THE PLANTS OF NEEDHAM, MASSACHUSETTS

100 YEARS OF CHANGE

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A floristic survey of Needham, MA was undertaken in 2000-2002 to compare the floristic diversity of this suburban community with a checklist of the flora written in 1885 by Timothy Otis Fuller, a local naturalist, and to identify patterns and potential causes of change in biodiversity. The modern flora consists of 628 species of plants, of which 32% are not native to New England. Although the total number of species remained fairly constant (691 species were present in 1885), 43.5% of the native species, including 73 genera and 12 families, have been lost. The largest changes in the diversity of native species occurred in two groups: the orchid family, with the loss of 85% of the original species, and the ferns with the loss of 50% of the species, including all taxa in the grape fern family. Many of the native species still present in Needham are uncommon - 43% of the modern species are restricted to one or two sites - and are considered at risk of local extinction. The change in biodiversity appears most closely correlated with the loss of open pasture habitats as a result of both development and natural succession to forest.

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INTRODUCTION

This paper presents a description of the vegetation of Needham, a discussion of the change in the plants of Needham over 100 years – and possible reasons for this change – and a checklist of the modern flora. A list of the species lost over the last century is also included in the hopes that some of these species may be relocated.

I undertook this study to explore changes in floristic biological diversity in a small suburban Massachusetts town during the twentieth century. There are no comparable studies of floristic change in the Boston region that demonstrate the effects of land use changes on plant diversity, although other recent studies have examined floristic change in areas of different size, ranging from a small island in New Hampshire to Long Island, NY. Rather than a comprehensive flora of Needham, Massachusetts, this study contrasts two snapshots in time – 1880-1885 and 2000-2002. The study is intended to provide data from which to estimate the effects of development and vegetation change on floristic biodiversity.

The flora of the late 19th century is documented in an unpublished handwritten manuscript found in the New England Botanical Club (NEBC) archives, "A list of the Manual Plants That I have Collected In Needham", December 1885, by T. O. Fuller. Timothy Otis Fuller (1845-1916) was a lifelong resident of Needham. Son of Ezra Fuller, Jr., he was born in the Ezra Fuller House, which still stands at 1435 Great Plain Avenue, and was remembered as a botanist and bird lover, "a man of many accomplishments who excels as a botanist". With members of his in-laws, the Mills family, he entered into a glue-making business in 1872, which soon failed. He was apparently home-schooled, as no records of his education or botanical training have been located. In addition to his botanical work, Fuller wrote and illustrated a field guide to local birds (Needham Historical Society, www.needhamhistory.org) and a local newspaper series. Fuller's herbarium was one of the largest private collections in New England, with more than 2900 sheets representing 1535 species. After his death, his widow Mrs. Ella Fuller donated his herbarium to NEBC. The sheets, distinctly labeled in Fuller's hand and light blue ink, generally cite only "Needham" as the locality, although a few sheets provide specific locality names.

Fuller's only published work, appeared in the first volume of Rhodora (the journal of the New England Botanical Club), and presented an astonishingly modern perspective on biological diversity. The paper begins: "*Like that of most towns in the vicinity of large cities, the flora of Needham is undergoing slow but continual changes, by the introduction of species foreign to its soil, and the extinction of some endemic ones which are so unfortunate as to grow only in the path of settlement. However desirable the increase of population may be in the view of the political economist, some of its accompaniments cause serious mischief for the lover of wild plants… the extermination of a species from his township by the irresistible wave of improvement leaves a sense of keenest regret*." Fuller noted in 1899 that several species, present in 1880, had been lost to development. He listed others that were present in only one site and at risk from extirpation "*by what has been termed, not inaptly from our point of view, 'the shabby tide*

of progress'. None of these species, which included Indian paintbrush, bladdernut, bog rosemary, and walking fern, are present in 2002.

This study addressed several questions concerning floristic change. I attempted to determine if there had been changes in the diversity of native species, of alien species, and of rare or uncommon species, and whether changes had occurred disproportionately in some plant groups. I also attempted to determine if change was related to specific habitats or to the abundance of a particular species, and examine these floristic changes in light of changes in the landscape.

