and other factors. Impounding rivers, as with a dam, causes stagnation, and typically reduces the river's biological diversity. Likewise, human activity, such as development, which affects the ability of the surrounding landscape to retain floodwaters, will reduce a river's biological diversity due to scouring of the channel. Rivers provide habitat for floating aquatic species such as pondweeds, species rooted on the bottom and totally submerged such as quillworts, or emergent species such as cattails. Plants growing on the banks or immediately adjacent to a river will be discussed under "shoreline habitats." Plants growing in riverine habitats need to be well adapted to the extreme conditions presented by flooding and drought.

Marshes and swamps often occur in the floodplain of rivers, but not always. Marshes can be inland freshwater systems or tidal in nature, but are always dominated by herbaceous vegetation. Swamps in New England, on the other hand, are mainly freshwater in nature with a canopy of trees, shrubs or a combination of the two. Marshes are normally covered with shallow water all year, whereas swamps have groundwater or surface runoff water at or near the surface of the ground for a significant part of the growing season, but not all of it. The emergent or submerged vegetation of a marsh exists in standing or running water that is not confined to a channel. New England has excellent examples of both freshwater and tidal marshes. Marshes can be categorized based on differences in soil, water and vegetation. Some occur along rivers or pond edges, whereas others form in shallow depressions. Soils may be largely organic, or some mix of silt, sand and clay. They are open systems with an inflow and outflow of water where oxygen and nutrient levels are relatively high. As a result,

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Aster prenanthoides
crooked-stem aster 2
Betula nigra
river birch 2
Cardamine longii
Long's bitter-cress 1
Cardamine pratensis var. palustris
cuckoo flower 2
Carex alopecoidea
foxtail sedge 2
Carex arcta
contracted sedge 3:VT
Carex atherodes
awned sedge 4
Carex lupuliformis
false hop sedge 1
Carex mitchelliana
Mitchell's sedge 1
Carex vaginata
sheathed sedge 2
Eleocharis fallax 2
Eleocharis microcarpa var. filiculmis
tiny-fruited spike-rush 2
Eleocharis ovata ovate
spike-rush IND.
Eleocharis quadrangulata
four-angled spike-rush 2
Eleocharis rostellata
beaked spike-rush IND.
Equisetum x mackaii IND.
Eupatorium perfoliatum var. colpophilum
estuary boneset IND
Galium trifidum var. trifidum
northern three-lobed bedstraw 4
Ilex glabra
inkberry 3:ME
Juncus subtilis IND.
Juncus x oronensis IND.
Justicia americana
American water-willow 4
Leptochloa fascicularis var. maritima
saltpond grass 1

Mimulus ringens var. colpophilus
estuarine monkeyflower IND.
Myriophyllum pinnatum
pinnate water-milfoil IND.
Neobeckia aquatica
lake cress 2
Nuphar lutea ssp. advena
cow lily IND.
Nymphaea leibergii
pygmy water-lily 2
Nymphaea odorata ssp. tuberosa
tuberous water-lily IND.
Panicum stipitatum 4
Polygonum setaceum var. interjectum
strigose knotweed IND.
Populus heterophylla
swamp cottonwood 2
Potamogeton diversifolius
water-thread pondweed IND.
Potamogeton hillii
Hill's pondweed 1
Potamogeton pusillus ssp. gemmiparus
budding pondweed IND.
Puccinellia tenella ssp. langeana IND.
Ranunculus gmelinii var. hookeri
small yellow water crowfoot 2
Rhododendron viscosum
swamp azalea 3:ME
Rumex occidentalis
western dock 4
Sabatia campanulata
slender marsh pink 2
Sabatia dodecandra
large marsh pink 4
Sabatia stellaris
swamp pink 2
Salix exigua ssp. interior
sandbar willow 3:ME
Saururus cernuus
lizard's tail 2
Schoenoplectus x steinmetzii
Steinmetz's bulrush IND.
Scirpus longii
Long's bulrush 1
Scirpus pendulus
pendulous bulrush 3:ME
Scirpus polyphyllus
many-leaved bulrush 2
Scleria verticillata
low nutrush 4
Sparganium minimum
small bur-reed 3:MA
Spartina cynosuroides
salt reedgrass 2
Suaeda calceoliformis IND.
Suaeda maritima
low sea-blite IND.
Triglochin gaspense
Gaspe arrow-grass 4
Trollius laxus
spreading globeflower 1
Valeriana uliginosa
marsh valerian 2
Veronica catenata
sessile water-speedwell IND.
Viburnum nudum var. nudum
possum haw 2

