# A Qualitative Survey of Pond Shoreline Vegetation and Anthropogenic Threats at Eleven Freshwater Ponds in the Pleasant Bay Area of Critical Environmental Concern

Chatham & Orleans
Massachusetts



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**Horsley & Witten, Inc.**

90 Route 6A
Sandwich, MA 02563
www.horsleywitten.com
Phone (508) 833-6600
Fax (508) 833-3150

*Prepared for:*

*Pleasant Bay Resource Management Alliance*
*P.O. Box 1584*
*Harwich, Massachusetts 02645*

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## ABSTRACT

*Horsley & Witten, Inc. identified and documented vegetative communities around 11 freshwater bodies within the Pleasant Bay Area of Critical Environmental Concern (ACEC) during the 2002-growing season. The purpose of this study was to develop baseline habitat data identifying and documenting the presence and distribution of natural resources, including rare, indigenous, and invasive species of plants and animals in the vicinity of the shoreline. These data are intended to establish a baseline for potential future management considerations within these areas.*

*During this study, we documented the presence of natural vegetative communities, exemplary habitat of state and globally rare habitat, rare species, and invasive species, as well as potential threats to the natural communities of these ponds.*

*We recommend that the Pleasant Bay Resource Management Alliance notify the Massachusetts Natural Heritage and Endangered Species Program (NHESP) of the presence of habitat and occurrences of rare species, which in turn will expand the state database of rare species. More intensive studies on those habitats exhibiting exemplary habitat, or supporting rare species' habitat may allow for documentation and ultimately protection of additional rare species.*

*Management recommendations have been provided to minimize the threats to the natural systems, such that any future activities or development around these ponds can be adequately managed to have a minimum adverse effect on the natural systems of the ponds. The most important factor in protecting the delicate balance of the natural systems is providing public outreach to local residents and town citizens concerning the value of these globally and regionally significant ecosystems.*

## 1.0 INTRODUCTION

The Pleasant Bay Resource Management Alliance ("Alliance") contracted with Horsley & Witten, Inc. to identify and document natural resources along the respective shorelines of 11 freshwater bodies located within the Pleasant Bay Area of Critical Environmental Concern (ACEC). These 11 freshwater bodies, located within the Towns of Orleans and Chatham, have hydrologic connections to the Pleasant Bay estuary.

The purpose of this study was to collect baseline data identifying and documenting the presence and distribution of natural resources, including rare, indigenous and invasive species of plants and animals in direct proximity to the shoreline. These data will complement existing information from past studies and are intended to assist the Alliance in developing recommendations for regulatory agencies concerning environmental guidelines and development mitigation within these freshwater bodies.

## 2.0 PLEASANT BAY AREA OF CRITICAL ENVIRONMENTAL CONCERN


Areas of Critical Environmental Concern (ACECs) are places in Massachusetts that receive special recognition because of the quality, uniqueness, and significance of their natural and cultural resources. These ACECs are so designated by the State's Secretary of Environmental Affairs.

The Pleasant Bay ACEC was designated in 1987 for its outstanding regionally significant natural resources, including pristine barrier beaches and barrier islands, approximately 1,200 acres of salt marsh, thousands of acres of tidal flats, numerous fresh and saltwater ponds, a significant estuarine habitat, and a wealth of biodiversity.

Cape Cod is located within a transition zone between northern temperate boreal species and Mid-Atlantic temperate coastal species, and contains species that are at the northernmost or southernmost limits of their natural ranges. The ACEC is therefore representative of an ecological transition zone that differs from mainland Massachusetts and has an unusual concentration of state-listed species. There are 12 documented state-listed Threatened or Endangered species within the Pleasant Bay area, and more than 16 species listed as Species of Special Concern in Massachusetts also occur in the ACEC (Luchonok and Sorenson, 1993).

## 3.0 METHODOLOGY FOR DATA COLLECTION

Horsley & Witten conducted shoreline surveys by non-motorized boat, walking shoreline transects, and meander surveys around each of the following ponds over the course of the 2002 growing season: Lover's Lake, Stillwater Pond, Mill Pond, Minister's Pond, and Fox Pond in the Town of Chatham, and Sarah's Pond, Little Quanset Pond, Crystal Lake, Pilgrim Lake, Gould Pond and Uncle Seth's Pond in Orleans. Field investigations focused on characterizing the habitat within 100 feet of the water's edge of each pond.

Field surveys were conducted on June 21, July 2, 10 and 11, August 5 and 13, and September 11, 2002. Prior to conducting field investigations, Horsley & Witten reviewed existing information, studies and literature regarding the resources in order to develop a field evaluation plan. Each pond was surveyed a minimum of two separate times. Data were collected on plant communities and, when deemed significant, associated fauna when the latter were observed. The focus of the data collection was to document the pond shore communities, with emphasis on native, rare, and invasive plant species. Specific emphasis was made on areas exhibiting pristine vegetative community habitats. Data were also collected on communities that are facing threats from invasive species, sedimentation, nutrient input, or other types of human alteration.

### 3.1 Rare Species

An important goal of this baseline study was to document the occurrence of "state-listed" species, i.e., those that are defined by the Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program (NHESP) as Endangered, Threatened, or Species of Special Concern. These species are protected under the Massachusetts Endangered Species Act regulations at 321 CMR 10.00. Species whose primary habitat falls within wetland resource areas are also protected under the Massachusetts Wetlands Protection Act regulations (310 CMR 10.00). It is especially important for the maintenance of biodiversity that occurrence of such species be documented for future protection. Additional efforts were made to document any species that are currently on the "Watch List – Uncommon or Rare Massachusetts Plants" (April 1990).

NHESP defines state-listed species as follows:

**Endangered** species are defined as native species which are in danger of extinction throughout all or part of their range, or which are in danger of extirpation from Massachusetts, as documented by biological research and inventory.

**Threatened** species are native species that are likely to become endangered in the foreseeable future, or which are declining or rare as determined by biological research and inventory.

**Species of Special Concern** are defined as native species which have been documented by biological research or inventory to have suffered a decline that could threaten the species if allowed to continue unchecked, or which occur in such small numbers or with such restricted distribution or specialized habitat requirements that they could easily become threatened within Massachusetts.

**Watch List** species are those native species that are believed to be very uncommon or rare, undergoing severe population decline, and/or for which information is lacking on a number of current sites. The Watch List also contains species that have been removed ("delisted") from the official state list of "Rare Native Plants of Massachusetts" (i.e., as designated above).

### 3.2 Invasive Species

**Purple Loosestrife** *(Lythrum salicaria)*

An all-too common problem in many wetlands and waterbodies on the Cape is the rapid proliferation of non-native, invasive plants that threaten the integrity of our native flora. Where Barnstable County was once a "hotbed" for botanical research due to its unique floral and faunal diversity and pristine nature, the ratio of native versus non-native species is today approximately 60:40 (Svenson and Pyle 1979). While not all exotic plant species are invasive or aggressive in growth habit, in many cases alien taxa from Asia or Europe out-compete Cape Cod's indigenous plant communities, at times completely overgrowing and creating a monoculture in place of a diverse, native plant community.

Several emergent plant species meeting the definition of exotic and invasive habits were documented during our Pleasant Bay study. The two most common species were purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites australis*). While neither of these invasives poses an immediate threat to rare pondshore species within the study area due to the small populations of these invasive species that could be readily managed or eliminated from these areas, Mill Pond, with its hitherto undocumented population of Plymouth gentian (*Sabatia kennedyana*) also provided shoreline habitat for both the loosestrife and common reed in close proximity to the rare gentians.

Invasive non-native plants can gain a foothold by several means: nutrient inputs from stormwater runoff, particularly nitrates and phosphates from lawns, golf courses, and cultivated fields and cranberry bogs, sub-standard septic systems and cesspools, and erosion-borne sediments from disturbed banks and artificially created beaches. Boat propellers that have been in ponds infested with aquatic invasives, such as milfoil

(*Myriophyllum spicatum*) and hydrilla (*Hydrilla verticillata*), can infest previously pristine ponds. Even well intentioned shorefront owners can create an invasive problem by planting 'pretty' species such as yellow flag (*Iris pseudacorus*) or purple loosestrife, which are sold commercially by some nurseries.

Mitigation measures that are often effective in reducing or eliminating the invasion of non-native species include:

- Preserving native shoreline vegetation to filter nutrients and other water-borne sediments (i.e., buffer strips);
- Implementing erosion control measures, including native plantings, and elimination of stormwater runoff conduits and culverts;
- Using low or non-phosphate detergents;
- Establishing limitations on lawn areas, especially on slopes bordering the water bodies;
- Upgrading substandard septic systems;
- Thorough cleaning of boats and other recreational craft of any plant debris from off-Cape ponds and lakes; and
- Discouraging feeding of waterfowl that can spread invasive plants via fecal dispersal.

### 3.3 Natural Community Types

One of the goals of this study was to document the presence of exemplary habitat communities as defined by The Nature Conservancy and the NHESP. Two such habitats were observed among the freshwater bodies within the Pleasant Bay ACEC: the New England Coastal Plain Pond Shore Community and the Atlantic White Cedar Swamp Community. A description of each community type is provided below.

#### 3.3.1 New England Coastal Plain Pond Shore Communities

New England Coastal Plain Pond Shore communities are unique to southeastern Massachusetts, Rhode Island, and parts of Long Island. According to the recently released BioMap by the Massachusetts Natural Heritage and Endangered Species Program (NHESP, 2001), this community is ranked G2-S2 by the NHESP, meaning that this community is both globally and state imperiled, with only 6-20 occurrences statewide. A total of 43 rare plant and animal species have been documented within this community type. These species are specially adapted to the desiccation-inundation effects of the seasonal hydrologic cycles evident in the yearly rise and fall of the water table.

The subject ponds within the ACEC are characteristically located in gradually sloping depressions lacking any outlet or inlet within the glacial outwash plain. Such ponds are directly hydrologically linked to the underground aquifer through the highly porous, sandy soils derived from the outwash parent material. Thus pond levels fluctuate considerably from year to year, depending on the hydrologic cycle, precipitation, surface water level

manipulation and groundwater depression related to aquifer withdrawals. In low water years, fluctuating water levels create broad sandy to peaty margins around the water body, where a unique assemblage of herbaceous and graminoid plant species is found. New England Coastal Plain Pondshore communities may be found within this open sandy band along the pond shore.

Species commonly found within Coastal Plain Pond Shore communities include slender-leaf goldenrod (*Euthamia tenuifolia*), pink tickseed (*Coreopsis rosea*), golden-pert (*Gratiola aurea*), thread-leaved sundew (*Drosera filiformis*), and large horned rush (*Rhynchospora macrostachya*). Concentric bands of vegetation encircling the pond edge are characteristic of Coastal Plain Pond shore communities.

**Pink Tickseed** *(Coreopsis rosea)*

Pondshore plant communities form wide bands of concentric colonies or guilds that segregate by species from year to year. For instance, golden pert is generally found in a solid band lower down on the pond slope where finer sand and silts have settled out. In contrast, thread-leaved sundew (*Drosera filiformis*) and hyssop-leaved hedge-nettle (*Stachys hyssopifolia*) are found predominantly on the upper slope profile where coarser sands and gravels are present. These conditions have provided both exposed pond margins and growth enhancing moisture that provide ideal conditions for pondshore plant growth.

Other coastal plain pondshore endemic species include autumn fimbristylis (*Fimbristylis autumnalis*), Dortman's lobelia (*Lobelia dortmanna*), and pipewort (*Eriocaulon aquaticum*) (See Appendix C for Natural Heritage Element Occurrence information on all state-listed species).

The year 2002, in particular, has seen the lowest water levels in many years, due to drought, negligible snowfall last winter, and continued groundwater withdrawal from individual and municipal wells.

### 3.3.2 Atlantic White Cedar Swamp Community

Atlantic White Cedar swamps are forested wetland communities with a dense, primarily evergreen canopy, a deciduous shrub layer, and a sparse herb layer dominated by mosses. Ranked as G3-S2 by the Massachusetts NHESP, this community type is globally rare throughout its range with only 6-20 occurrences statewide. Atlantic White Cedar swamps are often found associated with red maple swamps and open bogs.

Based on differences in location and physical setting, four distinct Atlantic White Cedar swamp community types are currently recognized in Massachusetts: Coastal Atlantic White

Cedar Swamps, Inland Atlantic White Cedar Swamps, Northern Atlantic White Cedar Swamps, and Seasonally-Flooded Atlantic White Cedar Swamps. Coastal Atlantic White Cedar swamps typically occur at low elevations (less than 40 feet above sea level), in sand and gravel deposits or glacial lake bottom sediments. They are generally found in coastal areas in Massachusetts.

Some plant species commonly co-occur with Atlantic white cedar (*Chamaecyparis thyoides*) in each of the community types, including red maple (*Acerrubrum*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), and sphagnum moss (*Sphagnum* spp.). In coastal Atlantic white cedar swamps, Atlantic white cedar is the dominant tree, mixed with red maple. Pitch pine (*Pinus rigida*), white pine (*Pinus strobus*), and hemlock (*Tsuga canadensis*) are infrequent associates. These swamps can have a very dense shrub layer, including species such as highbush blueberry, swamp azalea, sweet pepperbush (*Clethra alnifolia*), and swamp fetterbush (*Leucothoe racemosa*). Due to the density of the canopy and shrub strata, the herb layer is typically sparse and patchy. Several of the more common species found here are cinnamon fern (*Osmunda cinnamomea*), Virginia chain-fern (*Woodwardia virginica*), starflower (*Trientalis borealis*), Canada mayflower (*Maianthemum canadense*) and wild sarsaparilla (*Aralia nudicaulis*). Sphagnum mosses generally dominate the ground layer. In at least one white cedar swamp in Yarmouth, the state-endangered orchid heartleaf twayblade (*Listera cordata*) has been recently documented.

## 4.0 BASELINE STUDY RESULTS

### 4.1 Pond Descriptions

Horsley & Witten documented the location, size, geologic origin, and surrounding topography of each pond, collected data on the associated plant communities within approximately 100 feet of the shoreline, noted the presence and distribution of rare or invasive species, documented the recreational use of the pond (if any), and noted any alterations to the natural habitat of the ponds. These data are presented in individual fact sheets within Appendix A as follows:

**Orleans** (alphabetically)

- Crystal Lake
- Gould Pond
- Little Quanset Pond
- Pilgrim Lake
- Sarah's Pond
- Uncle Seth's Pond

**Chatham** (alphabetically)

- Lover's Lake
- Stillwater Pond
- Fox Pond
- Mill Pond
- Minister's Pond

Maps of each pond are also provided in Appendix A. The topographic quadrangles (Chatham and Orleans quadrangles) and the ACEC boundary were adapted from MassGIS data layers. These maps depict the locations of any rare species (state-listed Endangered, Threatened, Species of Special Concern, or Watch List species) or invasive species observed during our field investigations.

Comprehensive lists of dominant plant species observed at each pond during the field investigations are provided in Appendix B . These lists are intended to provide baseline data and are by no means inclusive of all species within 100 feet of the shoreline.

### 4.2 Documentation of Rare or Regionally Significant Species

**Plymouth Gentian**
*(Sabatia kennedyana)*

The Massachusetts NHESP maintains a database of all rare species observations throughout the state. As of the most recent inquiry, the database indicates that there are nine documented rare species found within or in close proximity to the Pleasant Bay ACEC. These include five animals (Short-eared Owl, Piping Plover, Diamondback Terrapin, Water-willow Stem Borer, and Eastern Box Turtle), and four plants (Plymouth Gentian, Bushy Rockrose, Pondshore Knotweed, and New England Blazing Star). Available Fact Sheets published by NHESP for these species are provided in Appendix C. We were likely to encounter the habitat of four of these species during the baseline survey: Plymouth Gentian, Pondshore Knotweed, Water-willow Stem Borer, and Eastern Box Turtle.

Horsley & Witten documented the presence of rare species at four of the ponds: Crystal Lake, Gould Pond, Uncle Seth's Pond, and Mill Pond. These taxa include two Species of Special Concern, Plymouth gentian (*Sabatia kennedyana*) and slender arrowhead (*Sagittaria teres*), and a Watch List species, Hemicarpha, an annual sedge (*Hemicarpha micrantha*).

Both Plymouth gentian and slender arrowhead have been previously documented in the Towns of Orleans and Chatham (see Appendix C). However, according to the Town of Chatham Water Quality Laboratory Director, Dr. Robert Duncanson, the documentation of Plymouth gentian at Mill Pond is a new record of this species. Locations of rare species observed are noted on the site maps (Appendix A).

Despite these records, the only pond mapped by the NHESP as Estimated Habitats of Rare Wildlife is Gould Pond. Gould Pond and portions of Crystal Lake, Lover's Lake, Stillwater Pond, and Minister's Pond are mapped for Priority Habitats of Rare Species (Figure 13).

Given the amount of suitable habitat present within these ponds, specifically, Gould Pond, Crystal Lake, Minister's Pond, and possibly Pilgrim Lake, future field investigation should focus on confirming the presence of rare fauna and/or additional rare flora in these areas.

Historically, New England Coastal Plain pond shores have also provided habitat for several rare damselflies and dragonflies (Order *Odonata*), such as the barren's bluet (*Enallagma recurvatum*), lateral bluet (*E. laterale*) and the long-legged green darner (*Anax longipes*). These damselflies and dragonflies require emergent vegetation, particularly bayonet rush (*Juncus militaris*) along the water's edge for completion of their life cycle from egg to nymph to adult. Emergent vegetation, specifically bayonet rush, was observed at more than half of the freshwater bodies within the Pleasant Bay ACEC: Crystal Lake, Pilgrim Lake, Gould Pond, and Uncle Seth's Pond in Orleans, and Lover's Lake and Minister's Pond in Chatham. However, state-listed Odonates were not observed during the site visits. In follow-up monitoring, investigators should focus on determining whether or not such state-listed Odonates are present in these otherwise suitable habitats.