METHODS

The flora at the end of the 20th century was documented through field investigations between June 2000 and September 2002. During that period, I investigated plant communities and habitats in Needham on numerous occasions throughout the growing season and identified the plant species occurring at each site. This investigation focused on publicly accessible lands owned by the Town of Needham, the Metropolitan District Commission (MDC), and the Trustees of Reservations (TTOR). Some privately owned lands, with owner permission, were also visited. Voucher specimens were collected when necessary for verification of identification, and are deposited at the New England Botanical Club herbarium. I conducted this survey over three field seasons and did not visit all possible sites in Needham. For these reasons, it is likely that a few taxa have been overlooked and may be discovered in subsequent investigations.

The list of plants in Fuller's manuscript were converted to modern species names by verifying Fuller's spelling in the 5th edition of Gray's Manual (1880), updated using subsequent editions and Kartesz. All names used in this study are based on Sorrie and Somers. Fuller's specimens at NEBC were examined to verify the 1885 data.

An analysis was done to determine if species losses were related to losses of particular habitat types. Species were assigned to one of 8 habitat types (pond, acid fen, marsh, swamp, field, oak woods, rich woods, ruderal) based on personal experience and the published literature. The field category includes wet meadows as well as dry grasslands, while the oak woods category also includes dry clearings and rock outcrops that typically occur in this habitat type. These habitat types were combined for analysis, since species occurred in more than one subtype.

Species abundance was estimated by the number of localities at which I located each species. Species were classified as rare (one locality), at-risk (two localities), or secure (three or more).

Description of the Study Area. Needham is a suburban community located in the southwestern Boston Metropolitan Area, approximately 10 miles southwest of downtown Boston. The town was originally settled in the 1640s, and was originally part of the town of Dedham. Needham was incorporated as a separate town in 1711 (with more than 50 families) and included East Needham and West Needham, which separated as the Town of Wellesley in 1881. The town currently consists of 11.7 square miles of land, of which 55.5 percent (4200 acres) is developed. A small amount of land (180 acres, 2.2%) is still in agricultural use, and 222 acres (2.7%) of the town is open water. The remaining 38 percent (2840 acres) remain open and undeveloped, and

includes 1200 acres of wetlands. Development is concentrated in the northeast portion of the town, in the commercial/industrial area east of Interstate 95 and in the commercial and residential areas close to the Town Center.

Land use and development changed in the mid-1800s. The railroad was extended to Needham in 1853, when large knitting factories were developed in Highlandville (now Needham Heights). Mills and factories were also located in Charles River Village, Upper Falls, and at the dams of Rosemary Lake and Blacksmith Pond. Farming remained the primary land use in Needham well into the 20th century. Early farmers concentrated on cattle raising and hay. After the establishment of the railroad, Needham also specialized in raising vegetables and flowers. Photographs from the late 1800s show a landscape of rolling pastures and small forested woodlots throughout much of the town. Commercial flower and seedling production was done in large complexes of greenhouses.

Over the past century, forest cover and agricultural land has been lost. Aerial photogrammetry in 1952 showed 3700 acres (49 % of the town) with a forest vegetation cover. In 1977, forest cover was estimated to have decreased by 20 %, to less than 1200 acres. Current (2001) MassGIS mapping shows 17 percent (1300 acres) of the land in forest. A comparison of the 1977 and 1952 mapping showed that 67 % of the former agricultural land had been developed in 1999. According to the Needham Historical Society (1998), one of these remaining farms has been in cultivation since the early 1700s.

Physical Features. Needham has a generally rolling terrain, with elevations from 100 to 300 feet msl. The surficial geology of Needham was shaped by regional glaciation, which resulted in the deposition of till. Glacial features of the current landscape include four drumlins and several eskers. Glacial Lake Charles covered approximately 750 acres in the center of Needham (and extended across several other towns), and left behind a flat deposit of sand and fine gravel. A substantial amount of these deposits were excavated and transported to Boston in the 1860s to fill the Back Bay.