***Saururus cernuus* (lizard's tail)** — One of two species in an oddly named genus, this perennial plant, which sometimes appears in water garden catalogues, may reach a height of three to four feet, creating thick carpets of stems that carry long, curved spikes with small fragrant white flowers. Found in Connecticut and Rhode Island (and historically in Massachusetts), this species can grow prolifically where well-established along streams and wooded swamps. Though it reaches the northeastern limit of its range in southern New England, it is not clear why this species is not encountered more frequently.

***Sabatia stellaris* (sea pink)** — A six-inch tuft of pink appearing in August at the edges of salt or brackish marshes, this species may be difficult to spot even when its general location is known.The plant is usually found in sandy soils tucked in between shrubs or salt-tolerant grasses. Because it must germinate annually from seed, changes in water levels can greatly affect this species. *S. stellaris* reaches its northern limit here in New England in Connecticut, Rhode Island and Massachusetts (but has not been seen in the latter state in recent years).

***Trollius laxus* (spreading globeflower)** — This species reaches its eastern limit in Connecticut, which has all five of the occurrences in New England. The plant is a calcareous swamp denizen and, though it can survive in deep shade with intense competition, it needs light to flower and produce seed. Blooming in April and May when about six inches high, its stem ultimately reaches about one and one-half feet. The early bloom period and the ability to withstand competition have helped the New England occurrences survive, but, as their habitats become more forested, some thinning of the tree cover will probably be needed to help these plants thrive.

***Valeriana uliginosa* (marsh valerian)** — Found in cool, calcareous swamps associated with white cedar (*Thuja occidentalis*) and larch (*Larix laricina*), in New England this species occurs primarily in Maine with a few occurrences in both Vermont and New Hampshire. It grows in openings in limy swamps and, if the trees close in, this species may be shaded out. It should not be confused with an introduced species of *Valeriana* which can be seen on many roadsides throughout Northern New England.

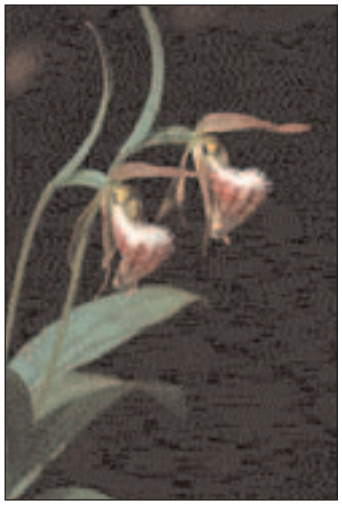
Rivers

Continued from p. 25

marshes are typically very productive ecosystems. Marsh plants, such as sedges, bulrushes, cattails, and arrowheads, must tolerate having their root systems totally immersed all or most of the year. New England swamps are also rich in variety. Probably the most common swamp tree species in New England is red maple, but other swamps are dominated by Atlantic white cedar or balsam fir. Shrubs such as buttonbush or swamp loosestrife can be dominant species.

The functions and ecological values of wetlands such as rivers, swamps and marshes include erosion and flood control, groundwater and saltwater intrusion control, water quality enhancement, microclimate regulation, provision of habitat for fish, wildlife, and plants, waterfowl breeding habitat, and recreation. In recent years, with recognition of the value of keeping these ecosystems intact, federal and state laws have been passed to prohibit or restrict further encroachment on most remaining wetlands.

***Neobeckia aquatica* (lake cress)** — This species was originally described from a western Massachusetts population, but neither that population nor a specimen has been found. Although it has also been reported from Maine, the only extant occurrences of this species in New England (four populations) are in Vermont. It inhabits the shores of Lake Champlain and some of its tributaries, and has the curious ability to change leaf shape. When growing submerged, its leaves are finely cut and feathery. When growing on a bank, the plant produces thicker, entire leaves. In all cases these leaves break off easily, and form roots within several days, enabling vegetative dispersal.