Pondshore communities supporting significant populations of water willow (*Decodon verticillatus*) may provide habitat for the state Threatened water-willow stem borer (*Papaipema sulphurata*), a globally restricted species, whose larvae bore into and feed exclusively upon water willow. Other possible rare taxa that may be present include spotted turtle (*Clemmys guttata*) and Eastern pond mussel (*Ligumia nasuta*), both of which have been documented in coastal ponds on the Upper and Mid-Cape area (Division of Fisheries and Wildlife, 1988).

## 5.0 DISCUSSION

Exemplary habitat for the New England Coastal Plain Pondshore community is largely predicated on glacially-formed isolated kettle ponds in outwash deposits having no inlet or outlet with a periodically fluctuating surface water elevation that creates barriers to woody encroachment of pines, oaks and other successional species. The 'purging' effect of the desiccation-inundation cycle results in exposure in some years of a wide sandy margin conducive to the habitat requirements of many of these shade-intolerant pondshore species. Several of the subject ponds within the study exhibited at least some of this specialized habitat; these include Mill Pond in Chatham and Crystal Lake and Gould Pond in Orleans. The latter pond in particular supports spectacular populations of Plymouth gentian, perhaps numbered in the thousands.

Others, due to stream outlets, nutrient loading, shoreline development or natural succession have led to a more organic, mucky substrate lacking the specialized habitat need for this globally-significant community. These waterbodies include Pilgrim Lake, Little Quanset, and Uncle Seth's in Orleans and Stillwater and Minister's Ponds in Chatham. Fox Pond in Chatham has been colonized by the native but increasingly invasive narrow-leaved cattail (*Typha angustifolia*), a product of brackish and saline environments.

Sarah's Pond in Orleans supports a different exemplary habitat type. Though this pristine pond lacked the exposed pondshore margins for rare herbaceous species, a healthy Atlantic White Cedar swamp exists along its north shore. Overhanging limbs and branches have provided specialized perching sites for the black-crowned night heron (*Nycticorax nycticorax*), a number of which were documented during the survey. From a wildlife and aesthetic viewpoint, Sarah's Pond could be described as the least impacted and most pristine of all the ponds within the survey area.

## 5.1 Identification of Potential Threats To The Ponds

Horsley & Witten has identified several potential threats to the integrity of the natural vegetative communities within the freshwater bodies of the Pleasant Bay ACEC. These potential threats include the presence of invasive species, discharge of stormwater and nutrient sources, armoring or other direct alteration to the pondshore, erosion, and to a lesser extent, docks and floats used for recreation. These potential threats are discussed below.

### 5.1.1 Nutrient Loading and Eutrophication

These shallow-water ponds and pondshore flora are highly sensitive to nutrient loading, which can cause eutrophication and encourage growth of invasive and undesirable plant species (Sorrie, 1994). Although no information on the trophic status of these ponds was obtained in this study (see Roman et al., 2001), human sources of nutrients should be minimized or prevented, to the greatest extent practical. Potential sources of excess nutrients include lawns and gardens (due to fertilizer use), road runoff, septic systems, and animal wastes.

**Examples of potential nutrient sources from lawn and landscaped areas immediately upgradient of shoreline** (Minister's Pond and Stillwater Pond, respectively).

### 5.1.2 Erosion and Sedimentation

In at least one location adjacent to the Route 28 Town landing for Crystal Lake, stormwater runoff from the road has created a sediment fan extending into the natural pondshore community. This may have encouraged the local colonization by multiflora rose (*Rosa multiflora*) that is currently displacing native species.

### 5.1.3 Recreational Impacts

Towns and private residents use the shorelines of nearly all of the freshwater ponds within the Pleasant Bay ACEC for recreational purposes, with the exception of Gould Pond, that is located within the Town of Orleans watershed. Beaches, boat ramps, private docks and floats have impacted the vegetated communities along the waterbodies.

**Examples of recreational activities interrupting the natural vegetative community** (Crystal Lake and Stillwater Pond, respectively).

While these activities may have prevented woody encroachment by willows and other invasive woody plants, expansion or creation of new recreational beaches, boat landings and docks should be carefully regulated or discouraged in future management plans for the ACEC, in order to protect the fragile pondshore environment.

**Stormwater culvert near town landing at Crystal Lake**

### 5.1.4 Water Use and Potential Impacts of Ground Surface Water Withdrawal

Alteration of the hydrology of these ponds can have short or long-term impacts to the intricate growth patterns of the pondshore community and the rare species populations within New England Coastal Plain Pond Shore Communities. Generally speaking, fluctuations between high water years and low water years are needed to perpetuate this type of pond shore community. High water years, where water levels remain at the upper reaches of the pond shore, prevent encroachment of woody species such as pitch pines, oaks, and willows into the rare pondshore communities; low water years expose the shoreline and allow these plants to flower and set seed.

Too many high water years due to water impoundment from phenomena such as cranberry bog farming or blocked culverts, can prevent these plants from flowering and fruiting. Too many low water years due to extended drought conditions and public water consumption can mean an increase in the growth of aggressive, woody invasive species that are otherwise intolerant of prolonged inundation. For instance, in 1991, as a result of increased water withdrawal by the local privately-owned water company and a particularly dry summer, the most significant of all coastal plain kettles ponds, Mary Dunn Pond in Barnstable, Massachusetts, completely dried out, leading to an encroachment of pitch pine seedlings and invasive grasses such as crabgrass (*Digitaria* spp.) into the rare plant zone ringing the pond (Sorrie, 1994). Mary Dunn Pond, which has been documented to having more state-listed rare plant species than any other coastal pond in the Commonwealth, completely recovered within two years when the hydrologic cycle and diminished water withdrawal by the water company allowed water levels to return to normal.

## 5.2 Specific Threats to New England Coastal Plain Pondshore Communities

**Eutrophic Conditions**

Two of the most challenging problems in protecting rare plant communities, such as the New England Coastal Plain Pond shore community, are the threats of eutrophication/succession and shoreline development. The plants that occur here are adapted not only to a wide sandy shoreline in low water years, but to a very acidic, low nutrient substrate. The character of the substrate is dictated by the glacial parent material and is also greatly influenced by wave sorting and by nutrient loading (Sorrie, 1994).

The physical properties of periodic inundation, shoreline exposure and a low nutrient-acidic growing medium enables the plant species associated with these communities to flourish in an ecological niche in which other more invasive, nitrogen-adapted plants cannot compete.

Management goals should center on two vectors of change within these ecosystems. The first is a result of fluctuations of nitrogen, phosphorous and other nutrients from various sources that could potentially create more organic-rich conditions conducive to predominantly invasive or aggressively colonizing non-native species. Examples of the latter include herbaceous taxa such as crabgrass, purple loosestrife, common reed, and macro-aquatics such as green algae and milfoil.

The second conduit for impacts centers on natural succession and so-called 'lake-fill' processes where conditions for aggressively colonizing native species such as cattails (*Typha* spp.), spatterdock (*Nuphar variegata*), fragrant water lily (*Nymphaea odorata*), water shield (*Brasenia* spp.) and water willow (*Decodon verticillatus*), can proliferate. Woody upland invaders such as willow (*Salix* spp.), pitch pine, and oak can establish within 2-3 growing seasons of unusually low water years (Sorrie, 1994).

The shallow water, generally warm water column temperatures, and low slope gradients bordering most coastal plain kettle ponds leave these water bodies particularly vulnerable to nutrient influxes from a variety of sources. These sources may include lawn fertilizers, sub-standard septic systems, stormwater runoff, and fecal matter from waterfowl, wildlife and domestic animals. Likewise, the greater the density of the bordering vegetative wetland community and resulting leaf litter decay, the higher the organic fraction in the soils due to the accumulation of organic detritus. This could allow a 'foot-hold' for aggressively, colonizing native, and non-native or invasive species such as the ones listed above.

Buildup of organic matter in sediments in such ponds may be affected by water level fluctuations over a period of years. In situations where low water years can oxidize the organic layer and leave a more mineral, sandy substrate, maintaining the typical hydroperiod and water fluctuations is critical for coastal plain pondshore rarities that are so dependent on cyclical inundation-drawdown periods. Even during low water years, many of these plant species are so specialized that they may not re-appear for decades.

These natural communities and rare species should continue to be documented over a period of years. A single study year provides only a snapshot-in-time approach that is insufficient to document changes in flora or fauna in the long-term. Existing or even potential impacts to state-listed species and exemplary communities should be documented and mitigated as soon as possible. Cooperative agreements in managerial goals and methods between private shorefront owners and public entities such as local conservation commissions and the Pleasant Bay Resource Management Alliance involve all parties in protecting these fragile and valuable natural assets.

The loss of one or two sites for rare species can have long-lasting impacts on local populations. A disjunct species that has a localized, fragmented habitat range, may not be able to recover because local sources of seeds and propagules may be geographically too distant to allow for recolonization of the lost or impacted site (Reznicek, 1994).

## 6.0 MANAGEMENT RECOMMENDATIONS

The most important element in a comprehensive management plan for the freshwater bodies within the Pleasant Bay ACEC is protection of the New England Coastal Plain pondshore habitat bordering Gould Pond and Crystal Lake. Such protection will in turn protect the habitat of the rare species documented by this baseline study and previous studies, while protecting the natural plant communities along each of freshwater ponds. The four major causes of short and long term disturbance to this globally significant community within the most important rare plant zone located on the Cape Cod are:

- Impacting the hydroperiod by prolonged groundwater withdrawal and drawdown of the water table;

- Nutrient loading from septic systems, lawn fertilizers and stormwater runoff containing nitrogen, phosphorus and other nutrients;

- Erosion and sedimentation; and

- Development and recreational impacts to the physical substrate.

Even small differences in the hydrologic regime potentially could have a major influence on the wetland plant community (Schneider, 1994). Providing a buffer from all causes of disturbance to the pondshore water regime is of primary importance.

To this end, Horsley and Witten recommends the following for consideration in the ecological management of natural freshwater communities within the Pleasant Bay ACEC, in addition to the enforcement of regulations already in place as established by the Massachusetts Department of Environmental Protection (DEP), the Cape Cod Commission, and/or local Conservation Commissions.

- Encourage the establishment of a minimum undisturbed naturally vegetated buffer of at least 25-50 feet to all waterbodies. The function of such a buffer would be to help mitigate the effects of existing development or proposed projects involving installation of septic systems, lawns and landscaping, residential dwellings, and impervious surfaces.

- Discourage the use of fertilizers, herbicides, and pesticides within a set distance to the pond edge.

- Regulate or condition expansion of existing water-dependent recreational facilities, including beaches, docks, floats, and boat landings. This would not prohibit the maintenance and repair of existing structures. In some cases, opening in dense pondshore vegetation can have a beneficial effect on herbaceous plant communities.

- Encourage upgrades of substandard septic systems to Title 5 standards, including the use of alternative denitrifying septic systems, which would result in reduce nutrient loading.

- Discourage the feeding of waterfowl that can increase nutrients and spread invasive plant seeds via fecal dispersal.

- Encourage the removal of invasive flora such as purple loosestrife, common reed, bush-honeysuckle, multiflora rose, and Oriental bittersweet, particularly where only small discrete populations were observed, while encouraging the establishment of native flora. Invasive plant species management plans should be developed in accordance with the guidelines established by the Cape Cod Commission.

- Preserve native shoreline vegetation to filter nutrients and other water-borne sediments.

- Encourage erosion control measures including native plantings and elimination of stormwater runoff conduits and culverts.

- Monitor water quality in ponds, stormwater runoff point sources and groundwater.

- Combine data on water quality and natural resources to develop a coherent integrated picture of conditions in the ACEC, ranging from the pristine (Sarah's Pond) to the highly impacted (Pilgrim Lake, Uncle Seth's Pond).

- Provide public education on the imperative to protect and enhance these delicate shoreline properties, without the cudgel of regulations and penalties, may make more of an impression on shorefront landowners.

Management of natural resources should differentiate between natural processes (lake-fill; succession) and conditions where human impacts have occurred or may occur. Questions regarding restoration of ponds that are naturally succeeding to marshes or wet meadows or are being impacted by nutrient loading with consequent water quality and native species degradation need to be pondered within a goal-oriented management plan. An adaptive management approach that can change and react to an increase in knowledge and data will provide a mechanism to evaluate and change management goals in the long term.

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# Appendix


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Pleasant Bay
Area of Critical Environmental Concern
Orleans and Chatham, Massachusetts

9/26/02 JLC
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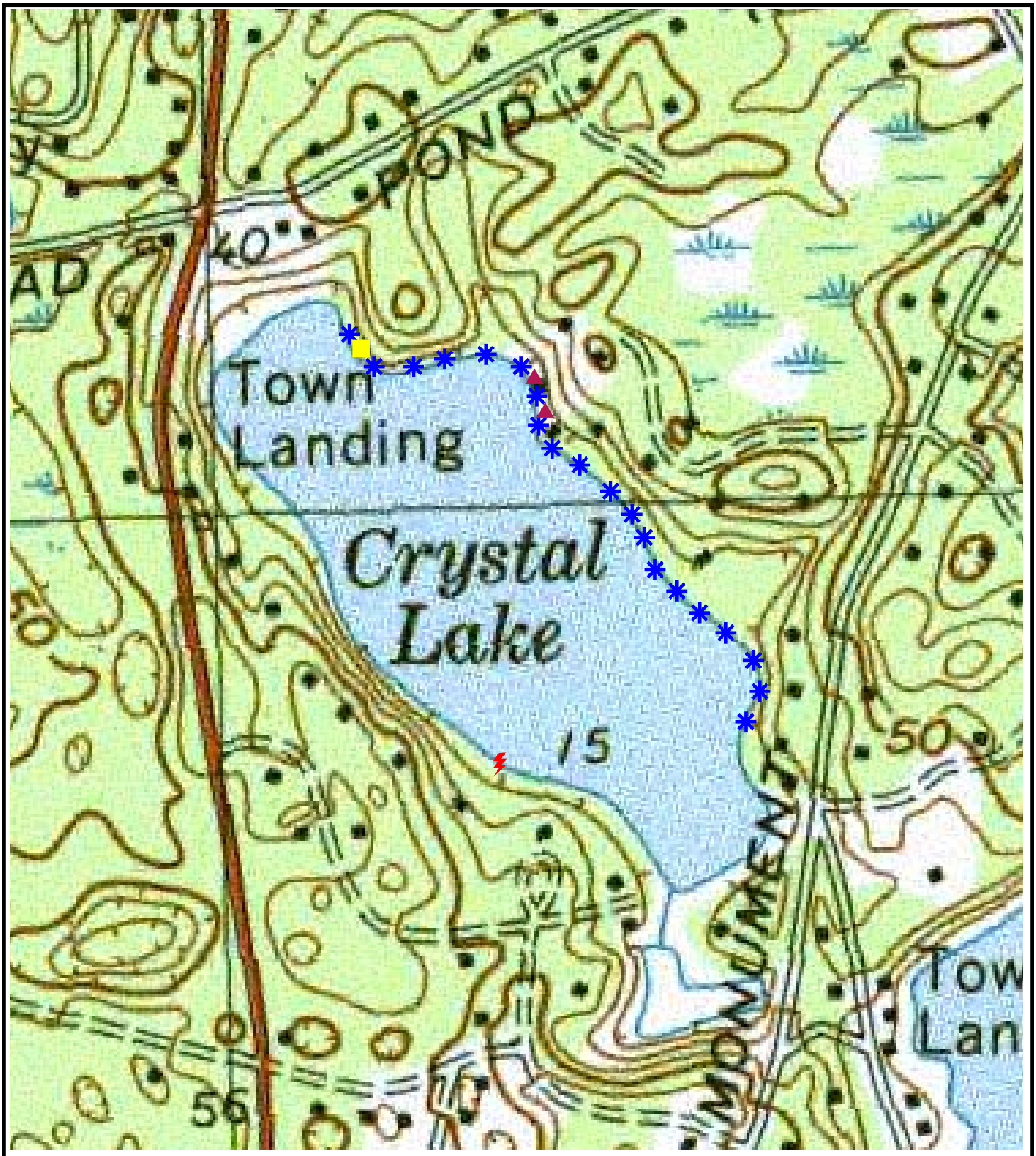
Figure 1.




Hemicarpha micrantha- Watch List

Terete Arrowhead
(Sagittaria teres)- Special Concern

Plymouth Gentian
(Sabatia kennedyana)- Special Concern

Purple Loosestrife
(Lythrum salicaria)-Invasive

N

70 0 70 140 Meters

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Crystal Lake
Orleans, Massachusetts
Approximate Distribution of
State-Listed and Invasive
Plant Species

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 2.

# Crystal Lake

| | |
|---|---|
| **Location** | Crystal Lake is located east of Route 28, southeast of the Route 28/Pond Road/Finlay Road intersection in Orleans, Massachusetts. Two Town Landings, one off Route 28, and one off Monument Road provide access. |
| **Size** | 36 acres (Massachusetts Great Pond) |
| **Geologic origin** | Outwash plain, kettle pond |

**Vegetation Community**

Crystal Lake is one of the largest freshwater bodies within the Pleasant Bay ACEC. Formed as a kettle pond during the last ice age, portions of the pondshore community found here are representative of a New England Coastal Plain pondshore (see discussion in Section 3.3. A total of 65 plant species were documented within 38 families, including two **Species of Special Concern**: Plymouth gentian (*Sabatia kennedyana*) and slender arrowhead (*Sagittaria teres*). A **Watch List species** (*Hemicarpha micrantha*), as well as a small local population of the regionally rare Atlantic white cedar (*Chamaecyparis thyoides*) were also observed. Horsley & Witten was unable to confirm the presence of the Massachusetts Endangered Maryland meadow beauty (*Rhexia mariana*) observed by others (Scanlon and Meservey, 2001); however, a small clump of meadow beauty (*R. virginiana*) was observed along the eastern shoreline.

**Plymouth gentian**
(*Sabatia kennedyana*)

The bordering vegetated wetland consists of a narrow band of wetland indicator vegetation dominated by red maple (*Acer rubrum*), tupelo (*Nyssa sylvatica*), highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), fetterbush (*Leucothoe racemosa*), winterberry (*Ilex verticillata*), and leatherleaf (*Chamaedaphne calyculata*), with various ferns, grasses, and St. John's worts within the herbaceous groundcover.