Approximately 75 % of the boundary of Needham is the Charles River, with 12 miles of river shoreline. The Charles is impounded by several dams, including the Cochrane Dam (1675) at the historic Charles River Village and Upper Falls Dam. The river generally flows through a broad floodplain with oxbows and old channels. Only one reach, immediately south of the Cochrane Dam, passes through a narrow channel and remains free-flowing. All of the surface waters in the town are tributary to the Charles River. These include numerous un-named intermittent streams as well as three major perennial watercourses, Fuller Brook, Hurd Brook, and Rosemary Brook. Ponds occur as a result of artificial impoundment associated with prior mill and agricultural development. Cutler Pond, a 54-acre waterbody, is adjacent to the Charles River and within the MDC's Charles River Reservation. Rosemary Lake, a 14-acre pond, was built in 1830. Other smaller ponds include the Needham Reservoir, Farley Pond, Walker Pond, and Sabrina Lake. These are small man-made impoundments with partially developed watersheds, and are consequently shallow and eutrophic. Several small ponds have been lost since the late 1800s. Blacksmith Pond, a shallow impoundment upstream of Rosemary Lake, was drained and filled in the 1930s.

Needham's bedrock geology is largely formed of relatively old volcanic and sedimentary formations. (Needham Open Space Plan, unpubl.) The oldest rock formation is the Dedham granodiorite dated to the Precambrian Era. The Mattapan volcanics, Devonian in age, occur in numerous locations. Outcrops of the Roxbury conglomerate, a massive sedimentation formation locally known as "Roxbury puddingstone", were deposited in the late Carbonifereous, and are overlain and interspersed with a more recent basalt known as the Brighton volcanics. These formations, with the exception of the granodiorite, have a circumneutral pH. Outcrops of these rocks are frequent and spectacular in the steep walls and cliffs of Hemlock Gorge, eroded by the Charles River near the northeast border with Newton.

BIODIVERSITY OF THE NEEDHAM FLORA

In 1885, Fuller recorded 691 species of vascular plants in Needham. 563 of these are native to New England, and 128 (18.5%) are introduced (Table 1). These represent 117 families, 42 species of trees, 36 species of ferns and lycopods, and 12 species of orchids. The largest families were the Aster family (75 species), Grass family (62 species), and Sedge family (59 species). In 2000-2002, I recorded 628 species, of which 427 are native and 201 (32%) are introduced. There are 114 families, 57 species of trees, 23 ferns, and 3 species of orchids. The largest families are the grasses (70 species), Aster family (64) and sedges (55). In combination, the two surveys include 914 species of vascular plants.

The actual floristic change was determined on a species-by-species comparison of species lost and gained. This analysis demonstrated that 405 species found in 1885 are still present (Table 1). Of the native species, 245 (43.5%) found in 1885 have been lost, while 107 native species not found in 1885 are now present. Of the introduced species, 42 species (primarily agricultural weeds) have been lost, and 115 species have been gained. Only 64.5% of the flora of 1885 is still present at the end of the 20th century.

Comparison of 1885 and 2002 Floristic Composition of Needham, MA

	Number of Species		
	Native	Introduced	Total
1885	563	128	691
2002	427	201	628
Species Persisting from 1885	318	87	405
Species Lost since 1885	245	42	293
New Species present in 2002	107	115	227

There has been turnover at the family level as well as species. Twelve families present in 1885 are no longer extant. These include the Grape-Fern family (Ophioglossaceae, with 5 species), Saxifrage family (Saxifragaceae, with 3 species), Quillwort family (Isoetaceae), Flax family (Linaceae), and buckbean family

(Menyanthaceae). 73 genera have been lost. Most of these were represented by single species, although several genera once present with multiple species have been lost. Other genera, although persisting, have lost a substantial percent of the species present in 1885: tick-trefoil (*Desmodium*, 5 of 5 species); shinleaf (*Pyrola*, 2 of 3); beak-rush (*Rynchospora*, 2 of 3): meadow-rue (*Thalictrum*, 2 of 3) and violets (*Viola*, 5 of 8).