***Cypripedium arietinum* (ram's head lady's-slipper)** — The ram's head is the smallest, most inconspicuous of the lady's-slippers, but its intriguing flower looks like a charging ram. Blooming during May/June the short-lived flowers last only about seven days. Requiring both cool air and cool soil temperatures, the ram's head is considered to be globally rare, despite its affinity for several types of habitats. Although it can be found in peatlands in some parts of its range, it is adapted to other habitats, including rich deciduous woodlands, cedar swamps and even a few moist, partially shaded roadside ditches.

Paul Somers is a botanist employed for the past five years by the Massachusetts Natural Heritage & Endangered Species Program, Division of Fisheries and Wildlife, in Westborough, Massachusetts. He held a similar state position in Tennessee for fifteen years. His educational background includes a Ph.D. from the University of Tennessee and an M.S. degree from the University of Maine.

Dueling Canoes

Early in my career as a botanist for the Tennessee Natural Heritage Program, I enthusiastically joined several of my colleagues from Tennessee and counterparts in Kentucky to explore the Big South Fork of the Cumberland River. The headwaters are in the Cumberland Plateau of Tennessee and the river runs north into Kentucky through a 1200–1500-foot gorge cut through thick sandstone rimrock. The area had recently been designated a National River and Recreation Area and better documentation of rare species was needed. After consulting with the stuntmen for the film "Deliverance," our Kentucky trip planners arranged for a local outfitter to provide canoes.

The trip began ominously with dark clouds and rain as our hardy crew of Tennesseans put in the river more than an hour late, unaware that we had crossed from Central to Eastern time, and that the Kentuckians were already ahead somewhere on the river. The canoes were loaded with gear for a three day camping expedition and, with paddlers aboard, sank to within three to four inches of the gunnels. Catching up with the Kentuckians, who were perched on a flat ledge of rock, we inquired our location on the river. "Angel Falls portage," was the calm reply. "Ohhh," we said, and hastily backpaddled to join them on the safety of the ledge. For two days we paddled on in the rain, collecting, mapping, and photographing plants. By the end of the second day, all but one boat had capsized, cameras and plant presses were wet, and specimens of Cumberland rosemary and Barbara's buttons had been retrieved from the drink. We camped on the second night with every intention of going on next day, but Mother Nature had a different plan. By morning, the river had swollen six feet and looked like the raging Colorado. Canoes beached on a dry rock for the night were now floating among the shoreline trees and their tethers had to be slashed to free them. One Kentuckian suggested paddling on, but wisdom finally took hold and we were able to portage ourselves out of the gorge on an old logging road a short distance downstream and eventually made it home. Documentation and photos from this trip were used in listing the Cumberland rosemary as a "Threatened Species" and we rediscovered sweet-fern in Kentucky for the first time since the 1830's.

Shoreline

William E. Brumback

Agalinis neoscotica
Nova Scotia agalinis 1
Amaranthus pumilus
seabeach amaranth 4
Amaranthus tuberculatus
water-hemp 2
Angelica lucida
seaside angelica IND.
Aster anticostensis
anticosti aster 4
Astragalus alpinus var. brunetianus
alpine milk-vetch 1
Astragalus canadensis
Canadian milk-vetch 2
Astragalus eucosmus
elegant milk-vetch 4
Astragalus robbinsii var. jesupii
Jesup's milk-vetch 1
Bidens eatonii
Eaton's beggar-ticks 1
Bidens heterodoxa IND.
Bidens hyperborea
estuary beggar-ticks 2
Bidens hyperborea var. svensonii IND.
Bolboschoenus maritimus
alkali bulrush 3:VT
Bolboschoenus novae-angliae
salt-marsh bulrush 2
Cacalia suaveolens
indian-plantain 4
Calamagrostis pickeringii
Pickering's reed bent-grass 2
Calamagrostis stricta ssp. stricta
reed bent-grass 2
Carex arcta
contracted sedge 3:VT
Carex crawei Crawe's sedge 2
Carex garberi Garber's sedge 1
Carex saxatilis russett sedge 2
Chenopodium rubrum
coast-blite 3:ME

New England is blessed with an abundance of water, and the junction of water and land is home for some of New England's rarest species. Water conditions are the primary factors determining the character of different shoreline habitats. Rare plant preferences range from salt water to brackish to fresh water. Within fresh water, some species thrive only in alkaline (higher pH) water, while others are found in water that is nearly as acid as vinegar.