**Slender arrowhead**
(*Sagittaria teres*)

Observed emergent vegetation includes spatterdock (*Nuphar variegata*), arrowhead (*Sagittaria latifolia*), bayonet rush (*Juncus militaris*), Olney three-square (*Scirpus americanus*), and spike-rush (*Eleocharis acicularis*). Two **invasive** species were observed: several small scattered patches of purple loosestrife (*Lythrum salicaria*) along the shoreline, and an area of multiflora rose (*Rosa multiflora*) adjacent to the outfall pipe near Route 28. A complete list of species observed during the 2002-growing season is provided in Appendix B).

Topography surrounding Crystal Lake is shallow along the pond edge and rises abruptly from the narrow vegetated wetland, where the vegetative community is typical of that found on Cape Cod: a forested upland community dominated by pitch pine (*Pinus rigida*) and various oaks (*Quercus* spp.).

**Pond Use**

Crystal Lake is used recreationally for boating, swimming, fishing, and passive recreation (as evidenced by the fragmented footpath around the pond. There are two town landings, which allow for boating access[1], as well as a small beach area (near the Monument Road town landing). Crystal Lake has been historically stocked with game fish (Brown Trout, Rainbow Trout, and Brook Trout). Several private docks and/or floats are also located within Crystal Lake. This water body is hydrologically connected to cranberry operations located to the south.

Lawn and landscaped areas associated with the surrounding residential development interrupt the natural plant communities, while several sections of the shoreline have been armored or otherwise altered. A discharge pipe that receives stormwater from Route 28 is a potential source of pollutants.

**General Comments**

Crystal Lake exhibits exemplary habitat of the globally rare New England Coastal Plain Pond Shore community along the northeast shoreline, where a broad area of sand and gravel within the drawdown zone is exposed on an annual basis. This area supports two state-listed **Species of Special Concern**, as well as a **Watch List** species. Potential threats to this community include the presence of **invasive** species, which may be a product of nutrient inputs from the stormwater discharge from Route 28 and the cultivated cranberry bogs to the south.

[1] A 10 hp limit of motorized boats is strictly enforced by the Town.


* Plymouth Gentian (Sabatia kennedyana)- Special Concern

N

40 0 40 80 Meters

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Gould Pond
Orleans, Massachusetts
Approximate Distribution of
State-Listed and Invasive
Plant Species

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 3.

# Gould Pond

| | |
|---|---|
| **Location** | Located west of Route 28 within the Orleans water shed, between Morgan's Way and Monument Road in Orleans, Massachusetts |
| **Size** | 6 acres |
| **Geologic origin** | Kettle Pond-Outwash Parent Material |

**Vegetation Community**

In many ways, this small kettle pond, tucked away in a pine barrens upland, represents the finest example of New England Coastal Plain Pond Shore found in any of the eleven subject ponds. Literally thousands of rosettes and flowering stems of the state-listed **Species of Special Concern** Plymouth gentian (*Sabatia kennedyana*) encircle the entire shoreline. Other rarities include black-fruited spike rush (*Eleocharis melanocarpa*) and Hemicarpha (*Hemicarpha micrantha*), both state **Watch List** species. The broad, peaty-sand margin lends habitat to a host of interesting species such as spatulate-leaved sundew (*Drosera intermedia*), rose coreopsis (*Coreopsis rosea*), yellow-eyed grass (*Xyris difformis*), three-way sedge (*Dulichium arundinaceum*), and pipewort (*Eriocaulon aquaticum*).

**Rosettes of Plymouth gentian**
(*Sabatia kennedyana*)

Despite its small size, Gould's Pond is habitat for a wide range of species' diversity, both plant and animal. Twenty-eight (28) families and forty-nine (49) species in forty-four (44) plant genera were recorded. Significantly, every taxon documented was native in origin; no alien or exotic species were noted. A complete list of species observed during the 2002-growing season is provided in Appendix B.

Surrounding topography of Gould Pond is moderately sloping from a pitch pine barren dominated community to a shrub border to the sandy exposed shoreline. A second smaller water body is located just to the northwest of Gould Pond and may be hydraulically connected during high water years.

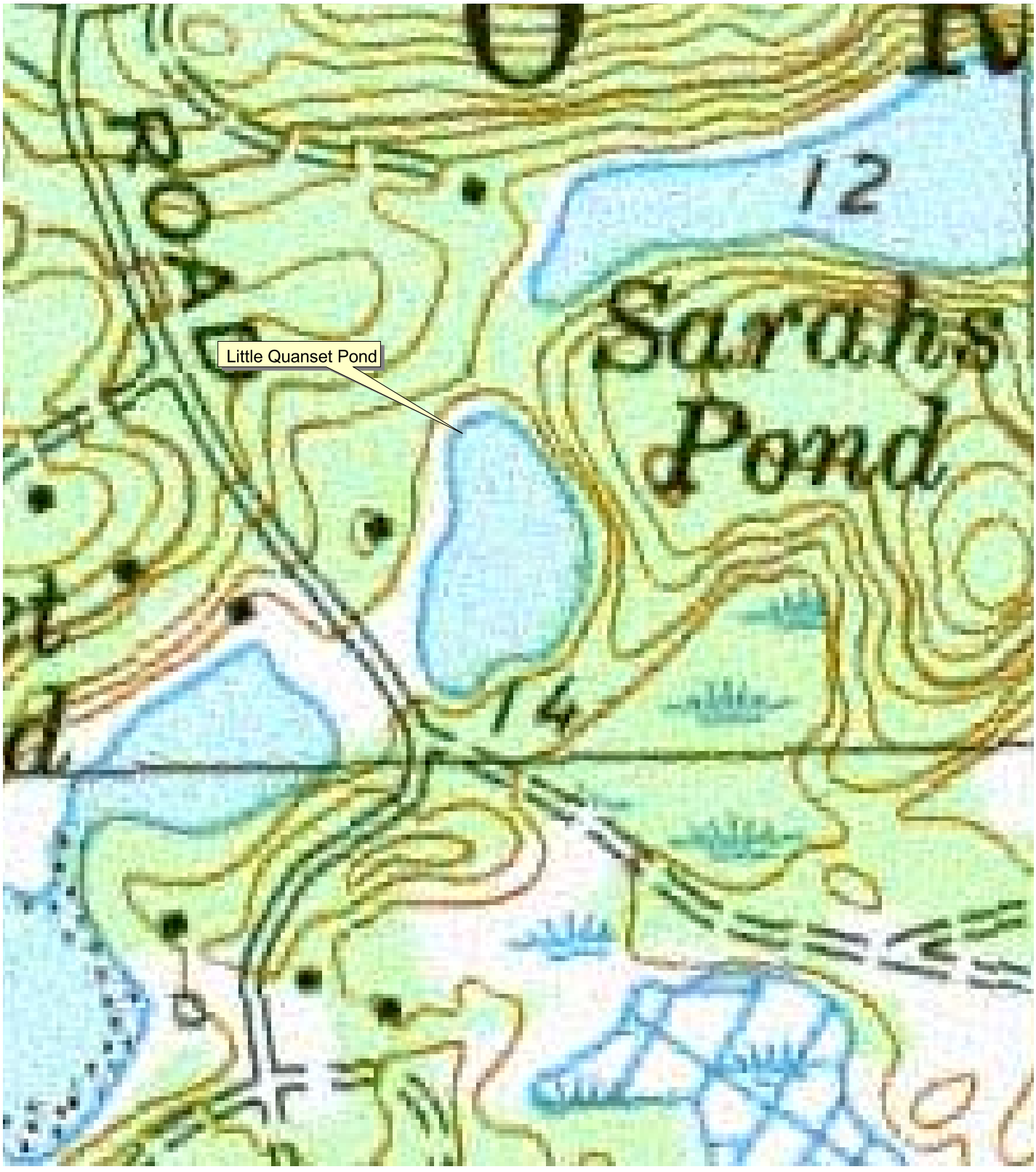
***Sabatia* in flower and in fruit with slender-leaf goldenrod**
(*Euthamia tenuifolia*)

## Pond Use

Gould's Pond is within the Town of Orleans Watershed Protection District and has remained undeveloped and intact ecologically as a result.

## General Comments

Wildlife habitat at Gould Pond is rich, with a well-used game trail ringing the perimeter of the pond. Spotted sandpipers, belted kingfishers, fingerling bass and painted turtle all were noted feeding or basking.




N

40 0 40 80 Meters

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Little Quanset Pond
Orleans, Massachusetts

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 4.

# Little Quanset Pond

**Location** Located immediately northeast of Quanset Road and Quanset Pond in Orleans, Massachusetts

**Size** approximately 3 acres

**Vegetation Communities**

At approximately 3 acres, Little Quanset Pond is one of the smallest ponds within the Pleasant Bay ACEC. Surrounding topography to the pond is generally gently to moderately sloping; whereas topography along the eastern shoreline rises sharply. Little Quanset Pond is likely hydrologically connected to Sarah's Pond through a vegetated wetland.

Our baseline study documented a total of 32 plant species within 26 families, including several **invasive** species immediately adjacent to the pond, such as black locust (*Robinia pseudoacaia*), multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculata*), Morrow's honeysuckle (*Lonicera morrowii*) and Japanese honeysuckle (*Lonicera japonica*), with common reed (*Phragmites australis*) in close proximity to the pond.

The vegetative community, consists of small populations of narrow-leaf cattail (*Typha angustifolia*), pickerel weed (*Pontederia cordata*), and swamp loosestrife (*Decodon verticillatus*) along the shoreline. Scattered colonies of spatterdock (*Nuphar variegata*) and floating heart (*Nymphoides cordata*) cover the surface of the pond.

**Pickerel Weed** (*Pontederia cordata*)

Woody vegetation along the pond edge, Similar to that along Sarah's Pond, includes swamp azalea (*Rhododendron viscosum*) and arrowwood (*Viburnum dentatum*), with scattered individuals of red maple (*Acer rubrum*). There is no indication of a New England Coastal Plain pondshore (see discussion in Section 3.3). A complete list of species observed during the 2002-growing season is provided in Appendix B.

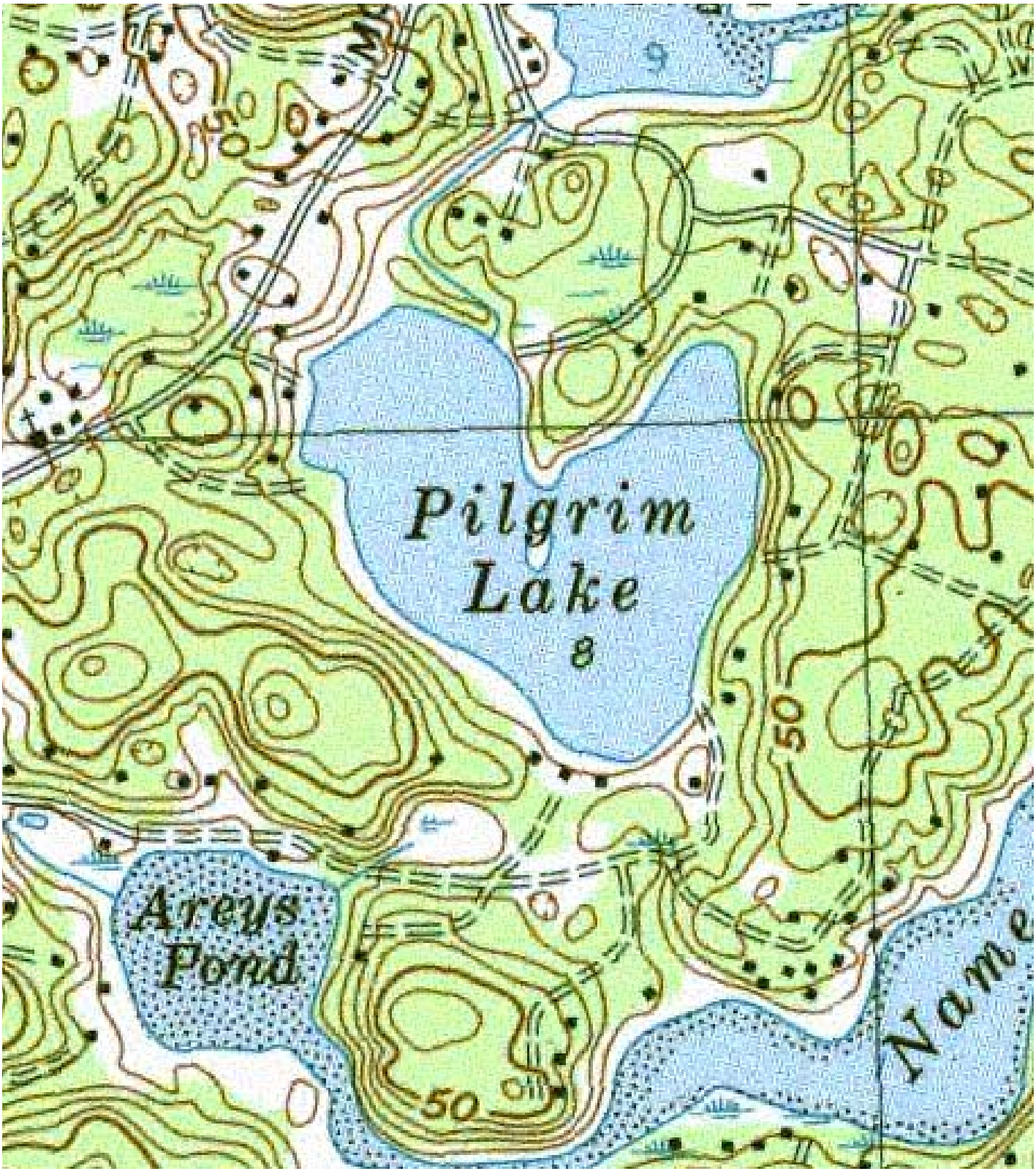
**Pond Use**

Local residents likely use little Quanset Pond recreationally for boating, fishing, and swimming. A single dock was observed within this pond.

**General Comments**

Of all the freshwater bodies located within the Pleasant Bay ACEC, the vegetative community within Little Quanset Pond appears to be at the greatest risk for invasion by aggressively colonizing, native and non-native species. These invasive species, observed largely along the southwestern pond edge and across the street within Quanset Pond, which is hydrologically connected beneath Quanset Road through a culvert, are currently displacing native vegetation. The presence of common reed immediately adjacent to the culvert within Quanset Pond is particularly troublesome. As the colony of common reed is fairly small at this location, it may be prudent to closely monitor and manage this species, as necessary, before it is able to colonize within Quanset Pond.

Stormwater runoff from Quanset Road likely discharges to Little Quanset Pond via an asphalt sluice way. Although the proximity of the roadway to the pond edge cannot be mitigated, upgraded stormwater management practices in this location would mitigate some of the pollutant and nutrient run-off within this freshwater body.




N

90 0 90 180 Meters

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Pilgrim Lake
Orleans, Massachusetts

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 5.

# Pilgrim Lake

| | |
|---|---|
| **Location** | Located southeast of Monument Road, and northwest of Arey's Lane in Orleans, Massachusetts. A town landing located off Herring Brook Road provides access to the Town Beach; a second access point is located off a private roadway (Rohmers Road). |
| **Size** | 39 acres (Massachusetts Great Pond) |
| **Geologic origin** | Outwash plain, kettle pond |

## Vegetation Communities

Pilgrim Lake is the largest freshwater body within the Pleasant Bay ACEC. Formed as a kettle pond during the last ice age, surrounding topography is moderately sloping. A small, densely vegetated island is located within the central portion of the lake. A single surface water outlet connects this waterbody to Kescayogansett Pond to the northeast.

A total of 55 plant species were documented within 37 families. A dense population of emergent vegetation dominated by water willow (*Decodon verticillatus*), pickerel weed (*Pontederia cordata*), and scattered patches of wide-leaf cattail (*Typha latifolia*). Dense mats of water lilies (*Nymphaea*, *Nuphar*, *Nymphoides*) occupy the nearshore open water habitat.

The fringing freshwater wetland consists of a transitional shrub swamp-forested swamp, dominated by red maple (*Acer rubrum*) and tupelo (*Nyssa sylvatica*) in the canopy with shrubs of winterberry (*Ilex verticillata*), Virginia rose (*Rosa virginiana*), swamp rose (*Rosa palustris*), buttonbush (*Cephalanthus*

*occidentalis*), bayberry (*Myrica pensylvanica*), sweet pepperbush (*Clethra alnifolia*), elderberry (*Sambucus canadensis*), and arrowwood (*Viburnum dentatum*). Dominant herbaceous species include swamp candles (*Lysimachia terrestris*), various sedges and rushes, and boneset (*Eupatorium perfoliatum*). Only one **invasive** species was observed: multiflora rose (*Rosa multiflora*).

Surrounding upland habitat consists of a pitch pine/oak forest community with interspersions of lawn and landscaped areas. A complete list of species observed during the 2002-growing season is provided in Appendix B.

Historic records of the state-listed **Species of Special Concern** Plymouth gentian (*Sabatia kennedyana*) were not confirmed during this survey (likely due to the timing of field investigations); however, documented presence of this species is an important factor in protecting the overall plant community within Pilgrim Lake.

**Town Beach at Pilgrim Lake**

With the exception of the areas immediately surrounding the town beach and adjacent to small cleared areas where private docks and beaches have been established, the vegetative community within Pilgrim Lake is not indicative of a New England Coastal Plain Pond. This may be reflective of the large amounts of organic matter (rather than sandy substrate) within the underlying substrate. Pilgrim Lake is surrounded by residential development and as a result, several areas immediately upgradient of the pond shoreline have been cleared of natural vegetation for lawn and landscaping. Individual septic systems are potential sources of nutrient loading to the lake. Pilgrim Lake also appears to receive stormwater from Rohmer's Road to the south, which is another potential source of pollutants to the lake.

## Potential Significant Wildlife Habitat

The dense population of swamp loosestrife (*Decodon verticillatus*) may provide habitat for the state Threatened water-willow stem borer (*Papaipema sulphurata*), a globally restricted species, whose larvae bore into and feed exclusively upon water willow (see Appendix C).