Ferns and orchid are the two taxonomic groups that have seen the largest losses of species. Twenty-one species of ferns and other cryptogamic groups are no longer found in Needham, a loss of 50% of the original fern flora. Eight genera and 11 of the 13 original species of orchids have been lost, 85% of the original orchid flora. Only two native species (pink ladies' slipper and rattlesnake plantain) remain, along with the introduced helleborine. Substantial losses (49% of the original 59 species) have also occcured in the sedge family (Cyperaceae).

The loss of native tree species is relatively small. Tree species lost since 1885 include Atlantic white cedar, larch, black spruce, American chestnut, butternut, and sycamore. The tree species not present in 1885 are primarily introduced, although it is interesting to note that Fuller did not identify gray birch, a species now common.

Losses of native species were distributed across all habitats with the highest numbers and percentages of lost species occurred in the field habitat (58 species, 23.6 %) and the rich woods habitat (55 species, 22.4%). Species of wet and dry fields and pastures have largely disappeared from Needham. These include several asters, thistles, bottle-gentian, fringed gentian, blue-eyed grass, mountain mint, wood lily, fringed orchid, and little blue-stem. Most of the obligate fen or bog species, including Atlantic white cedar, larch, black spruce, sweet gale, pitcher plant, rose pogonia, grass-pink, buckbean, and cotton grass have been lost, indicating that many fen and bog habitats have disappeared. Some species of other wetland habitats have also been lost, including golden hedge-hyssop and slender grass-leaved goldenrod, species typical of coastal-plain pondshores or of other pondshores that are flat and seasonally exposed. Wild rice and bulrush have also vanished from the Charles River in Needham.

Most of the rich woods species and species of calcareous rock outcrops (bladdernut, maidenhair fern, grape fern, round-leaved dogwood, oak fern, rue-anemone, purple avens, and downy yellow violet) also are no longer present. Rich woods are relatively uncommon in the region, and may have occurred in a very limited area in Needham.

Invasive exotic species now recognized as significant threats to native communities have been introduced after 1885, including japanese barberry, garlic mustard, fanwort, japanese honeysuckle, bush honeysuckle, autumn olive, Eurasian milfoil, yellow flag iris, common reed, tree of heaven, and common buckthorn. Norway maple, oriental bittersweet, winged euonymus, multiflora rose, and glossy buckthorn are present at virtually all sites regardless of the apparent level of disturbance. Other exotic species well-established in Needham are not recognized as invasives, but are dominant in some communities or are present in virtually all communities, and include Savoy hawkweed and witch elm.

The native species present in 2000 were categorized by frequency to estimate potential future turnover. Those native species thought to have been planted were

excluded from the analysis. 240 species (56.5%) occur in three or more localities, and are considered to be secure. 58 species (13.7%) occur in two localities, and 127 native species (29.9%) were found in only a single locality. Species that occur in one or two localities are considered at risk of loss, and constitute 43.5% of the extant native flora.

Why have so many species vanished? There are likely to have been multiple causes of species loss, which cumulatively have reduced the native flora by 44%. Development has undoubtedly resulted in the loss of habitat. As discussed above, agricultural fields, pastures and grasslands, and rich woods have largely disappeared. Robinson et al. (1994) found that the most significant change in land use on Long Island was from agriculture to suburban housing, and speculated that the agricultural landscape protected a diversity of habitats, including woodlots, wetlands, and hedgerows as well as pastures. Although large tracts of dry oak woods remain, much of this habitat has also been developed. Some water bodies, notably Blacksmith Pond, reported by Fuller to have populations of Engelmann's quillwort and floating-heart, was drained and filled in the early 20th century.