Proximity to water and water depth are other considerations. Some of our rare plants are found rooted to the bottom, emerging from several feet of water. Others are always found on land just adjacent to the water's edge, which may be subject to seasonal flooding. Seasonal flooding is a double-edged sword — too much water may be deadly, but if a plant can tolerate being inundated, competition from other species, especially trees and shrubs, may be greatly reduced. Rare plants usually survive the floods either by being very strongly rooted or by dispersing large amounts of seed to insure that some individuals will be there after the waters recede.

The soil substrate is also important. Rare species can be found on shoreline soils ranging from sand, to mud, to cobble or rock, to organic muck and peat. Even rock ledges along rivers, scoured seasonally by water or ice, provide habitats for certain species. With so many different conditions, the only truly common denominator for shoreline rare plants is their proximity to the shoreline itself.

Seacoast shorelines support salt-tolerant rare species. Some, such as *Aristida tuberculosa* (seabeach needlegrass), are found in dunes or sandy areas away from the ocean. Others, such as *Polygonum glaucum* (seabeach knotweed), are able to seed themselves into the beach itself. The beach habitat changes constantly and species living here tend to be annuals, surviving the precarious conditions by producing masses of seed. Among other perils, human use, especially off-road-vehicles (ORVs) and development, can seriously damage fragile beach and dune systems, destroying the plants that grow there.

Salt marshes and brackish (part-salt) river shores make up a large part of the New England shoreline. At the brackish transitional zones of tidal river systems *Bolboschoenus novae-angliae* (the saltmarsh bulrush also known as *Scirpus cylindricus*) can sometimes be found.

Water at the mouth of rivers is often brackish, but further upriver the water becomes fresh, although it is still influenced greatly by the tides, often rising and falling several feet within each cycle. Along mudflats in this freshwater tidal zone are found a such rare plants as *Eriocaulon parkeri*, (Parker's pipewort) and *Bidens eatonii* (Eaton's-beggar-ticks). These plants manage to survive two daily tidal inundations and, though considered globally rare, can sometimes be found in great abundance when conditions are right.

Freshwater river systems are common throughout New England, but rivers are also host to some of the region's rarest species. Along the gravelly river shores of the St. John River, which separates Maine from Canada, can be found at least six rare species, including *Pedicularis furbishiae* (Furbish's lousewort) *Tanacetum bipinnatum* ssp. *huronense* (Huron tansy) and *Viola novae-angliae* (New England violet). Other New England rivers are host to species that also grow in rock, sand or gravel shores, including *Mimulus*

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Mimulus moschatus **(muskflower)** — Growing only about eight inches tall, this plant of the river's-edge forms small clumps of creeping, sticky stems that are said to be musk-scented. Individual plants reproduce easily by seed, a characteristic that probably enables them to survive and spread in a habitat where there is usually a great deal of disturbance. Although native to several New England states, some populations are believed to be introduced, posing a problem for botanists trying to determine where this species should be protected.

Eupatorium leucolepis **var.** ***novae angliae*** **(New England aster)** — This aster family member is endemic to Massachusetts and Rhode Island. Growing in sandy open areas, usually near or along coastal plain ponds, this variety may be an ancient hybrid. Interestingly, both of the likely parents have disappeared from the vicinity of the offspring. Like many of its associates, *E. leucolepis* is able to withstand flooding for much of the year and yet bake in warm sand for several months during the summer.

Sabatia kennedyana **(Plymouth gentian)** — Although this plant is considered globally rare, New England, especially Massachusetts, has the lion's share of populations on its coastal plain pondshores. In late summer, when water levels drop, pondshores may be lined with thousands of Plymouth gentians, whose seed lies dormant in the soil until exposed by the receding waters.

Mertensia maritima **(oysterleaf)** — This northern species occurs in large numbers along the Maine seacoast on cliffs and cobble beaches, but populations are also found far to the south on the sandy beaches of Cape Cod and Nantucket in Massachusetts. As disjuncts, therefore, these Massachusetts populations are of conservation concern and the *Flora Conservanda* lists the species as Division 3 in that state. Like its close relative, the familiar garden plant, Virginia bluebells (*Mertensia virginica*), the flowers of this species are blue, but pink in bud. The leaves, however, are bluish and glaucous and reportedly taste like oysters.