## Pond Use

Pilgrim Lake is used recreationally year-round for boating, swimming, fishing, and passive recreation. A town beach was created in the northern section of the shoreline, and is the only area where sandy substrate is evident. Several private docks and/or floats are also located within Pilgrim Lake, although access to these structures appears to be somewhat less maintained (i.e., small, narrow, meandering paths rather than open expanses of lawn or landscaping), and thus less interruptive to the overall natural plant community surrounding the lake.

## General Comments

The dense emergent vegetative community consists of several "nitrophyles" (nitrogen-loving species), which thrive in situations where influxes of nitrogen, phosphorous, and other nutrients from a wide number of sources can create more organic conditions, limiting the presence of a New England Coastal Plain Pondshore community, which would otherwise be anticipated in a freshwater kettle depression. However, the presence of an outlet to a nearby waterbody, further limits this pond to support such exemplary habitat.

Lawn and landscaped areas associated with the surrounding residential development interrupt the natural plant communities in some instances. Encouraging larger vegetated buffer strips around the pond, limiting fertilizer use, upgrading septic systems to meet Title 5 standards, and/or removing some of the vegetation choking the water column would likely reduce nutrient loading to Pilgrim Lake and may improve trophic conditions within the pond.


▲ Atlantic White Cedar (Chamaecyparis thyoides)

N

100 0 100 200 Meters

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Sarah's Pond
Orleans, Massachusetts
Approximate Distribution of a
Priority Natural Community

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 6.

# Sarah's Pond

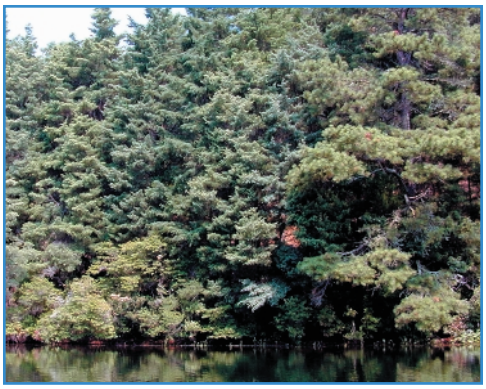
| | |
|---|---|
| **Location** | Located southwest of Davis Road (private) Between Sarah's Lane and Teal Road in Orleans, Massachusetts |
| **Size** | 6 acres |
| **Geologic origin** | Kettle pond, outwash plain |

**Vegetative Communities**

Sarah's Pond is one of the smaller and most pristine ponds within the Pleasant Bay ACEC. Formed as a kettle pond during the last ice age, topography surrounding Sarah's Pond is relatively steeply sloping with the exception of the southwestern-most corner where there may occur an overland hydrological (i.e., vegetated wetland) connection to Little Quanset Pond.

A total of 29 plant species were documented within 23 families during this baseline study. Small areas of various pond lilies were observed throughout the pond, with limited populations of pickerel weed (*Pontederia cordata*), swamp loosestrife (*Decodon verticillatus*) and blue flag iris (*Iris versicolor*) along the shoreline. A dense population of a submergent species, slender pondweed (*Potamogeton pusillus*), was observed in the pond interior.

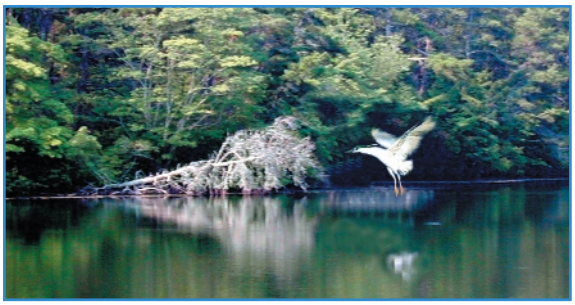
Woody vegetation along the pond edge includes highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), arrowwood (*Viburnum dentatum*), and maleberry (*Lyonia ligustrina*) with an understory of various ferns. Large portions of the pondshore community are overhung with mature trees and branches of red maple (*Acer rubrum*) and gray birch (*Betula populifolia*). A small local population of the regionally rare Atlantic White Cedar (*Chamaecyparis thyoides*) community occupies the north-central shoreline. There is no indication of a New England Coastal Plain pondshore (see discussion in Section 3.3). A complete list of species observed during the 2002-growing season is provided in Appendix B).



**Atlantic white cedar community along northern shoreline of Sarah's Pond**

## Wildlife of Note

Sarah's Pond is home to a small colony of Black-crowned Night-Heron (*Nycticorax nycticorax*). Significant overhanging woody vegetation (mature trees) provides ideal roosting, nesting, and perch habitat for this species, whose primary food source is fish. Chiefly a summer resident, the Black-crowned Night-Heron, was once thought to be in decline nationally, and is an uncommon species on Cape Cod.



**Black-crowned Night-Heron** (*Nycticorax nycticorax*) in flight

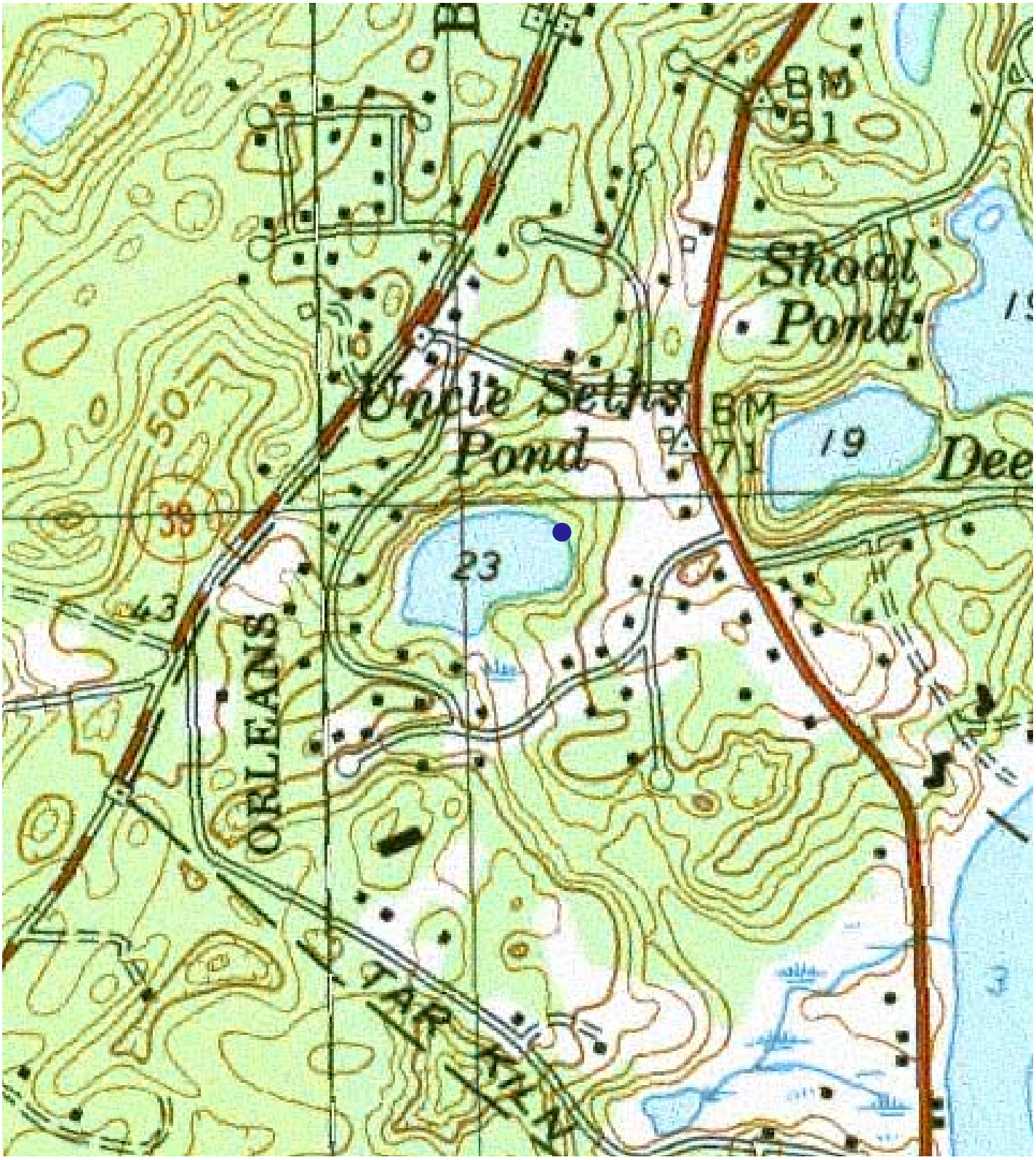
## Pond Use

Currently, recreational use of Sarah's Pond is minimal, as there are only two residences along the pond, and only a single, unobtrusive dock. Horsley & Witten observed some clearing of understory species to the northwestern slope, although this clearing did not appear to extend to the pond edge.

## General Comments

Sarah's Pond is generally a pristine, undisturbed area that demonstrates little to no accelerated eutrophication due to artificial nutrient input. This is largely due to the lack of development on the pond.

The presence of an Atlantic White Cedar community is significant to the overall need for protection of this pond. This community type is ranked as "G3-S2" by the Massachusetts Natural Heritage & Endangered Species Program (NHESP), meaning that this community type is rare (21-100 occurrences) throughout its global range or else is vulnerable to extinction due to biological factors, with only 6-20 occurrences statewide. A significantly larger Atlantic White Cedar swamp is located south of Sarah's Pond and east of Little Quanset Pond.




● black fruit spike rush (Eleocharis melanocarpa)- Watch List

N

90 0 90 180 Meters

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Uncle Seth's Pond
Orleans, Massachusetts
Approximate Distribution of
State-Listed and Invasive
Plant Species

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 7.

# Uncle Seth's Pond

**Location** Located west of Route 28 and east of Route 39 (Harwich Road), south of Cross Road in Orleans, Massachusetts

**Size** 5 acres

**Vegetation Communities**

Uncle Seth's Pond is one of the smaller freshwater ponds located within the Pleasant Bay ACEC. Surrounding topography is gently to moderately sloping with the exception of the northwestern shoreline where topography is more steeply sloping.

Dominant species observed within Uncle Seth's Pond include a dense mat of white water lily (*Nymphaea odorata*), spatterdock (*Nuphar variegata*), and water shield (*Brasenia schreberi*) which cover a large percentage of the open water. Other dominant species include pickerel weed (*Pontederia cordata*), water willow (*Decodon verticillatus*), pipewort (*Eriocaulon aquaticum*), umbellate water pennywort (*Hydrocotyle umbellata*), slender-leaf goldenrod (*Euthamia tenuifolia*), various St. John's worts, and various grasses, including dense patches of reed canary-grass (*Phalaris arundinacea*). A total of 53 plant species within 32 different families were documented during this baseline survey. One **Watch List** species, an annual sedge (*Hemicarpha micrantha*), was observed along the eastern shoreline.

**Eutrophic conditions within Uncle Seth's Pond**

The vegetative community is not indicative of a New England Coastal Plain Pond. This may be reflective of the large amounts of organic matter (rather than sandy substrate) within the underlying substrate. Additionally, many of the species observed are "nitrophyles" (nitrogen-loving species), which thrive in situations where influxes of nitrogen, phosphorous and other nutrients from a wide number of sources can create more eutrophic conditions. This small pond is surrounded by residential development and appears to also receive stormwater from Winslow Drive to the south. Several areas upgradient of the southwestern pond shoreline have been cleared of natural vegetation for lawn and landscaping, which may also be a source of nutrient runoff.

The surrounding Bordering Vegetated Wetland consists of a narrow band of shrub swamp dominated by maleberry (*Lyonia ligustrina*), highbush blueberry (*Vaccinium corymbosum*), swamp azalea (*Rhododendron viscosum*), and sweet pepperbush (*Clethra alnifolia*) with scattered red maple (*Acer rubrum*) and tupelo (*Nyssa sylvatica*). The shrub swamp is somewhat broader to the northeast.

Surrounding upland habitat consists of lawn and landscaped areas, and where undisturbed, a pitch pine/oak forest community, although the understory vegetation has been cleared in the pine/oak forest to the north. A complete list of species observed during the 2002-growing season is provided in Appendix B.

**Pond Use**

Uncle Seth's Pond is used recreationally for boating and fishing, and passive recreation (as evidenced by a soft footpath encircling the pond and a wooden bench). Water levels this growing season were extremely low, exposing water lilies more than 50 feet upgradient of the current water levels, thus active recreational may have been limited this year.

**General Comments**

Lawn and landscaped areas associated with the surrounding residential development interrupt the natural plant communities. Encouraging residents to maintain wider vegetated buffer strips around the pond and discouraging fertilizer use, and/or removing some of the vegetation choking the water column would reduce nutrient loading to Uncle Seth's Pond and may improve trophic conditions within the pond.


Purple loosestrife (Lythrum salicaria)- Invasive

N

60 0 60 120 Meters

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Fox Pond
Chatham, Massachusetts
Approximate Distribution of
Invasive Plant Species

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 8.

# Fox Pond

**Location** Located at the eastern end of Nickerson Neck, east of Rush Drive and north of Strong Island Road, in Chatham, Massachusetts

**Size** approximately 5 acres

**Vegetation Community**

One of the smaller ponds within the Pleasant Bay ACEC, Fox Pond is the only pond that exhibits a saline influence. Vegetation within Fox Pond is dominated by narrow-leaf cattail (*Typha angustifolia*) and an **invasive** species, purple loosestrife (*Lythrum salicaria*) with marsh St. John's wort (*Triadenum virginicum*), sensitive fern (*Onoclea sensibilis*), jewelweed (*Impatiens capensis*), poison ivy (*Toxicodendron radicans*), and marsh bedstraw (*Gallium trifidum*). Dense patches of white water lily (*Nymphaea odorata*) are scattered throughout the pond.

Peripheral vegetation consists of a dense, narrow band of shrubs including arrowwood (*Viburnum dentatum*), elderberry (*Sambucus canadensis*), bayberry (*Myrica pensylvanica*), and Virginia rose (*Rosa virginiana*) with entanglements of the **invasive** species, Oriental bittersweet (*Celastrus orbiculata*). Thirty-two (32) individual species (24 families) were documented through this baseline study. A complete list of species observed during the 2002 growing season is provided in Appendix B.

**Purple Loosestrife (*Lythrum salicaria*)**
**note, picture not from this pond*

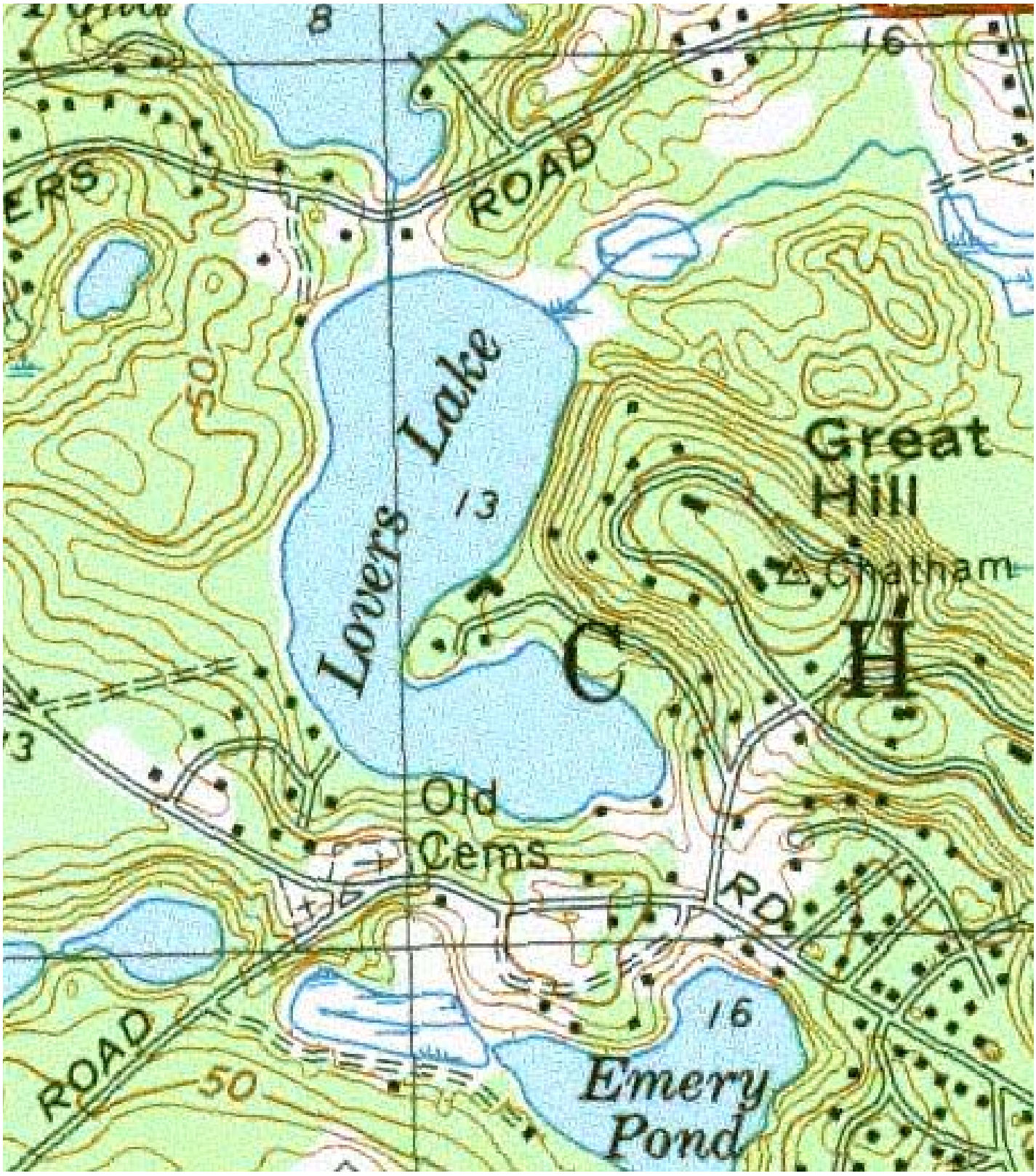
An elevated wooden boardwalk extends from Rush Drive, toward the beach areas across the northwestern portion of the pond vegetation, presumably to allow for beach access. North of Fox Pond is a barrier beach, which functions to protect this freshwater body/ brackish pond from coastal storms. Dominant vegetation within the barrier beach system includes American beachgrass (*Ammophila breviligulata*) and seaside goldenrod (*Solidago sempervirens*).