Changes in habitat due to succession are also likely to have resulted in floristic change. O'Keefe and Foster (1998) note that the peak of deforestation in Massachusetts occurred around 1860, when 70% of the land was cleared. With the decline in agriculture in the second half of the 19th century, forests rebounded in most of the state. Fuller sampled this transitional period between the peak of agriculture and the recovery of forest, although expansion of the Boston suburbs was also beginning to affect land use. When abandoned as pastures, wet meadows and fens develop into shrub swamp and red maple swamp wetlands. Upland fields and pastures develop into successional white pine-oak forest. Both examples of natural community change result in the loss of plant species adapted to open communities.

Epidemic disease has resulted in the loss of American chestnut (as a tree, although it is still present as a shrub or short-lived sapling), butternut, and American elm. Invasive species are also likely to have resulted in floristic change, although not well documented in the literature. Many meadows along the Charles River, formerly contained diverse communities of grasses, rushes, sedges and orchids, today are dominated by purple loosestrife or by dense stands of canary reed grass. Neither species was present in 1885. The effects of introduction of glossy buckthorn, multiflora rose, or oriental bittersweet on native plant communities are not known.

The risk of loss of species in the future is due to factors of development (anthropogenic habitat loss), random stochastic events, and habitat change due to succession, invasive species, or management. Species loss due to development is likely to be low, as the majority of locations are in conservation ownership (Metropolitan District Commission, Trustees of Reservations, Town of Needham Conservation or Town Forest lands). However, town-owned lands not dedicated to conservation or parkland could be converted to other uses such as schools or low-income housing. Wetland habitats are protected from development by stringent state and local wetlands protection laws, and by the extensive areas in the Army Corps of Engineers Natural Valley Storage program.

Minor changes in management of public lands can affect populations; during this study, the number of populations of New Jersey tea. was reduced from two to one as a result of cemetery expansion. Several at-risk species occur only on a natural gas pipeline easement. If the pipeline needed to be replaced, excavation and construction could result in the loss of these species. The continued expansion of invasive species and their increasing dominance in many communities could also result in the loss of native species.

As demonstrated by numerous researchers, small populations are vulnerable to stochastic change, decrease in size, and localized extinctions. These effects may be offset if there are "source" populations close enough to allow recolonization of suitable habitat. However, for many of the at-risk species in Needham, such as round-leaved sundew, there are not likely to be large populations within dispersal distance due to their specialized habitat requirements and degree of development of the surrounding communities. Continued change in the landscape, due both to development and natural succession, is likely to result in continued loss of native species. It is likely that, in 2100, researchers may find that the diversity of native vascular plants had declined by a further 43% with the loss of most of the "at-risk" native species.

WHERE TO FIND NATIVE PLANTS IN NEEDHAM

Native plant species are best observed at the large tracts of public lands in Needham where a diverse range of habitat types are present. The best areas are:

- High Rock Town Forest
- Ridge Hill Reservation (and adjacent conservation lands)
- Farley Pond Reservation
- MDC Cutler Park
- TTOR Charles River Peninsula
- MDC Hemlock Gorge Reservation

PLANT COMMUNITIES IN NEEDHAM

Vegetation in Needham is typical of the Northeastern Coastal Zone, Boston Basin subunit, dominated by low rolling topography, acidic soils, and suburban land uses. Plant community types include rock outcrops, hemlock ravine, various oak-dominated forests, red maple swamp, and several wetland community types, described below.

Acidic Rock Outcrop – This is an open community of exposed acid bedrock dominated by mosses and lichens, with herbaceous and woody vegetation in soil pockets, crevices, or around the margins of the outcrop. Characteristic species include white pine, red oak, scrub oak, huckleberry, lowbush blueberry, little bluestem, pensylvania sedge, and pink corydalis.

Circumneutral Rock Outcrop – Like the Acidic Rock Outcrop, this open community of exposed circumneutral bedrock is often dominated by mosses and lichens, with herbaceous and woody vegetation in crevices. Characteristic species include red cedar, hickories, pensylvania sedge, poverty grass, pink corydalis, and panic grasses. Some species more characteristic of calcareous rock cliffs (maidenhair spleenwort, columbine, and basswood) also occur on these outcrops. This community type is found in the High Rock town forest and the MDC Hemlock Gorge Reservation. They typically support small populations of pink corydalis, ebony spleenwort, marginal shieldfern, panic grasses, and scrub oak. .