Coreopsis rosea **pink tickseed 1**
Cuscuta coryli **hazel dodder 2**
Cyperus engelmannii
Engelmann's umbrella-sedge IND.
Echinodorus tenellus
little bur-head1
Eleocharis equisetoides
horsetail spike-rush 2
Eleocharis pauciflora var. fernaldii
few-flowered spike-rush 2
Eleocharis tuberculosa
tuberculed spike-rush 3:ME
Elymus villosus **hairy wild rye 2**
Eriocaulon parkeri
Parker's pipewort 1
Eupatorium leucolepis var. novae-angliae
New England boneset 1
Euthamia galetorum
Nova Scotia flat-topped goldenrod IND.
Fuirena pumila
umbrella grass 3:MA
Gentianella amarella
northern gentian 2
Gratiola virginiana
Virginia hedge-hyssop 2
Hieracium robinsonii
northeastern hawkweed 1
Hydrocotyle verticillata
saltpond pennywort 2
Hypericum adpressum
creeping St. John's-wort 1
Isoetes riparia **shore quillwort 2**
Isoetes x eatonii
Eaton's quillwort IND.
Iva frutescens var. oraria
marsh elder 3:ME,ME
Juncus alpinus **alpine rush 2**
Juncus biflorus
two-flowered rush 2
Juncus debilis **weak rush 2**
Juncus pervetus IND.
Lathyrus ochroleucus
pale vetchling 2
Lilaeopsis chinensis
eastern lilaeopsis 3:ME
Lomatogonium rotatum
marsh felwort 2
Ludwigia polycarpa
many-fruited false-loosestrife 2
Ludwigia sphaerocarpa
round-fruited false-loosestrife 2
Mertensia maritima
oysterleaf 3:MA
Mimulus alatus
winged monkey-flower 2
Mimulus moschatus
muskflower 2
Muhlenbergia richardsonis
soft-leaf muhly 2
Oxytropis campestris var. johannensis
St. John oxytrope 1
Panicum amarum
panic grass 2
Panicum flexile
stiff witch-grass 2

Panicum rigidulum var. *pubescens* 2
Panicum stipitatum 4
Pedicularis furbishiae Furbish's lousewort 1
Polygonum glaucum seabeach knotweed 1
Polygonum puritanorum pondshore knotweed IND.
Primula laurentiana bird's-eye primrose 2
Primula mistassinica Mistassini primrose 3:VT
Puccinellia tenella ssp. alascana goose grass IND.
Rhynchospora nitens short-beaked bald-sedge 2
Rosa acicularis ssp. sayi northern prickley rose 2
Rosa blanda var. glabra IND.
Rotala ramosior toothcup 2
Sabatia kennedyana plymouth gentian 1
Sabatia stellaris sea pink 2
Sagina nodosa ssp. borealis pearlwort 2
Sagina nodosa ssp. nodosa knotted pearlwort IND.
Sagittaria rigida stiff arrowhead 3:ME
Sagittaria subulata arrowleaf 2
Sagittaria teres slender arrowhead 1
Salix cordata heartleaf willow IND.
Salix myricoides blue-leaf willow 2
Schoenoplectus hallii Hall's bulrush 4
Schoenoplectus heterochaetus slender bulrush IND.
Scirpus ancistrochaetus barbed-bristle bulrush 1
Scleria reticularis reticulated nut-rush 1
Solidago ptarmicoides upland white aster 2
Stachys hyssopifolia hyssop-leaved hedge nettle 3:CT
Subularia aquatica water awlwort 2
Tanacetum bipinnatum ssp. huronense St. John tansy 2(a)
Tofieldia glutinosa sticky false asphodel 3:NH,VT
Tricophorum clintonii Clinton's bulrush 2
Trisetum melicoides purple false oats 2
Viola novae-angliae New England violet 2
Xyris smalliana Small's yellow-eyed grass 3:ME
Zigadenus elegans var. glaucus white camass 4

Shorelines

Continued from p. 28

moschatus (muskflower) and *Hieracium robinsonii* (northern hawkweed), the latter being found in only one location in New England. Ledges along the Connecticut River are home to *Astragalus robbinsii* var. *jesupii* (Jesup's milk-vetch), and *Carex garberi* (Garber's sedge), among other rare species. Fluctuating water levels and ice dams may account for both the rarity and the current locations of these species on the river.