**Pond Use**

Residential development surrounds Fox Pond to the east, south, and west. Fox Pond may be used for boating and swimming, as well as passive recreation along the periphery.

**General Comments**

The vegetative composition of Fox Pond indicates a saline influence, which is logical given its location within a peninsula extending into Pleasant Bay. This pond is dominated by an invasive species, as well as an aggressively colonizing native species (cattail), which are reducing the diversity of species within this pond. Monitoring invasive species and implementing an invasive species management plan are recommended.




N

90 0 90 180 Meters

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Lovers Lake
Chatham, Massachusetts

9/26/02 JLC
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Figure 9.

# Lover's Lake

| | |
|---|---|
| **Location** | Located south of Old Comers Road and north of Old Queen Anne Road in Chatham, Massachusetts. The lake is accessed at the end of the Lover's Lake Circle cul-de- sac and at the boat landing at the end of Lake Shore Drive. |
| **Size** | 36 acres (Massachusetts Great Pond) |
| **Geologic origin** | Kettle Pond-Outwash Parent Material |

**Vegetation Communities**

Lover's Lake is one of the largest freshwater ponds within the Pleasant Bay ACEC, and reaches a total depth of 10.09 meters (approximately 33 feet).

Aquatic and emergent vegetation documented within Lover's Lake consists of spatterdock (*Nuphar variegata*), pickerel weed (*Pontederia cordata*), water willow (*Decodon verticillatus*), ribbon-leaf pondweed (*Potamogeton* epihydrus), narrow-leaf cattail (*Typha angustifolia*), wide-leaf cattail (*Typha latifolia*), bayonet rush (*Juncus militaris*), soft rush (*Juncus effusus*), and Olney three-square (*Scirpus americanus*).

**A field of pickerel weed**
(*Pontederia cordata*)

Fifty-one (51) plant species were observed within 32 Families. The peripheral vegetation consists of pitch pine (*Pinus rigida*), bayberry (*Myrica pensylvanica*), oaks (*Quercus* spp.), smooth alder (*Alnus serrulata*), sweet pepperbush (*Clethra alnifolia*), arrowwood (*Viburnum dentatum*), with rod (*Viburnum nudum* var. *cassinoides*), elderberry (*Sambucus canadensis*), winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*), and swamp azalea (*Rhododendron viscosum*). A complete list of species observed during the 2002-growing season is provided in Appendix B.

The two **non-native** species documented during field investigation were curly dock (*Rumex crispus*) and peppermint (*Mentha piperita*).

A culvert beneath Old Comers Road connects Lover's Lake with Stillwater Pond, and a tributary from Frost Fish Creek is located on the northern shoreline.

**Pond Use**

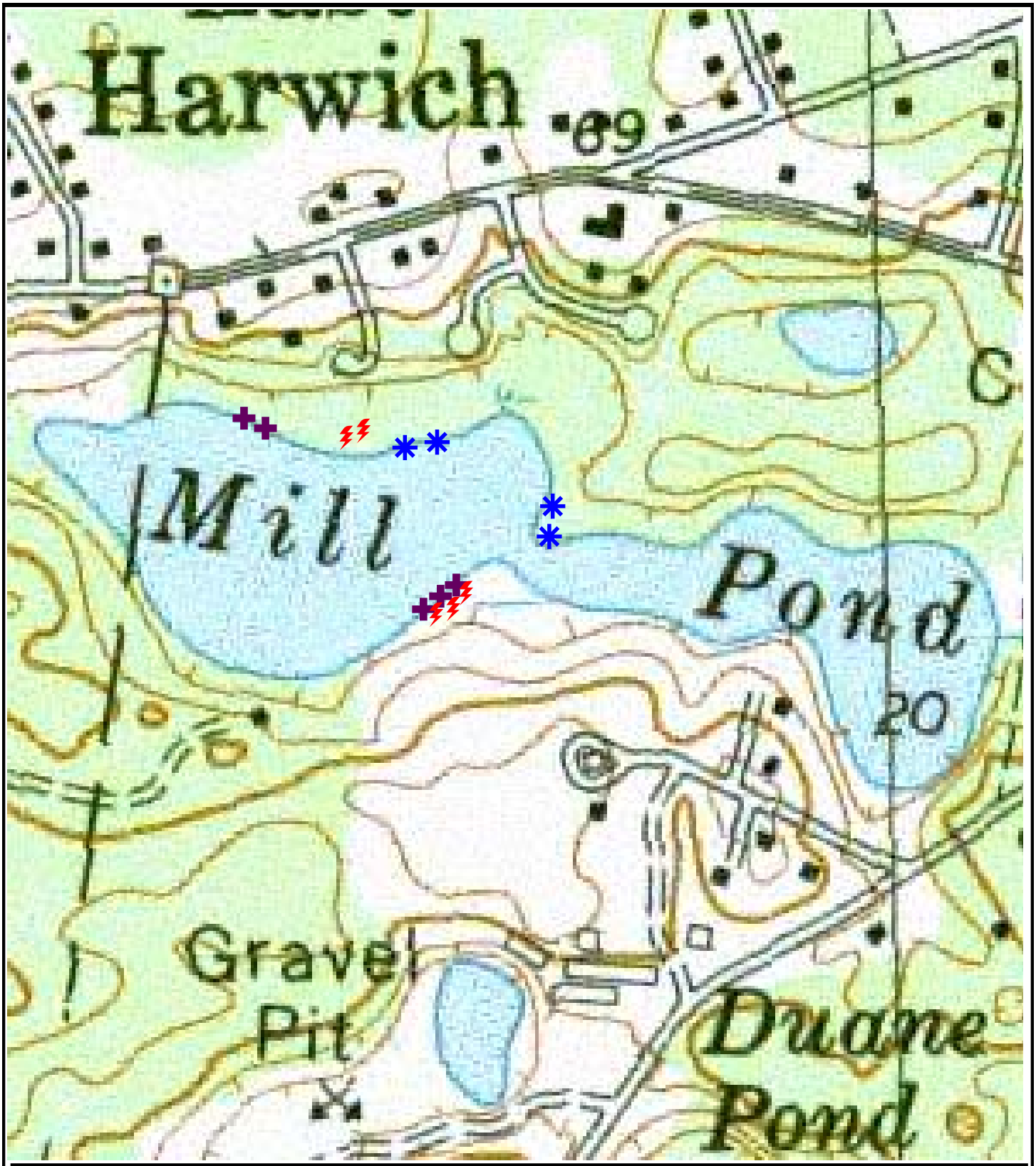
Lover's Lake is used recreationally for swimming, boating, and passive recreational activities. Several small beach areas are scattered along the pond periphery. Numerous docks and boats were observed on the lake, along with floating rafts for swimming activities. The residential surroundings have disrupted and fragmented lakeshore vegetation where docks, clearings and small beach areas have been constructed. Historically the pond has been stocked with game fish including brook trout and smallmouth bass.

**Potential Significant Wildlife Habitat**

The surrounding shoreline community of water willow may provide habitat for the Water Willow Stem Borer (*Papaipema sulphurata*), a Threatened species in Massachusetts, and globally restricted to southeastern Massachusetts. The Stem Borer utilizes the water willow as a larval food source.

**General Comments**

Lover's Lake is surrounded by residential development, and as a result, several areas immediately upgradient of the pond shoreline have been cleared of natural vegetation for lawn and landscaping. Use of fertilizers and existence of individual septic systems are potential sources of nutrient loading to the lake. This potential nutrient input may be reflective in the presence of "nitrophyle" (nitrogen-loving) vegetation dominating the shoreline.




Plymouth Gentain (Sabatia kennedyana)- Special Concern

Purple loosestrife (Lythrum salicaria)- Invasive

Common Reed (Phragmites australis)- Invasive

N

40 0 40 80 Meters

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Mill Pond
Chatham, Massachusetts
Aproximate Distribution of
State-Listed and Invasive
Plant Species

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 10.

# Mill Pond

**Location** Located south of Old Queen Anne Road, off Duncan Lane in Chathamhatham, Massachusetts

**Size** 22 acres (Massachusetts Great Pond)

**Vegetation Communities**

Mill Pond is a narrow, linear-shaped freshwater pond that is constricted in the center, dividing the pond into two basins (eastern and western). The pond is very shallow and at its deepest point only reaches 2.92 meters (approximately 9.5 feet) in depth. The bordering topography of Mill Pond is gently sloping for the most part, rising sharply in the southeastern section.

A total of 32 plant species were documented from 25 families, including Plymouth gentian (*Sabatia kennedyana*), a Massachusetts **Species of Special Concern.** Two local populations of *S. kennedyana* were documented along the northern shoreline where the pond becomes constricted (see Appendix A). These two populations have not been documented prior to this study; the Massachusetts Natural Heritage & Endangered Species Program (NHESP) has no historical record of these occurrences. The gentian populations consist of 300-350 individuals, and are approximately 200 feet apart. The gentians appear healthy and show little signs of herbivory or disease. One population was growing, uncharacteristically along the waters edge in a mucky, peaty substrate, while the other was found along the sandy shoreline in typical gentian habitat. Low water levels have exposed a sandy shore where both

**Local population of Plymouth gentian** (*Sabatia kennedyana*)

gentian and golden pert (*Gratiola aurea)* were observed. There appears to be no immediate threat to the *S. kennedyana* populations, though a small stand of purple loosestrife (*Lythrum salicaria*) is within 100 feet west of one of the populations.

Mill Pond is dominated by aquatic vegetation. Observed species include spatterdock (*Nuphar variegata*), white water lily (*Nymphaea odorata*), bladderworts (*Utricularia* spp.), soft rush (*Juncus effusus*), pickerel weed (*Pontederia cordata*), pipewort (*Eriocaulon aquaticum*), swamp loosestrife (*Decodon verticillatus*), and various sedges (*Carex* spp.).

The bordering vegetated wetland consists of sweet pepperbush (*Clethra alnifolia*), swamp azalea (*Rhododendron viscosum*), leatherleaf (*Chamaedaphne calyculata*), bayberry (*Myrica pensylvanica*), steeplebush (*Spiraea tomentosa*), and swamp loosestrife (*Decodon verticillatus*). A complete list of species observed during the 2002-growing season is provided in Appendix B.

Two non-native, **invasive** species were observed within Mill Pond. Purple loosestrife (*Lythrum salicaria*) as previously stated, was observed within 100 feet of the gentian populations; a second patch of purple loosestrife was observed on the southern shoreline near a stand of the **invasive** common reed (*Phragmites australis*). A second stand of *Phragmites* located near the access point off Duncan Lane currently consists of less than 20 stems.

**Pond Use**

Mill Pond is recreationally used for boating. Six private docks were observed on the pond; two in the western basin and four in the eastern basin. A sandy beach area has been created along the pond edge in one location. Non-motorized boats have been pulled up on the shore interrupting the normal growth of shoreline vegetation.

**General Comments**

A limited portion of the Mill Pond shoreline exhibits habitat characteristics of the globally significant New England Coastal Plain Pondshore community. Periodic low water levels associated with the draw down effect from the hydrologically connected aquifer create a suitable habitat for the state-listed gentian. Threats to this species and to overall native plant species community include the presence of purple loosestrife and common reed, both of which may be a product of nutrient run-off from the surrounding homes on the eastern side.

The population of swamp loosestrife suggests the potential for the presence Water Willow Stem Borer (*Papaipema sulphurata*), a Massachusetts Threatened Species. Swamp loosestrife is the only plant used by *P. sulphurata* in its larval stages. The *P. sulphurata,* is a globally restricted species of Lepidoptera and is only found in southeastern Massachusetts.


N

90 0 90 180 Meters

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Ministers Pond
Chatham, Massachusetts

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 11.

# Minister's Pond

**Location** Located southeast of the Route 137/Old Queen Anne Road intersection. Access to Ministers Pond is through 1347 Old Queen Anne Road, Chatham, Massachusetts

**Size** 5 acres

**Vegetation Communities**

Ministers Pond is one of the smallest freshwater ponds within the Pleasant Bay ACEC. The topography surrounding Ministers Pond is gently to moderately sloping. An intermittent stream connects Ministers Pond to an adjacent retired cranberry bog to the north.

A total of 20 plant species were documented within 17 families within the pond and the associated 100-foot buffer. Documented species within the adjacent vegetated wetland consists of red maple (*Acer rubrum*), gray birch (*Betula populifolia*), swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), and highbush blueberry (*Vaccinium corymbosum*), and leatherleaf (*Chamaedaphne calyculata*).

Observed emergent and aquatic vegetation includes spatterdock (*Nuphar variegata*), white water lily (*Nymphaea odorata*), swamp loosestrife (*Decodon verticillatus*), soft rush (*Juncus*

*effusus*), wide-leaf cattail (*Typha latifolia*), pickerel weed (*Pontederia cordata*), and bayonet rush (*Juncus militaris*). A complete list of species observed during the 2002-growing season is provided in Appendix B.

The emergent shrub swamp located to the north-northwest of the pond has developed along the intermittent stream connecting Ministers Pond to the nearby abandoned bog.

Recreational use of Minister's pond

**Pond Use**

The presence of the stream suggests that the pond may have been used, historically, as a water source for the adjacent cranberry bog.

Currently, Ministers Pond is used recreationally for swimming, boating, and fishing, as well as for passive recreation; a narrow footpath surrounds the pond. Two small docks with non-motorized boats were noted. In one area, vegetation has been cleared to the pond edge to allow for recreational access.

**General Comments**

The dense population of population of water willow may provide habitat for the Water-willow Stem-borer (*Papaipema sulphurata*), a Massachusetts Threatened Species. Swamp loosestrife is the only plant used by P. *sulphurata* in its larval stages. The *P. sulphurata,* is a globally restricted species of Lepidoptera and is only found in southeastern Massachusetts.

Close-up of dock on Minister's pond


Purple loosestrife
(Lythrum salicaria)- Invasive

Common Reed
(Phragmites australis)- Invasive

N

60 0 60 120 180 Meters

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Stillwater Pond
Chatham, Massachusetts
Approximate Distribution of
State-Listed and Invasive
Plant Species

9/26/02 JLC
File: x://Pleassant Bay/gis/acec.apr

Figure 12.

# Stillwater Pond

| | |
|---|---|
| **Location** | Located east of Training Field Road, off Stillwater Road, Chatham, Massachusetts |
| **Approximate Size** | 16-18 acres (Massachusetts Great Pond) |
| **Geologic origin** | Outwash plain, kettle pond |

**Vegetation Community**

Stillwater Pond is one of the larger ponds in the Pleasant Bay ACEC. Formed as a kettle pond during the last ice age, Stillwater Pond reaches a depth of 14.68 meters (approximately 48 feet). The topography surrounding the pond is gently to moderately sloping, with the exception of the southwest side, which rises more steeply.

Stillwater Pond's shoreline is dominated by aquatic and emergent vegetation. Water willow (*Decodon verticillatus)* surrounds the ponds shoreline and is only fragmented in areas where natural vegetation has been cleared to the water's edge and in places where docks have been constructed. Large populations of (*Pontederia cordata*), white water lily (*Nymphaea odorata*), and spatterdock (*Nuphar variegata*) exist along the pond periphery. Other emergent and aquatic vegetation observed include common water milfoil (*Myriophyllum sibiricum*), wide-leaf cattail (*Typha latifolia*), soft rush (*Juncus effusus*), and Olney three-square (*Scirpus americanus*).

**Pink variety of water lily**
(*Nymphaea odorata*)

Several non-native, **invasive** species were noted within and adjacent to Stillwater Pond. Stands of common reed (*Phragmites australis)* were observed among dense populations of wide-leaf cattail (*Typha latifolia*) in the northeastern, northwestern, and southwestern sections of the pond. Purple loosestrife (*Lythrum salicaria)* was observed among areas of water willow (*Decodon verticillatus*) along the northern and eastern shorelines. Additionally, a pink variety (probable escaped cultivar) of *N. odorata* was noted in the pond .

Observed species within the shrub community included bayberry (*Myrica pensylvanica*), alder (*Alnus* spp.), pussy willow (*Salix discolor*), sheep laurel (*Kalmia angustifolia*), sweet pepperbush (*Clethra alnifolia*), red chokeberry (*Aronia arbutifolia*), arrowwood (*Viburnum dentatum*), with rod (*Viburnum nudum* var. *cassinoides*), elderberry (*Sambucus canadensis*), and the non-native, **invasive** species, Tatarian honeysuckle (*Lonicera tatarica*) and Morrow's honeysuckle (*Lonicera morrowii*). A complete list of species observed during the 2002 growing season is provided in Appendix B.

Stillwater Pond is hydrologically connect with Lover's Lake through a culvert beneath Old Comers Road, and is connected to Rydlers Cove by a small inlet on the northern shoreline.

**Pond Use**

Stillwater Pond is used for passive recreational activity and boating. Five private docks with non-motorized boats were observed around the pond. The water willow and pickerel weed were fragmented only in areas were the docks were constructed.

**Potential Significant Wildlife Habitat**

As is the case in the other ponds within the Pleasant Bay ACEC the presence swamp loosestrife suggests the potential habitat for the Water-willow Stem-borer (*Papaipema sulphurata*), a Massachusetts Threatened Species (see Appendix C).

**General Comments**

As stated above, purple loosestrife and common reed and other nitrophyles are evident where the shoreline has been disturbed and fragmented by the construction of docks and the clearing of vegetation for lawns to the waters edge. Lawn and landscaping adjacent to the pods edge may potentially be contributing excess nutrients within Stillwater Pond.

Invasive species should be monitored and managed as necessary to protect the native plant community.