Cultural grassland – Grassland communities occur in former pastures dominated by native graminoids (pensylvania sedge, poverty grass and little bluestem) or by introduced grasses (sweet vernal grass, orchard grass, fescue grasses, timothy, and bluegrasses) depending on moisture regime, soil fertility, and past agricultural practices. Forbs such as milkweed, hawkweeds, blue toadflax, blackberries, and goldenrods also are frequent in this community. Cultural grassland occurs in the Trustees of Reservations Peninsula Reservation along the Charles River, the only large and diverse grassland area remaining in Needham. Other areas of cultural grassland occur in the Needham Cemetery, mowed areas along a gas pipeline, and in small fields at Olin College. An additional grassland community type not recognized by Swain and Kearney occurs in a few locations in Needham. This is a community of dry, sandy or gravelly disturbed sites that occurs along railroad embankments, old railroad yards, and the former Nike missile site. This community characteristically is dominated by grasses, including cheat grass and purple love grass, sedges, and some characteristic forbs (orange grass, blue toadflax, pinweed, and bracted plantain). Sweet fern is the most frequent shrub species.

White Pine-Oak forest – These forests of mixed dominance on moderately dry moraine or till deposits and are dominated by white pine and species of oaks, also including black birch, sassafras, hickories, chestnut, lowbush blueberry, huckleberry, and maple-leaved viburnum. Characteristic herbaceous species include canada mayflower, pink lady's slipper, cow wheat, whorled loosestrife, wintergreen, hayscented fern, and bracken fern.

Successional white pine forest – This is a transitional community of old fields and pastures, dominated by white pine with scattered oaks and red maples. Exotic or weedy shrub and vine species such as glossy buckthorn, honeysuckles, multiflora rose, oriental bittersweet, and poison ivy are common. The herbaceous layer is often dominated by canada mayflower and tree clubmoss. This is the dominant forest community throughout Needham, found in small woodlots as well as the large tracts of forest in the MDC Cutler Park Reservation, Ridge Hill Reservation and adjacent lands, High Rock Town Forest, and Farley Pond Reservation.

Oak forests – Oak forests occupy a broad ecological continuum across a range of mesic to xeric soils. Depending on slope, soil type, fire frequency, and other disturbance factors, these forests may be classified as mixed oak forest; black oak-scarlet oak forest woodland, or oak-hickory forest. These communities have canopies dominated by white oak, scarlet oak, red oak, and black oak, with hickories, black birch, red maple, sassafras, and white ash. The understory and shrub layers are typically dominated by hop hornbeam, chestnut, witch hazel, flowering dogwood, hazelnut, maple-leaved viburnum,

lowbush blueberry, and huckleberry. The generally sparse herbaceous layer includes hayscented fern, canada mayflower, pensylvania sedge, Swan's sedge, poverty grass, tree clubmoss, and pink lady's slipper. Oak forests occur on the dry ridgetops in the High Rock Town Forest, where there are occasional unauthorized fires, and on the esker in Ridge Hill Reservation.

Hemlock ravine community – A hemlock ravine community occurs in Hemlock Gorge, on the rim and north-facing steep slopes and cliffs of the ravine. The community is dominated by hemlock with some patches of beech. There is little or no shrub or herbaceous layer, although beechdrops (a parasitic plant) is common under the beech trees and marginal shield fern on rock outcrops.

Red maple swamp – These forested wetland communities are dominated by red maple in the canopy, with occasional tupelo and swamp white oak. The dense shrub layer contains sweet pepperbush, highbush blueberry, swamp azalea, winterberry, and arrowwood. The herbaceous layer characteristically contains skunk cabbage, cinnamon fern, royal fern, marsh fern, dewberry, tussock sedge, and manna grass. Red maple swamps are the dominant wetland type in the Fuller Brook watershed, which includes areas within the High Rock Town Forest, Ridge Hill Reservation, and other lands west of the Newman School.