Other shoreline species prefer the relatively quiet edges of ponds and lakes, but water levels can greatly influence whether a plant appears in a given year. A good example is *Echinodorus tenellus* (little burhead) which can be found on the mud flats of a Connecticut pond in drier years when the mud is exposed. Coastal plain ponds in New England, a globally rare habitat, are known for the number of their rare species which include *Coreopsis rosea* (pink tickseed), and *Sabatia kennedyana* (Plymouth gentian). These plants may be underwater for much of the year but, as water levels recede in summer, they burst into bloom, producing bands of color around certain ponds. Unfortunately, sandy pond shores also make excellent race tracks for ORVs and drawdown of the water table through increased development and tourism is also a threat to this rare habitat.

***Solidago ptarmicoides* (upland white aster)** — Is it an aster or is it a goldenrod? The latest interpretation leans toward goldenrod, but no one debates the rarity of this species in New England. In the western United States it is a prairie species, but here, where it reaches the eastern edge of its range, it is found on calcareous ledges and sometimes in outcrops of other rock types, usually along rivers. The plant looks like a miniature daisy, growing to less than two feet tall and blooming from July to early September depending on location.

***Astragalus robbinsii* var. *jesupii* (Jesup's milk-vetch) —** A true New England endemic, found at only three locations along the Connecticut River in New Hampshire and Vermont, this plant is a federally-listed endangered species. It grows in rocky ledges that are scoured each year by ice, and probably maintains itself by producing large numbers of seeds.

"And know the place for the first time..."

Historically, Robinson's hawkweed (*Hieracium robinsonii*) has been seen at only three sites in New England (two in Maine and one in New Hampshire). Only the New Hampshire population is currently known to exist and, although this occurrence was first discovered in 1907, it had not been reverified since the 60s. In July 1993, as part of NEPCoP's monitoring role, David Moore, then of the New Hampshire Natural Heritage Inventory, and I traveled to a northern New Hampshire gorge in an attempt to relocate the species. We parked a car at the lower end of the gorge and drove another car along the river to a point where the gorge was not as steep, allowing us to reach the river below. Then, with David on one side of the gorge (reached by wading across the river at a shallow point) and I on the other, we scrambled, waded, climbed, and swam along the gorge walls searching in vain for the yellow flowers of this hawkweed. At last we reached the spot where we had left our car. There we found more than 200 blooming plants of Robinson's hawkweed.

William Brumback is Conservation Director of the New England Wild Flower Society, where he has worked for 17 years. As coordinator of the New England Plant Conservation Program (NEPCoP), he was a key contributor to "*Flora Conservanda:* New England."

Regional and National Resources for More Information on Plant Conservation

New England

The New England Plant Conservation Program (NEPCoP) is a voluntary collaboration among botanists, state agencies, and conservation organizations in each of the New England states whose goal is to prevent the extirpation and promote the recovery of the endangered flora of the region.

Contact: William Brumback, Conservation Director, New England Wild Flower Society, 180 Hemenway Road, Framingham, MA 01701, 508/877-7630, Fax 508/877-3658; brumback@newfs.org http://www.newfs.org/~newfs

State Natural Heritage Programs, originally conceived by the Nature Conservancy in the 1970s and now under state jurisdiction, maintain databases on the plants, animals, and ecosystems that occur within a given state.

Contact (by state):

Vermont Nongame & Natural Heritage Program, Dept. of Fish and Wildlife, 103 So. Main St., 10 South, Waterbury, VT 05671-0501, 802/241-3700, Fax 802/241-3295; http://www.heritage.tnc.org/nhp/us/vt/ nnhp@fpr.anr.state.vt.us

Rhode Island Natural Heritage Program, DEM, Division of Planning & Development, 235 Promenade St., Providence, RI 02908, 401/277-2776, x 4308, Fax 401/277-2069

Natural Heritage & Endangered Species Program, MA Division of Fisheries & Wildlife, 1 Rabbit Hill Rd, Westborough, MA 01581, 508/792-7270 x 200, Fax 508/792-7275; http://www.abi.org/nhp/us/ma/

Maine Natural Areas Program, 93 State House Station, Augusta, ME 04333-0093, 207/287-8042; http://www.state.me.us/doc/nrimc/mnap/home.htm

New Hampshire Natural Heritage Inventory/DRED, 172 Pembroke Road, P.O. Box 1856, Concord, NH 03302-1856, 603/271-3623, Fax 603/271-2629; http://www.abi.org/nhp/us/nh/