# Appendix

## Plant Inventory: Crystal Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| SPHAGNACEAE | *Sphagnum* spp. | sphagnum moss | |
| ISOETACEAE | *Isoetes* sp. | quillwort | |
| ASPLENACEAE | *Thelypteris palustris* | marsh fern | |
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| PINACEAE | *Pinus rigida*<br>*Juniperus virginiana* | pitch pine<br>eastern red cedar | |
| CUPRESSACEAE | *Chamaecyparis thyoides* | Atlantic white cedar | |
| NYMPHAEACEAE | *Nuphar variegata* | spatterdock | |
| MYRICACEAE | *Myrica pensylvanica* | bayberry | |
| POLYGONACEAE | *Polygonum* spp. | smartweed | |
| CLUSIACEAE | *Hypericum canadense*<br>*Triadenum virginicum* | Canada marsh St. Johns wort<br>marsh St. Johns wort | |
| DROSERACEAE | *Drosera intermedia* | spatulate-leaf sundew | |

## Plant Inventory: Crystal Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| VIOLACEAE | *Viola lanceolata* | lance-leaf violet | |
| SALICACEAE | *Salix* spp. | willow | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICAEAE | *Rhododendron viscosum* | swamp azalea | |
| | *Leucothoe racemosa* | fetterbush | |
| | *Chamaedaphne calyculata* | leatherleaf | |
| | *Vaccinium corymbosum* | highbush blueberry | |
| | *Vaccinium macrocarpon* | American cranberry | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |
| ROSACEAE | *Rosa multiflora* | multiflora rose | Non-native; **Invasive** |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| | *Lythrum salicaria* | purple loosestrife | Non-native; **Invasive** |
| MELASTOMATACEAE | *Rhexia virginica* | Virginia meadow beauty | |
| CORNACEAE | *Nyssa sylvatica* | tupelo | |

## Plant Inventory: Crystal Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| AQUIFOLIACEAE | *Ilex verticillata* | winterberry | |
| VITACEAE | *Vitis labrusca* | fox grape | |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| APIACEAE | *Hydrocotyle umbellata* | umbellate water pennywort | |
| GENTIANACEAE | *Sabatia kennedyana* | Plymouth gentian | **Species of Special Concern** |
| SOLANACEAE | *Solanum dulcamara* | climbing nightshade | |
| LAMIACEAE | *Lycopus virginicus*<br>*Lycopus amplectens* | water horehound<br>sessile-leaf bugleweed | |
| SCHROPHULARIACEAE | *Gratiola aurea*<br>*Lindernia dubia* | golden hedge hyssop<br>false pimpernel | |
| LENTIBULARIACEAE | *Utricularia cornuta* | horned bladderwort | |

## Plant Inventory: Crystal Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CAPRIFOLIACEAE | *Viburnum dentatum* | arrowwood | |
| ASTERACEAE | *Coreopsis rosea* | pink tickseed | |
| ASTERACEAE (cont.) | *Solidago rugosa* | rough-stem goldenrod | |
| | *Euthamia tenuifolia* | slender-leaf goldenrod | |
| | *Aster novi-belgii* | New York aster | |
| | *Eupatorium perfoliatum* | boneset | |
| ALISMATACEAE | *Sagittaria engelmanniana* | Engelmann's arrowhead | |
| | *Sagittaria latifolia* | broad-leaf arrowhead | |
| | *Sagittaria teres* | slender arrowhead | **Species of Special Concern** |
| ERIOCAULACEAE | *Eriocaulon aquaticum* | pipewort | |
| JUNCACEAE | *Juncus effusus* | soft rush | |
| | *Juncus canadensis* | Canada rush | |
| | *Juncus pelocarpus* | brown-fruited rush | |
| | *Juncus militaris* | bayonet rush | |
| CYPERACEAE | *Scirpus americanus* | Olney three-square | |
| | *Scirpus cyperinus* | woolgrass | |
| | *Eleocharis acicularis* | spike-rush | |
| | *Fibristylis autumnalis* | tufted annual sedge | |

## Plant Inventory: Crystal Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CYPERACEAE (cont.) | *Cyperus diandrus* | umbrella flatsedge | |
| | *Cyperus bipartitus* | annual sedge | |
| | *Carex scoparia* | tufted sedge | |
| | *Carex lurida* | lurid sedge | |
| | *Hemicarpha micrantha* | annual sedge | **Watch List Species** |
| POACEAE | *Calamagrostis canadensis* | blue-joint | |
| | *Panicum virgatum* | panic grass | |
| SPARGANIACEAE | *Sparganium androcladum* | branching bur reed | |
| IRIDACEAE | *Sisyrinchium atlanticum* | eastern blue-eyed grass | |

## Plant Inventory: Gould Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| SPHAGNACEAE | *Sphagnum* spp. | sphagnum moss | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYMPHAEACEAE | *Nuphar variegata*<br>*Nymphaea odorata* | spatterdock<br>white water lily | |
| MYRICACEAE | *Myrica pensylvanica* | bayberry | |
| CLUSIACEAE | *Triadenum virginicum*<br>*Hypericum canadense* | marsh St. Johns wort<br>Canada St. Johns wort | |
| DROSERACEAE | *Drosera intermedia* | spatulate-leaf sundew | |
| VIOLACEAE | *Viola lanceolata* | lance-leaf violet | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| AQUIFOLIACEAE | *Ilex verticillata* | winterberry | |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |

## Plant Inventory: Gould Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| GENTIANACEAE | *Sabatia kennedyana* | Plymouth gentian | **Species of Special Concern** |
| MELASTOMATACEAE | *Rhexia virginica* | Virginia meadow beauty | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICAEAE | *Rhododendron viscosum* | swamp azalea | |
| | *Chamaedaphne calyculata* | leatherleaf | |
| | *Vaccinium corymbosum* | highbush blueberry | |
| | *Vaccinium macrocarpon* | American cranberry | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |
| MENYANTHACEAE | *Nymphoides cordata* | floating heart | |
| LAMIACEAE | *Lycopus virginicus* | water horehound | |
| SCROPHULARIACEAE | *Gratiola aurea* | golden hedge hyssop | |
| | *Agalinus purpurea* | smooth agalinus | |
| LENTIBULARIACEAE | *Utricularia vulgaris* | common bladderwort | |

## Plant Inventory: Gould Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| RUBIACEAE | *Cephalanthus occidentalis* | buttonbush | |
| | *Galium trifidum* | bedstraw | |
| ASTERACEAE | *Coreopsis rosea* | pink tickseed | |
| | *Euthamia tenuifolia* | slender-leaf goldenrod | |
| | *Eupatorium perfoliatum* | boneset | |
| ERIOCAULACEAE | *Eriocaulon aquaticum* | pipewort | |
| XYRIDACEAE | *Xyris difformis* | common yellow-eyed grass | |
| JUNCACEAE | *Juncus effusus* | soft rush | |
| | *Juncus canadensis* | Canada rush | |
| | *Juncus militaris* | bayonet rush | |
| CYPERACEAE | *Scirpus americanus* | Olney three-square | |
| | *Scirpus cyperinus* | woolgrass | |
| | *Eleocharis melanocarpa* | black-fruit spike rush | **Watch List Species** |
| | *Eleocharis acicularis* | spike-rush | |
| | *Rhynchospora capitellata* | beakrush | |
| | *Cyperus diandrus* | umbrella flatsedge | |
| | *Dulichium arundinaceum* | three-way sedge | |
| | *Hemicarpha micrantha* | annual sedge | |

## Plant Inventory: Gould Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CYPERACEAE (cont.) | *Carex scoparia* | tufted sedge | |
| POACEAE | *Glyceria canadensis* | manna grass | |
| | *Calamagrostis canadensis* | blue-joint | |
| | *Panicum virgatum* | panic grass | |
| IRIDACEAE | *Iris versicolor* | blue flag iris | |

## Plant Inventory: Little Quanset Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ASPLENACEAE | *Thelypteris palustris* | marsh fern | |
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYPHAEACEAE | *Nuphar variegata* | spatterdock | |
| FAGACEAE | *Quercus coccinea* | scarlet oak | |
| LENTIBULARIACEAE | *Utricularia* spp. | bladderworts | |
| POLYGONACEAE | *Rumex crispus* | curly dock | Non-native |
| ERICACEAE | *Rhododendron viscosum* | swamp azalea | |
| ROSACEAE | *Rosa virginiana*<br>*Rosa multiflora*<br>*Prunus serotina* | Virginia rose<br>multiflora rose<br>black cherry | <br>Non-native, **Invasive**<br> |
| FABACEAE | *Robinia pseudoacaia* | black locust | Non-native, **Invasive** |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |

## Plant Inventory: Little Quanset Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CELASTRACEAE | *Celastrus orbiculata* | Oriental bittersweet | **Non-native, Invasive** |
| VITACEAE | *Parthenocissus quinquefolia*<br>*Vitis labrusca* | Virginia creeper<br>fox grape | |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| BALSAMINACEAE | *Impatiens capensis* | jewelweed | |
| SOLANACEAE | *Solanum dulcamara* | climbing nightshade | Non-native |
| MENYANTHACEAE | *Nymphoides cordata* | floating heart | |
| CAPRIFOLIACEAE | *Lonicera morrowii*<br>*Lonicera japonica*<br>*Viburnum dentatum* | Morrow's honeysuckle<br>Japanese honeysuckle<br>arrowwood | Non-native, **Invasive**<br>Non-native, **Invasive** |
| ASTERACEAE | *Bidens frondosa* | beggar's ticks | |
| POTAMOGETONACEAE | *Potamogeton* sp. | smartweed | |

## Plant Inventory: Little Quanset Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| LEMNACEAE | *Lemna minor* | duckweed | |
| CYPERACEAE | *Carex scoparia* | tufted sedge | |
| POACEAE | *Phragmites australis*<br>*Panicum clandestinum* | common reed<br>deer-tongue grass | Non-native, **Invasive** |
| TYPHACEAE | *Typha angustifolia* | narrow-leaf cattail | |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |

## Plant Inventory: Pilgrim Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| SPHAGNACEAE | *Sphagnum* spp. | Sphagnum moss | |
| NYMPHAEACEAE | *Nuphar variegata*<br>*Nymphaea odorata* | spatterdock<br>white water lily | |
| CABOMBACEAE | *Brasenia schreberi* | water shield | |
| MYRICACEAE | *Myrica pensylvanica* | bayberry | |
| PHYTOLACCACEAE | *Phytolacca americana* | pokeweed | |
| DROSERACEAE | *Drosera intermedia* | spatulate-leaf sundew | |
| SALICACEAE | *Salix discolor*<br>*Salix* spp. | pussy willow<br>willow | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICACEAE | *Vaccinium corymbosum* | highbush blueberry | |
| PRIMULACEAE | *Lysimachia terrestris*<br>*Trientalis borealis* | swamp candles<br>starflower | |

## Plant Inventory: Pilgrim Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ROSACEAE | *Rosa multiflora* | multiflora rose | Non-native; **Invasive** |
| | *Rosa palustris* | swamp rose | |
| ROSACEAE | *Rosa virginiana* | Virginia rose | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| CORNACEAE | *Nyssa sylvatica* | tupelo | |
| AQUIFOLIACEAE | *Ilex verticillata* | winterberry | |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| BALSAMINACEAE | *Impatiens capensis* | jewelweed | |
| APIACEAE | *Hydrocotyle umbellata* | water pennywort | |
| | *Sium suave* | water parsnip | |
| SOLANACEAE | *Solanum dulcamara* | climbing nightshade | Non-native |
| MENYANTHACEAE | *Nymphoides cordata* | floating hearts | |

## Plant Inventory: Pilgrim Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| LAMIACEAE | *Lycopus virginicus* | water horehound | |
| SCHROPHULARIACEAE | *Gratiola aurea* | golden hedge hyssop | |
| | *Lindernia dubia* | false pimpernel | |
| RUBIACEAE | *Cephalanthus occidentalis* | buttonbush | |
| | *Galium palustre* | marsh bedstraw | |
| CAPRIFOLIACEAE | *Viburnum dentatum* | arrowwood | |
| | *Sambucus canadensis* | elderberry | |
| ASTERACEAE | *Solidago rugosa* | rough-stem goldenrod | |
| | *Achillea millefolium* | common yarrow | Non-native |
| | *Eupatorium perfoliatum* | boneset | |
| NYPHAEACEAE | *Nymphaea odorata* | white water lily | |
| HYDROCHARITACEAE | *Elodea canadensis* | Canadian waterweed | |
| LEMNACEAE | *Lemna minor* | duckweed | |
| ERIOCAULACEAE | *Eriocaulon aquaticum* | pipewort | |

## Plant Inventory: Pilgrim Lake, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| JUNCAEAE | *Juncus effusus* | soft rush | |
| | *Juncus canadensis* | Canada rush | |
| JUNCACEAE (cont.) | *Juncus militaris* | bayonet rush | |
| CYPERACEAE | *Scirpus americanus* | Olney three-square | |
| | *Eleocharis acicularis* | spike-rush | |
| | *Carex scoparia* | tufted sedge | |
| | *Carex swanii* | Swan's sedge | |
| POACEAE | *Anthoxanthum odoratum* | sweet vernal-grass | Non-native |
| | *Bromus tectorum* | Junegrass | Non-native |
| | *Panicum virgatum* | panic grass | |
| TYPHACEAE | *Typha latifolia* | wide leaf cattail | |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| LILIACEAE | *Maianthemum canadense* | Canada mayflower | |
| SMILACACEAE | *Smilax rotundifolia* | common greenbrier | |
| ORCHIDACEAE | *Spiranthes cernua* | nodding ladies' tresses | |

## Plant Inventory: Sarah's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| OSMUNDACEAE | *Osmunda regalis* | royal fern | |
| | *Osmunda cinnamomea* | cinnamon fern | |
| ASPLENACEAE | *Thelypteris palustris* | marsh fern | |
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| CUPRESSACEAE | *Chamaecyparis thyoides* | Atlantic white cedar | |
| | *Juniperus virginiana* | eastern red cedar | |
| NYPHAEACEAE | *Nuphar variegata* | yellow water lily | |
| | *Nymphaea odorata* | white water lily | |
| FAGACEAE | *Quercus coccinea* | scarlet oak | |
| BETULACEAE | *Betula populifolia* | gray birch | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICACEAE | *Rhododendron viscosum* | swamp azalea | |
| | *Lyonia ligustrina* | maleberry | |

## Plant Inventory: Sarah's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ERICAEAE (cont.) | *Vaccinium corymbosum* | highbush blueberry | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |
| ROSACEAE | *Rosa virginiana*<br>*Prunus serotina* | Virginia rose<br>black cherry | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| AQUIFOLIACEAE | *Ilex verticillata* | winterberry | |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| MENYANTHACEAE | *Nymphoides cordata* | floating heart | |
| RUBIACEAE | *Galium* sp. | bedstraw | |
| CAPRIFOLIACEAE | *Viburnum dentatum* | arrowwood | |
| POTAMOGETONACEAE | *Potamogeton pusillus* | slender pondweed | |

## Plant Inventory: Sarah's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CYPERACEAE | *Scirpus americanus* | Olney three-square | |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| IRIDACEAE | *Iris versicolor* | blue flag iris | |

## Plant Inventory: Uncle Seth's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ASPLENACEAE | *Thelypteris palustris* | marsh fern | |
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYPHAEACEAE | *Nuphar variegata*<br>*Nymphaea odorata* | yellow water lily<br>white water lily | |
| CABOMBACEAE | *Brasenia schreberi* | water shield | |
| FAGACEAE | *Quercus coccinea* | scarlet oak | |
| POLYGONACEAE | *Polygonum* spp. | smartweed | |
| CLUSIACEAE | *Hypericum mutilum*<br>*Hypericum boreale*<br>*Hypericum canadense* | dwarf St. John's wort<br>northern St. John's wort<br>Canadian St. John's wort | |
| SALICACEAE | *Salix* spp. | willow | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |

## Plant Inventory: Uncle Seth's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ERICACEAE | *Rhododendron viscosum* | swamp azalea | |
| | *Lyonia ligustrina* | maleberry | |
| | *Vaccinium corymbosum* | highbush blueberry | |
| | *Chamaedaphne calyculata* | leatherleaf | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |
| ROSACEAE | *Spiraea tomentosa* | steeplebush | |
| | *Rosa palustris* | swamp rose | |
| | *Rosa virginiana* | Virginia rose | |
| | *Aronia arbutifolia* | red chokeberry | |
| FABACEAE | *Robinia pseudoacaia* | black locust | Non-native |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| CORNACEAE | *Nyssa sylvatica* | tupelo | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| APIACEAE | *Hydrocotyle umbellata* | umbellate water pennywort | |
| LAMIACEAE | *Lycopus virginicus* | water horehound | |

## Plant Inventory: Uncle Seth's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| SCHROPHULARIACEAE | *Gratiola aurea* | golden hedge hyssop | |
| CAPRIFOLIACEAE | *Viburnum dentatum* | arrowwood | |
| RUBIACEAE | *Gallium trifidum* | marsh bedstraw | |
| ASTERACEAE | *Bidens frondosa* | beggar's ticks | |
| | *Euthamia tenuifolia* | slender-leaf goldenrod | |
| | *Eupatorium perfoliatum* | boneset | |
| | *Lactuca scariola* | prickly lettuce | Non-native |
| XYRIDACEAE | *Xyris difformis* | common yellow-eyed grass | |
| ERIOCAULACEAE | *Eriocaulon aquaticum* | pipewort | |
| JUNCACEAE | *Juncus effusus* | soft rush | |
| | *Juncus canadensis* | Canada rush | |
| | *Juncus militaris* | bayonet rush | |
| CYPERACEAE | *Scirpus cyperinus* | woolgrass | |
| | *Eleocharis melanocarpa* | black-fruit spike rush | **Watch List Species** |
| | *Eleocharis ovata* | spike-rush | |
| | *Carex scoparia* | tufted sedge | |