Deep emergent marsh – This is a community dominated by herbaceous species that occurs in shallow permanent water in broad flat areas adjacent to ponds and the Charles River. Characteristic species include cattails, giant reed grass, wool grass, tussock sedge, canada bluejoint, and purple loosestrife, with water willow, arrowhead, and arrow arum along the edge of open water. Large expanses of deep emergent marsh dominated by either cattails or giant reed grass occur along the Charles River in the MDC Cutler Park Reservation, visible from Route 128 or the MBTA railroad. Deep emergent marsh also occurs in the inundated portion of Rosemary Brook at the Wellesley town line, known as Rosemary Meadow.

Shallow emergent marsh – This community is similar to the deep emergent marsh, but with water depths only seasonally above the surface. Dominant species include tussock sedge, canada bluejoint, canary reed grass, and purple loosestrife. The diverse community often also includes other sedges, rushes, ferns, and herbaceous species. Shallow emergent marshes occur in extensive areas along the Charles River, where they are dominated by canary reed grass. Silky dogwood, common nettle, red maple, swamp mallow, and buttonbush occur in higher hummocks within this marsh system.

Wet meadow – Wet meadow communities are similar to the shallow emergent marsh, but soils are seasonally saturated and rarely inundated. Dominant species include a wide range of sedges, canada bluejoint, wool grass, knotweeds, soft rush, manna grass, fowl meadow grass, meadow rue, joe pye-weed, sensitive fern, and flat-topped aster. Wet meadows also occur along the Charles River, primarily in the MDC Cutler Park Reservation, along the inlet of the Needham Reservoir, in Ridge Hill Reservation along the gas pipeline, and in low areas in the Trustees of Reservations Peninsula Reservation.

Shrub swamp – These are communities of permanently or seasonally saturated soils, often at the transition between emergent marshes and swamp forests, and are likely

a successional stage in the transition from wet meadow to forested wetland. Shrub swamps are dominated by alder, silky dogwood, winterberry, willows, meadowsweet, steeplebush, highbush blueberry, arrowwood, and red maple saplings. Herbaceous species typical of swamps or wet meadows may also occur.

Acidic graminoid fen – An acidic peatland community dominated by sedges and sphagnum, including bottlebrush sedge, beakrush, twig rush, cranberry, and a sparse shrub and tree community including red maple, poison sumac, swamp azalea, and highbush blueberry. Spatterdock and white water lily occur in deeper pools. This fen community occurs in several locations in the Ridge Hill Reservation, where the town's only population of sundew occurs. Acidic fens also occur in the Cutler Park reservation, in shallow depressions between the forested upland and the river marshes.

Acidic shrub fen – This community is similar to the graminoid fen, but dominated by shrubs and spagnum. Dominant species include water willow, leatherleaf, steeplebush, swamp St. Johnswort, and virginia chain fern. Good examples of this habitat type occur in small kettleholes in the High Rock Town Forest.

Open water communities in Needham occur in the shallow ponds and Charles River. Characteristic species of the Charles River impoundments include spatterdock, water lily, water meal, various pondweeds, eurasian milfoil, water smartweed, and water clover. Large-flowered bladderwort occurs in a few locations. Water willow, arrow arum, pickerel weed, and bur reed on the river shores. Water levels in these impoundments do not fluctuate greatly, and there are no seasonally exposed mud banks that would provide habitat for annual species. Ponds include numerous submerged and floating aquatics. Recently, both Sabrina Lake and Walker Pond have been treated with aquatic herbicides to reduce the growth of floating and submerged aquatics in an attempt to maintain these ponds for swimming and boating, and to retard eutrophication.

REFERENCES

ANONYMOUS, 1916. Timothy Otis Fuller. Needham Chronicle, August 1916.