Connecticut Natural Diversity Database, Dept. of Environmental Protection, 79 Elm St., Store Level, Hartford, CT, 06106-5127, 860/424-3540; http://www.abi.org/nhp/us/ct/

National

The Center for Plant Conservation (CPC) is a national not-for-profit organization headquartered at the Missouri Botanical Garden in St. Louis and governed by an independent national Board of Trustees. The Center is dedicated to conserving rare plants of the United States through cultivation, seed storage, research, reintroduction, and education. The Center's network of 28 botanical gardens and arboreta is coordinated by a national office in St. Louis.

Participating Institutions:

The Arnold Arboretum
The Berry Botanic Garden
Bok Tower Gardens
Chicago Botanic Garden
Denver Botanic Gardens
Desert Botanical Garden
Fairchild Botanical Garden
The Arboretum at Flagstff
Amy B.H. Greenwell Ethnobotanical Garden
The Holden Arboretum
Honolulu Botanical Gardens
Harold L. Lyon Arboretum
Mercer Arboretum and Botanic Gardens
Missouri Botanical Garden
The Morton Arboretum
National Tropical Botanical Garden
The Nebraska Statewide Arboretum
New England Wild Flower Society
The New York Botanical Garden
North Carolina Arboretum
North Carolina Botanical Garden
Rancho Santa Ana Botanic Garden
Red Butte Garden and Arboretum
Regional Parks Botanic Garden
San Antonio Botanical Garden
Santa Barbara Botanic Garden
University of California Botanical Garden
Waimea Arboretum and Botanical Garden

Contact: Center for Plant Conservation, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299, 314/577-9450; cpc@mobot.org; http://www.mobot.org/CPC

The Native Plant Conservation Initiative (NPCI) is a group of nine federal government agencies and over 60 non-federal cooperators. Plant conservation resources are pooled at the national level to provide a focused, strategic approach to plant conservation at the local level.

Contact: The Native Plant Conservation Initiative, 1849 C St. NW, Rm 3223, Washington, DC 20240-0001, 202/208-5895; native_plant@nps.gov http://www.aqd.nps.gov/natnet/npci

The Nature Conservancy operates a private system of nature sanctuaries worldwide, preserving habitats and species by buying land. In the United States, the Nature Conservancy has programs in each state.

Contact: TNC, Eastern Regional Office, 201 Devonshire Street, 5th Floor, Boston, MA 02110, 617/542-1908; http://www.tnc.org/

The U.S. Fish & Wildlife Service "conserves, protects, and enhances fish and wildlife and their habitats for the continuing benefit of the American people."

Contact: U.S. Fish & Wildlife Service, NE Field Office, 22 Bridge Street, Unit # 1, Concord, NH 03301-4901, 603/225-1411; 5HA_NEFO@fws.gov http://www.fws.gov/

Plant Pictures Available

Many of the beautiful images of rare plants in this issue of *New England Wild Flower* are part of the New England Wild Flower Society's collection of more than 40,000 slides. In addition to individual slides, the Society has slide sets on a variety of topics related to the horticulture and conservation of native plants. Both the individual slides and the sets are available for rent or purchase. For more information, contact the Slide Committee at NEWFS, 180 Hemenway Road, Framingham, MA 01701, 508/877-7630.

glossary of technical terms:

endemic–confined to a certain region.
eutrification–the process of becoming better nourished, or excessively nourished, either naturally or artificially, as by runoff from fertilization.
extirpated–destroyed, exterminated.
ORVs–"off-road vehicles."
substrate (substratum) – area that lies beneath the soil or surface; growing medium.
surficial geology – the study of surface deposits, including soils.
synonym– (in botany) an alternative name for a plant.
taxon (pl. **taxa**)–a taxonomic entity or grouping.
taxonomic– of the principles for classifying living organisms based on shared characteristics and relationships.

On the Front Cover

Cypripedium Reginae **(showy lady's-slipper)—** This species is common in parts of New England, but a decline has been documented in Connecticut and Massachusetts. Usually found in rich, limy fens or swamps where it blooms in the middle of June, shading by trees and shrubs can reduce both the vigor and flowering of individual plants. Although large clumps can be found in some locations, deer are fond of the flower buds and stems, often preventing seed formation.

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