## Plant Inventory: Uncle Seth's Pond, Orleans, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CYPERACEAE (cont.) | *Carex crinita* | fringed sedge | |
| | *Carex lurida* | lurid sedge | |
| POACEAE | *Calamagrostis canadensis* | blue joint | |
| | *Phalaris arundinacea* | reed canary-grass | |
| | *Andropogon virginicus* | broomsedge | |
| TYPHACEAE | *Typha latifolia* | wide leaf cattail | |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| SMILACACEAE | *Smilax rotundifolia* | common greenbrier | |
| SPARGANIACEAE | *Sparganium androcladum* | branching bur reed | |

## Plant Inventory: Fox Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ASPLENACEAE | *Thelypteris palustris* | marsh fern | |
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| CUPRESSACEAE | *Juniperus virginiana* | eastern red cedar | |
| NYPHAEACEAE | *Nymphaea odorata* | white water lily | |
| URTICACEAE | *Boehmeria cylindrica* | false nettle | |
| MYRICACEAE | *Myrica pensylvanica* | bayberry | |
| CHENOPODIACEAE | *Salsola kali* | common saltwort | |
| CLUSIACEAE | *Triadenum virginicum* | marsh St. Johns wort | |
| SALICACEAE | *Salix bebbiana* | Bebb's willow | |
| ERICACEAE | *Vaccinium corymbosum* | highbush blueberry | |
| ROSACEAE | *Rubus* spp.<br>*Rosa virginiana*<br>*Prunus serotina* | raspberry<br>Virginia rose<br>black cherry | |

## Plant Inventory: Fox Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| LYTHRACEAE | *Lythrum salicaria* | purple loosestrife | Non-native; **Invasive** |
| CELASTRACEAE | *Celastrus orbiculata* | Oriental bittersweet | Non-native; **Invasive** |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| BALSAMINACEAE | *Impatiens capensis* | jewelweed | |
| LAMIACEAE | *Lycopus virginicus* | water horehound | |
| RUBIACEAE | *Gallium trifidum* | marsh bedstraw | |
| CAPRIFOLIACEAE | *Viburnum dentatum*<br>*Sambucus canadensis* | arrowwood<br>elderberry | |
| ASTERACEAE | *Bidens frondosa*<br>*Solidago sempervirens*<br>*Erechtites hieracifolia* | beggar's ticks<br>seaside goldenrod<br>fireweed | |
| LEMNACEAE | *Lemna minor* | duckweed | |
| JUNCACEAE | *Juncus gerardii* | black rush | |

## Plant Inventory: Fox Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| JUNCACEAE (cont.) | *Juncus effusus* | soft rush | |
| CYPERACEAE | *Scirpus cyperinus* | woolgrass | |
| | *Carex scoparia* | tufted sedge | |
| POACEAE | *Holcus lanata* | velvet grass | Non-native |
| | *Ammophila breviligulata* | American beachgrass | |
| TYPHACEAE | *Typha angustifolia* | narrow-leaf cattail | |

## Plant Inventory: Lover's Lake, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYPHAEACEAE | *Nuphar variegata* | yellow water lily | |
| MYRICACEAE | *Myrica pensylvanica* | bayberry | |
| FAGACEAE | *Quercus alba* | white oak | |
| | *Quercus velutina* | black oak | |
| | *Quercus coccinea* | scarlet oak | |
| BETULACEAE | *Alnus serrulata* | smooth alder | |
| CLUSIACEAE | *Triadenum virginicum* | marsh St. Johns wort | |
| SALICACEAE | *Populus deltoides* | eastern cottonwood | |
| | *Salix bebbiana* | Bebb's willow | |
| | *Salix nigra* | black willow | |
| | *Salix* spp. | willow | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |

## Plant Inventory: Lover's Lake, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ERICACEAE | *Rhododendron viscosum* | swamp azalea | |
| | *Vaccinium corymbosum* | highbush blueberry | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |
| ROSACEAE | *Rosa palustris* | swamp rose | |
| | *Prunus serotina* | black cherry | |
| | *Amelanchier canadensis* | shadbush | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| AQUIFOLIACEAE | *Ilex verticillata* | winterberry | |
| VITACEAE | *Vitis labrusca* | fox grape | |
| POLYGONACEAE | *Rumex crispus* | curly dock | Non-native |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| BALSAMINACEAE | *Impatiens capensis* | jewelweed | |

## Plant Inventory: Lover's Lake, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| APIACEAE | *Sium suave* | water parsnip | |
| ASCLEPIADACEAE | *Asclepias incarnata* | swamp milkweed | |
| LAMIACEAE | *Mentha arvensis* | field mint | |
| | *Mentha piperita* | peppermint | Non-native |
| | *Lycopus virginicus* | water horehound | |
| SCHROPHULARIACEAE | *Gratiola aurea* | golden hedge hyssop | |
| CAMPANULACEAE | *Lobelia cardinalis* | Cardinal flower | |
| CAPRIFOLIACEAE | *Viburnum dentatum* | arrowwood | |
| | *Viburnum nudum* var. *cassinoides* | witherod | |
| | *Sambucus canadensis* | elderberry | |
| HYDROCHARITACEAE | *Elodea canadensis* | Canadian waterweed | |
| POTAMOGETONACEAE | *Potamogeton epihydrus* | ribbon-leaf pondweed | |
| TYPHACEAE | *Typha latifolia* | wide leaf cattail | |
| | *Typha angustifolia* | narrow-leaf cattail | |

## Plant Inventory: Lover's Lake, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| JUNCACEAE | *Juncus effusus* | soft rush | |
| | *Juncus canadensis* | Canada rush | |
| | *Juncus militaris* | bayonet rush | |
| CYPERACEAE | *Scirpus americanus* | Olney three square | |
| | *Eleocharis obtusa* | spike-rush | |
| | *Carex scoparia* | tufted sedge | |
| | *Carex lurida* | lurid sedge | |
| POACEAE | *Holcus lanata* | velvet grass | |
| | *Deschampsia flexuosa* | common hairgrass | |

## Plant Inventory: Mill Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| SPHAGNACEAE | *Sphagnum* spp. | sphagnum moss | |
| OSMUNDACEAE | *Osmunda cinnamomea* | cinnamon fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYMPHAEACEAE | *Nuphar variegata*<br>*Nymphaea odorata* | yellow water lily<br>white water lily | |
| CABOMBACEAE | *Brasenia schreberi* | water shield | |
| MYRICACEAE | *Myrica pensylvanica* | northern bayberry | |
| FAGACEAE | *Quercus coccinea* | scarlet oak | |
| CLUSIACEAE | *Triadenum virginicum* | marsh St. John's wort | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICACEAE | *Rhododendron viscosum*<br>*Chamaedaphne calyculata* | swamp azalea<br>leatherleaf | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |

## Plant Inventory: Mill Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ROSACEAE | *Spiraea tomentosa* | steeplebush | |
| | *Rosa virginiana* | Virginia rose | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| | *Lythrum salicaria* | purple loosestrife | Non-native, Invasive |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| GENTIANACEAE | *Sabatia kennedyana* | Plymouth gentian | **Species of Special Concern** |
| APIACEAE | *Hydrocotyle umbellata* | umbellate water pennywort | |
| ASTERACEAE | *Euthamia tenuifolia* | slender-leaf goldenrod | |
| SCROPHULARIACEA | *Gratiola aurea* | golden pert | |
| LENTIBULARIACEAE | *Utricularia* spp. | bladderworts | |
| ERIOCAULACEAE | *Eriocaulon aquaticum* | pipewort | |
| JUNCACEAE | *Juncus effusus* | soft rush | |

## Plant Inventory: Mill Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CYPERACEAE | *Scirpus americanus* | Olney three square | |
| | *Scirpus cyperinus* | woolgrass | |
| | *Cyperus diandrus* | umbrella flatsedge | |
| | *Carex* spp. | various sedges | |
| POACEAE | *Phragmites australis* | common reed | Non-native, Invasive |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| SMILACACEAE | *Smilax rotundifolia* | common greenbrier | |

## Plant Inventory: Minister's Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ASPLENACEAE | *Thelypteris palustris* | marsh fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYPHAEACEAE | *Nuphar variegata*<br>*Nymphaea odorata* | spatterdock<br>white water lily | |
| FAGACEAE | *Quercus coccinea* | scarlet oak | |
| BETULACEAE | *Betula populifolia* | gray birch | |
| CLUSIACEAE | *Triadenum virginicum* | marsh St. Johns wort | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICACEAE | *Rhododendron viscosum*<br>*Vaccinium macrocarpon* | swamp azalea<br>American cranberry | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| ACERACEAE | *Acer rubrum* | red maple | |
| JUNCACEAE | *Juncus effusus* | soft rush | |

## Plant Inventory: Minister's Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| JUNCACEAE (cont.) | *Juncus militaris* | bayonet rush | |
| CYPERACEAE | *Scirpus americanus* | Olney three square | |
| POACEAE | *Panicum virgatum* | panic grass | |
| TYPHACEAE | *Typha latifolia* | wide leaf cattail | |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| PRIMULACEAE | *Lysimachia terrestris* | swamp candles | |

## Plant Inventory: Stillwater Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| OSMUNDACEAE | *Osmunda cinnamomea* | cinnamon fern | |
| ONOCLEACEAE | *Onoclea sensibilis* | sensitive fern | |
| PINACEAE | *Pinus rigida* | pitch pine | |
| NYPHAEACEAE | *Nuphar variegata* | yellow water lily | |
| | *Nymphaea odorata* | white water lily | (possible escaped pink variety) |
| MYRICACEAE | *Myrica pensylvanica* | bayberry | |
| FAGACEAE | *Quercus alba* | white oak | |
| | *Quercus coccinea* | scarlet oak | |
| BETULACEAE | *Populous deltoides* | eastern cottonwood | |
| | *Alnus* spp. | alder | |
| SALICACEAE | *Salix discolor* | pussy willow | |
| CLETHRACEAE | *Clethra alnifolia* | sweet pepperbush | |
| ERICACEAE | *Kalmia angustifolia* | sheep laurel | |

## Plant Inventory: Stillwater Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| ROSACEAE | *Rosa virginiana* | Virginia rose | |
| | *Prunus serotina* | black cherry | |
| | *Aronia arbutifolia* | red chokeberry | |
| | *Rosa multiflora* | multiflora rose | Non-native, **Invasive** |
| FABACEAE | *Trifolium repens* | white clover | |
| HALORAGINACEAE | *Myriophyllum sibiricum* | common water milfoil | |
| LYTHRACEAE | *Decodon verticillatus* | swamp loosestrife | |
| | *Lythrum salicaria* | purple loosestrife | Non-native, **Invasive** |
| ACERACEAE | *Acer rubrum* | red maple | |
| ANACARDIACEAE | *Toxicodendron radicans* | poison ivy | |
| LAMIACEAE | *Lycopus virginicus* | water horehound | |
| PLANTAGINACEAE | *Plantago minor* | common plantain | |
| CAPRIFOLIACEAE | *Lonicera tatarica* | Tatarian honeysuckle | Non-native, **Invasive** |
| | *Lonicera morrowii* | Morrow's honeysuckle | Non-native, **Invasive** |
| | *Viburnum dentatum* | arrowwood | |

## Plant Inventory: Stillwater Pond, Chatham, Massachusetts

| Family | Scientific Name | Common Name | Notes |
|---|---|---|---|
| CAPRIFOLIACEAE (cont.) | *Viburnum nudum* var. *cassinoides* | withe-rod | |
| | *Sambucus canadensis* | elderberry | |
| JUNCACEAE | *Juncus effusus* | soft rush | |
| CYPERACEAE | *Scirpus americanus* | Olney three square | |
| | *Carex lurida* | lurid sedge | |
| POACEAE | *Phragmites australis* | common reed | Non-native, **Invasive** |
| TYPHACEAE | *Typha latifolia* | wide-leaf cattail | |
| PONTEDERIACEAE | *Pontederia cordata* | pickerel weed | |
| SMILACACEAE | *Smilax glauca* | cat greenbrier | |
| | *Smilax rotundifolia* | common greenbrier | |

# C Appendix

Commonwealth of Massachusetts

# Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

26 June 1996

Carol Ridley
115 Kendrick Rd.
East Harwich, MA 02645

Re: Pleasant Bay ACEC Rare Species List

Dear Ms. Ridley,

Thank you for contacting the Natural Heritage and Endangered Species Program for information regarding state-listed rare species in the vicinity of the above referenced site. I have reviewed the site and would like to offer the following comments.

Our database indicates that the following state-listed rare species are found within or in close proximity to the Pleasant Bay ACEC:

| Animals | Status |
|---|---|
| Short-eared Owl (*Asio flammeus*) | Endangered |
| Piping Plover (*Charadrius melodus*) | Threatened (State & Federal) |
| Diamondback Terrapin (*Malaclemys terrapin*) | Threatened |
| Water-willow Stem Borer (*Papaipema sulphurata*) | Threatened |
| Eastern Box Turtle (*Terrapene carolina*) | Special Concern |

| Plants | Status |
|---|---|
| Plymouth Gentian (*Sabatia kennedyana*) | Special Concern |
| Bushy Rockrose (*Helianthemum dumosum*) | Special Concern |
| Strignose Knotweed (*Polygonum setaceum*) | Special Concern |
| New England Blazing Star (*Liatrus scariosa var. novae-angliae*) | Special Concern |

These species are protected under the Massachusetts Endangered Species Act (M.G.L. c.131A) and its implementing regulations (321 CMR 10.00). I have enclosed fact sheets on these species for your information (fact sheets are not available for Strignose Knotweed and New England Blazing Star). I have also enclosed the State's guidelines for Piping Plover management. If you have questions

**Natural Heritage & Endangered Species Program**
Route 135, Westborough, MA 01581 Tel: (508) 792-7270 x 200 Fax: (508) 792-7275
An Agency of the Department of Fisheries, Wildlife & Environmental Law Enforcement

concerning management guidelines for rare species in the Pleasant Bay ACEC I suggest that you contact Henry Barbour (508 792-7270 x.166), our Habitat Protection Specialist, at the Natural Heritage Program.

This evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory.

Sincerely,

Hanni Dinkeloo
Environmental Reviewer

cc. Leslie Luchonok, ACEC Program


Area of Critical Environmental Concern

NHESP 1999-2001 Estimated Habitats of Rare Wildlife: Use with Wetlands Protection

NHESP 1999-2001 Priority Habitats of State-Listed Rare Species: NOT equivalent to 'Significant Habitat' as designated under the Massachusetts Endangered Species Act

N

600 0 600 1200 Meters

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Pleasant Bay
Area of Critical Environmental Concern
Orleans and Chatham, Massachusetts
Natural Heritage and Endangered Species Program
Estimated and Priority Habitats

9/26/02 JLC
File: x://2048Pleasant Bay/gis/acec.apr

Figure 13.

Natural Heritage & Endangered Species Program

**Commonwealth of Massachusetts**
**Division of Fisheries & Wildlife**
**Route 135**
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## MASSACHUSETTS THREATENED SPECIES

# Piping Plover
# (Charadrius melodus)

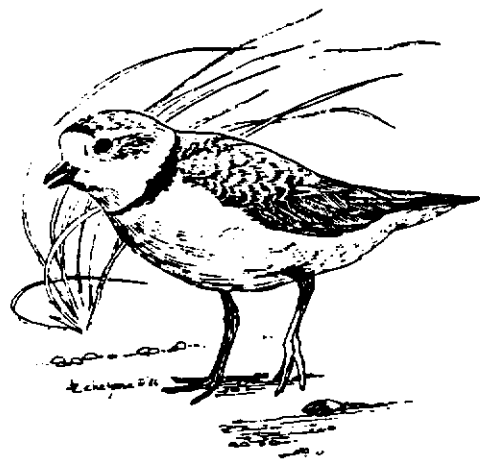


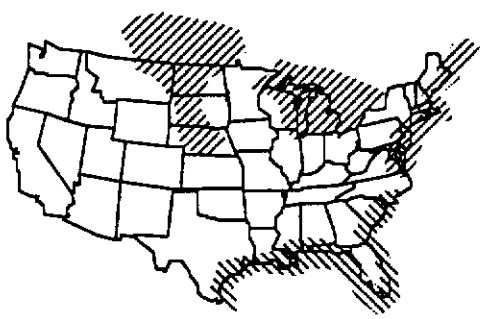
Illustration by J. Zickefoose, 1986

DESCRIPTION: The Piping Plover is a small, stocky shorebird with pale brownish gray or sandy-colored plumage on its backside, with a white breast, forehead, cheeks, and throat, a black streak on the forecrown extending from eye to eye, and a black breastband which may not always form a complete circle. Its coloration gives it excellent camouflage in sandy areas. The average Piping Plover is 15 to 17 cm (6 to 7 in.) long, with a wingspan of 35 to 40 cm (14 to 16 in.). The tail is white at the base and tip, but dark in the middle. It has yellow-orange legs and its short bill is yellow-orange with a black tip in the summer, but turns completely black during the winter. In general, females have darker bills and lighter plumage than males. The Piping Plover runs in a pattern of brief starts and stops; in flight, it displays a pair of prominent white wing stripes. Its call is a series of piping whistles.

SIMILAR SPECIES IN MASSACHUSETTS: The Piping Plover is similar to the Semipalmated Plover (Charadrius semipalmatus) in size, shape, and coloration; both also share the same general habitat. However, the Semipalmated Plover is a darker brown in color, and has much more black on its head than the Piping Plover. The Semipalmated Plover does not breed in Massachusetts but passes through in large numbers from late July to early September during its southward migration.

RANGE: During the summer, the Atlantic Coast population of Piping Plovers nests from the coast of Massachusetts north to Newfoundland, and south to Virginia and North Carolina. In winter they migrate farther south, from South Carolina to Florida, the Gulf of Mexico, and the West Indies. Other populations of Piping Plovers nest along rivers on the Northern Great Plains and along the shores of the Great Lakes, migrating to the Gulf of Mexico in the winter.