BERTIN, R. I. 2000. Vascular flora of Worcester, Massachusetts. Spec. Publ. Of the New England Bot. Club, Harvard University, Cambridge MA.

BERTIN, R. I. 2003. Losses of native plant species from Worcester, Massachusetts. Rhodora 104:325-349.

BLAKE, S.F. 1964. The Flora of Stoughton, Massachusetts. New England Botanical Club. Cambridge, MA.

BROWN, P. M. AND S. FOLSOM. 1997. Wild Orchids of the Northeastern United States. Cornell University Press, Ithaca NY.

CLARKE, G. K. 1910. History of Needham, Massachusetts 1711-1911. Privately published.

DAY, M. A. 1901. The Herbaria of New England. Rhodora XX: 67-71, 206-208, 219-222, 240-244.

DRAYTON, B. and R. B. PRIMACK. 1996. Plant species lost in an isolated conservation area in metropolitan Boston from 1894 to 1993. Conserv. Biol. 10:30-39.

EATON, R. J. 1974. A Flora of Concord. Harvard Univ. Mus. Compar. Zool. Spec. Publ. No. 4.

FULLER, T. O. 1995. A List of the Manual Plants Collected in Needham. Unpublished manuscript, New Engl. Bot. Club.

FULLER, T. O. 1899. Some rare plants of Needham, Massachusetts. Rhodora 1: 179-182.

GLEASON, H. A. AND A. CRONQUIST. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. New York Botanical Garden, New York, NY.

GRAY, A. 1880. Manual of the Botany of the Northeastern United States. 5th Edition. Ivison, Blakeman and Taylor. New York, NY.

GRIFFITH, G. E., J. M. OMERNIK, S. M. PIERSON AND C. W. KIILSGAARD. 1994. The Massachusetts Ecological Regions Project. United States Environmental Protection Agency, Publication No. 17587-74-6/94-DEP. Washington, D.C.

HOLLAND, M. M. AND B. A. SORRIE. 1989. Floristic dynamics of a small island complex in Lake Winnepesaukee, New Hampshire. Rhodora 91: 315-338.

JONES, F. A. 1962. Old Houses in Needham. Needham Times, Nov. 15, 1962.

KARTESZ, J. T. 1994. A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland. Second Edition. Timber Press, Portland OR.

LAMONT, E. E., J. M. BEITEL, AND R. E. ZAREMBA. 1988. Current status of orchids on Long Island, New York. Bull. Torrey Bot. Club 115:113-121.

MAGEE, D. W. AND H. E. AHLES. 1999. Flora of the Northeast. University of Massachusetts Press, Amherst MA.

NEEDHAM HISTORICAL SOCIETY, 1998. Images of America, Needham. Arcadia, Charleston SC.

O'KEEFE, J. AND D. R. FOSTER. 1998. An ecological history of Massachusetts forests. Arnoldia 58(2): 2-31.

OVERLEASE, W. R. 1987. 150 years of vegetation change in Chester County, Pennsylvania. Bartonia 53: 1-12.

RANDALL, R. 1998. A list of 399 invasive plants and weeds in North America and Canada. National Biological Information Infrastructure. http://www.invasive species.nbbi.gov/

ROBINSON, G. R., M. E. YURLINA, AND S. N. HANDEL. 1994. A century of change in the Staten Island flora: Ecological correlates of species losses and invasions. Bull. Torrey Bot. Club 121: 119-129.

SORRIE, B. A. AND P. SOMERS, 1999. The Vascular Plants of Massachusetts: a County Checklist. Massachusetts Div. of Fish. and Wildl., Natl. Heritage and Endangered Species Program, Westborough, MA.

SWAIN, P. C. AND J. B. KEARSLEY. 2000. Classification of the Natural Communities of Massachusetts. Massachusetts Div. of Fish. and Wildl., Natl. Heritage and Endangered Species Program, Westborough, MA.

WEATHERBEE, P. B. 1996. Flora of Berkshire County Massachusetts. Studley Press, Dalton MA.