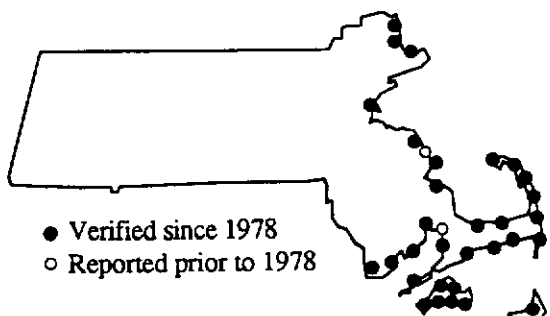
(continued overleaf)



Range of Piping Plover

Winter range

Summer (breeding) range




Massachusetts Distribution by Town

1990

HABITAT: Piping Plovers in Massachusetts require sandy coastal beaches which are relatively flat and free of vegetation. They prefer the dry, light-colored sand found along the outer coastal shores. Piping Plovers often build their nests in a narrow area of land between the high tide line and the foot of the coastal dunes; they also nest in Least Tern colonies. Water is a critical necessity for Piping Plover habitat, since the birds feed exclusively on organisms which live along the shoreline.

LIFE CYCLE / BEHAVIOR: As soon as Piping Plovers return to their breeding grounds in Massachusetts in late March or April, the males begin to set up territories and attract mates. Territorial rivalry between males is very strong; adjacent male Piping Plovers mark off their territories by running side by side down to the waterline. Each bird takes turns, one running forward a few feet, then waiting for the other to do likewise. Nests are usually at least 200 feet apart; the nesting pair will confront any intruding Piping Plover which approaches the nest. Male Piping Plovers also defend feeding territories encompassing beach front adjacent to the nesting territory.

Courtship consists of a ritualized display by the male, who flies in ovals or figure-eights around a female, then displays on the ground by bowing his head, dropping his wings, and walking in circles around the female. The male also scrapes shallow depressions in the sand at potential nest sites. The female then chooses one of these nesting sites, usually in a flat, sandy area. The nest itself is a shallow depression which is often lined with shell fragments and small pebbles, which may aid in camouflaging the eggs. Female Piping Plovers typically lay four eggs per clutch, one egg every other day over a week's time. The eggs are sandy gray in color with dark brown or black spots, and all hatch within 4 to 8 hours of each other. Both parents take part in incubating the eggs until they hatch 3 to 4 weeks later.

The young chicks leave the nest within 2 to 3 hours after hatching and may wander several hundred meters before they become capable of flight. When threatened by predators or human intruders, the young run or lie motionless on the sand while their parents often pretend to have broken wings in an effort to attract the intruder's attention away from the chicks. Young Piping Plovers are brooded by their parents for 3 to 4 weeks and finally fledge 4 to 5 weeks after hatching, at which time they leave the nesting area.

Piping Plovers feed on marine worms, molluscs, insects, and crustaceans. They forage along the waterline, on mudflats at low tide, and in wrack along the beach. Foraging behavior consists of running a short distance, then staring at the ground with the head tilted to one side, often standing on one foot while vibrating the other foot on the ground, and finally pecking at the food item it has detected in the sand.

Piping Plovers begin to migrate southward between late July and early September, although occasional stragglers remain behind until late October. Adult birds often return to the same nesting area every spring, although they frequently change mates from year to year. Young birds may nest anywhere from a few hundred feet to many miles from where they were hatched.

POPULATION STATUS IN MASSACHUSETTS: The Atlantic Coast population of Piping Plovers is listed as Threatened at both the state and federal levels. In 1990, 139 breeding pairs from 58 sites in Massachusetts were documented. Massachusetts has the second largest population of Piping Plovers along the Atlantic Coast.

Habitat loss due to development of coastal areas and waterways has caused a catastrophic decline in the Piping Plover population over the last 50 years. Predation on eggs and young has also increased due to the growing number of foxes, skunks, raccoons, and other predators that thrive in suburban areas. Due to their cryptic coloration, the nearly invisible eggs and chicks are often unintentionally crushed by off-road vehicles (ORV's) and pedestrians on the beach. Continual disturbance of nest sites from recreational use of the state's beaches may lead some breeding pairs to abandon their nests. Severe storms can wash away and destroy eggs.

In recent years, the placement of wire enclosures surrounding Piping Plover nest sites has drastically reduced predation at many nest sites. Protection of essential habitat from development and restriction of ORV use in these areas is crucial in order to maintain a healthy population of Piping Plovers in Massachusetts.

# Piping Plover

*(Charadrius melodus)*

Piping plovers have been described as everything from wind-up toys to tennis balls rolling along the sandy beaches of the coast. Sometimes they blend into the beach so thoroughly that they are almost impossible to see. Like other plovers, they run in short starts and stops.

The piping plover's name comes from its call-notes, plaintive bell-like whistles that are often heard before the birds are seen. When sitting still, their buff-colored plumage, black necks, and black forehead bands make them virtually invisible in the sand. From a distance, the scrapes in the sand that are their nests and their buff-colored eggs speckled with tiny black dots are indistinguishable from the beach. But although these adaptations protect plovers from natural predators, they do not help protect them from human activities, which have become the greatest threat to their survival.

## Life History

The piping plover breeds on coastal beaches from Newfoundland and the Gulf of Maine to North Carolina. They winter primarily on the Atlantic Coast from the Carolinas to Florida, but also as far south as the Yucatan Peninsula, the Bahamas, and the West Indies. Between March and April, piping plovers make the long flight from these wintering grounds to the beaches of the mid- and north Atlantic. They establish territories on these beaches, mate, and scratch out shallow nests in the unvegetated sand above the high tide line. Nests are no more than shallow depressions lined with shell fragments or pebbles.

Adults tend to return to beaches where they previously nested, arriving at breeding grounds on Gulf of Maine beaches in early April. Mating involves courtship displays that include mock nest scraping, pebble-tossing, tilts, and low, shallow flights. Incubation responsibilities are shared by both the male and the female. Their four eggs hatch after approximately 28 days, and the hatchlings soon follow their parents to forage for marine worms, crustaceans, and insects on the beach.

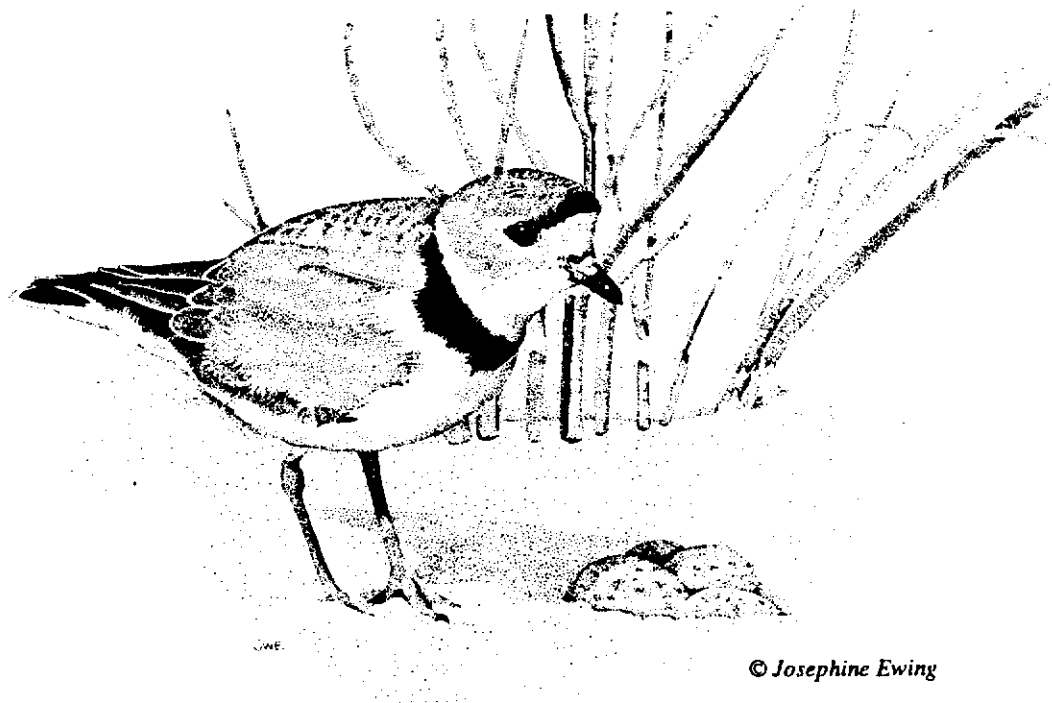
Once the hatchlings emerge, it generally takes about 30 to 35 days for them to learn to fly. If a predator or intruder approaches, the young become motionless while their parents try to divert the intruder's attention to themselves, often by pretending to hobble around with a broken wing.

## Distribution, Abundance, and Threats

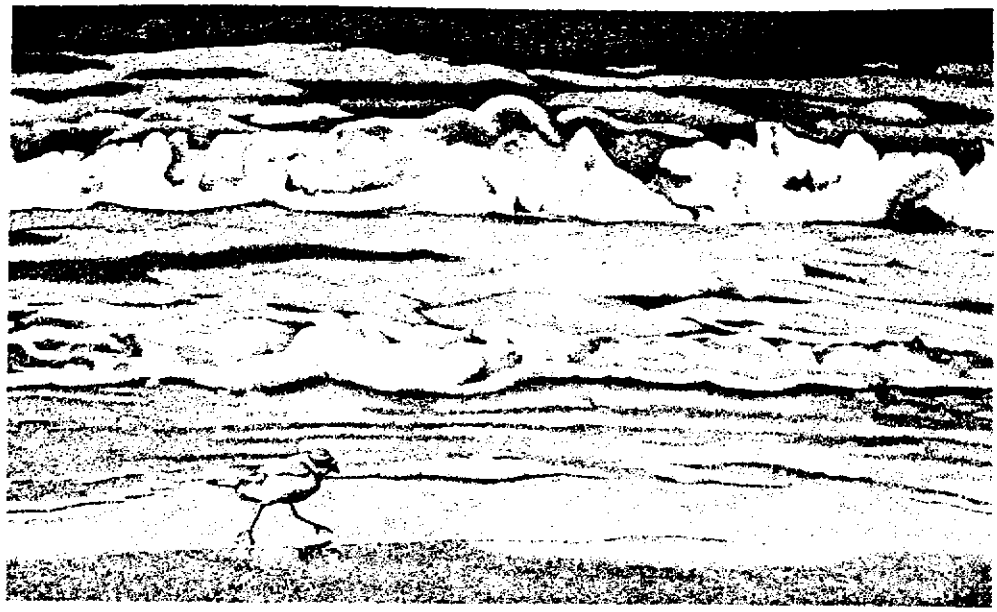
Historically, piping plovers were abundant in sandy coastal habitat throughout their range. But by the late 1800s, commercial hunting for feathers—primarily to decorate hats—nearly wiped out the species. Federal protection by the Migratory Bird Treaty Act of 1918 allowed piping plovers to recover to record numbers in the 1940s, but recent habitat loss and disturbance on beaches has caused a new and serious decline in their population. Most recent surveys count the entire Atlantic population at less than 1,000 pairs. Two other breeding populations of piping plovers exist in the United States; one on the Great Plains and the other in the Great Lakes region.

Human disturbance currently is the greatest threat to the piping plover's survival. People may intentionally or accidentally destroy nests and eggs by walking or driving over them on the beach. Hatchlings may often seek shelter in tire tracks left on beaches. This further camouflages them and makes them especially vulnerable to beach vehicles. Pets can harass adults off their nests long enough to cause overheating or chilling of eggs or even complete abandonment of chicks, exposing them to natural predators such as crows, gulls, red foxes, skunks, or rats.

Both human activities and natural changes in the piping plover's habitat have had serious impacts on the future of this species in the Gulf of Maine. Recently, beach erosion between breeding seasons



© *Josephine Ewing*



© *Josephine Ewing*

eliminated nesting sites along the Morse River in Phippsburg, Maine. In the 1960s, construction of a housing development in Scarborough, Maine, completely eradicated a prime nesting area for piping plovers and least terns. Summer storms with high winds or tides can bury or wash out nests. Vegetation can encroach and crowd out plovers, and even dune restoration programs must remain sensitive to the dune characteristics plovers need for their nests.

## *Piping Plover Facts*

- Plovers have been recorded making as many as 5 nesting attempts in a single season, laying a total of 18 eggs.
- If left unattended long enough on sunny days when beachgoers often share plover habitat, plover eggs can actually cook on the hot sand.
- Piping plovers are one of several species of shorebirds nesting in Maine. Others are killdeer, willets, spotted sandpipers, snipe, and woodcock.

## Protecting the Piping Plover

The piping plover came under the protection of the Endangered Species Act in January of 1986. It is listed as a threatened species, which means that without protection the remaining population would continue to decline. The Endangered Species Act prohibits taking, harassing, or harming piping plovers and assists in efforts to protect their habitat.

Since listing the piping plover, the U.S. Fish and Wildlife Service has formed recovery teams for the inland and Atlantic coast populations. These U.S. and Canadian research teams establish conservation priorities and procedures for restoring populations. Several projects are underway in the Gulf of Maine to protect the plover's breeding and wintering range. Nest exclosures (wire mesh fences around nest sites to exclude predators) and extensive use of informational signs to inform the public about sensitive areas are helping to protect plover habitat. Negotiations for purchase, easements, and consent agreements are underway with landowners. In some cases, predator control and habitat creation have kept nesting areas intact.

## *U.S. Fish and Wildlife Service*

Protection of migratory birds, seabirds, anadromous fish, and endangered species in the Gulf of Maine is the responsibility of the U.S. Fish and Wildlife Service. The Service established the Gulf of Maine Project in Portland, Maine, to protect and restore the watershed's ecosystems and habitats by providing a bridge between all Service programs in the Gulf of Maine and by building partnerships among state and federal agencies, local organizations, and private citizens working to improve coastal habitats. The Gulf of Maine Project participates in EPA's National Estuary Programs in Massachusetts Bays and Casco Bay, Maine, providing information on fish and wildlife habitat needs in order to promote thorough consideration of living resources in the management planning process. The Project has brought together state, federal, and non-governmental representatives from each jurisdiction in the watershed to conduct a priority habitat identification process as part of the international initiative of the Gulf of Maine Council on the Marine Environment, and has developed a GIS (Geographic Information System) that includes data-sharing and coordination with state fish and wildlife agencies. The Project has established partnerships with local conservation groups and land trusts, and is conducting wetland trends analyses in the watershed to target specific areas for local action. For more information, contact the Gulf of Maine Project in Portland, Maine, at (207) 828–1080.

*September 1993*

*Production of this publication was funded by the U.S. Environmental Protection Agency.* EPA

Massachusetts Natural Heritage Program

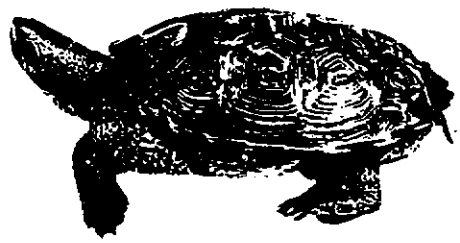
Natural Heritage & Endangered Species Program
MA Division of Fisheries & Wildlife
Route 135
Westborough, MA 01581-3337
508-792-7270 x 200

# MASSACHUSETTS RARE AND ENDANGERED WILDLIFE

The Northern Diamondback Terrapin
Malaclemys terrapin terrapin

## Description

The Northern Diamondback Terrapin is a medium sized salt marsh turtle. It has a wedge shaped carapace (top shell) variably colored in ash greys, light browns, and blacks. Concentric rings pattern the pronounced shell plates often forming ridges and bumps. The bottom of the shell, the plastron, also varies in color from yellowish-gray and orange to greenish yellow. Both sexes have grayish to black skin spotted with dark green flecks. This turtle has very large, paddlelike hind feet that are strongly webbed. The adult females are much larger than the males ranging from 6-9 inches (15-23 cm). Adult males reach a length of 4-6 inches (10-15 cm). Hatchlings range from two and a half to five centimeters in length.



Lazell, James Jr. Reptiles and Amphibians in Massachusetts. p. 25. 1972.

## Range

The Northern Diamondback Terrapin is distributed along the Atlantic coast from Cape Cod, Massachusetts south to Cape Hatteras, North Carolina. Other subspecies are found along the southern Atlantic and Gulf coasts to Texas.

## Habitat

Northern Diamondback Terrapins inhabit marshes which border quiet salt or brackish tidal waters. They can also be found in mud flats, shallow bays, coves, and tidal estuaries. Adjacent sandy dry upland areas are required for nesting. During the winter, the Northern Diamondback Terrapin hibernates on the bottoms of ponds, streams, and estuary channels.

## Feeding Habits

The Northern Diamondback Terrapin feeds on fish, crustaceans, mollusks, insects, and succulent marsh plants. It forages while floating.

Continued Overleaf

Distribution of Northern Diamondback Terrapins

● Verified since 1978
○ Reported prior to 1978

Distribution in Massachusetts by Town

## Breeding and Nesting Habits

The Northern Diamondback Terrapin is polygamous (each individual may breed with several others), and mates in the water. Females are capable of retaining viable spermatozoa for up to four years without subsequent matings. After breeding, females start the trip from the water during periods of high tides to their nesting sites which are usually located on high dunes. The journey may reach up to 1600 meters and take as long as 48 hours. The female digs a nest about 5 inches deep and then deposits a clutch of approximately 10 eggs. Laying occurs twice a year, usually in May and again in August. Incubation of the eggs lasts between 87 and 108 days depending on the temperature. When the climate is unseasonably cold, hatchlings may overwinter in their nest waiting until the following April and May to erupt from the sand. It may take from 2 to 11 days after the eggs hatch for the young turtles to emerge and start the hazardous trip from the nest to the water. Part of this time is spent rotating towards the sun in what is thought to be an orientation behavior.

Comprehensive studies of Massachusetts Northern Diamondback Terrapins have revealed nesting behavior and practices atypical of more southern terrapins. On Cape Cod, Northern Diamondback Terrapins were observed nesting during both day and night and on both vegetated and unvegetated dunes in contrast to southern turtles that were reported nesting only during the day and only on vegetated dunes. Eggs laid in unvegetated areas (although more susceptible to wind erosion), receive more heat thereby decreasing incubation time. The few hatchlings that survive the immense risks of early life mature at 5 or 6 years of age.

## Population Status

There are only 17 known current occurrences of the Northern Diamondback Terrapin in Massachusetts. Presently, this species is listed as Threatened by the Massachusetts Division of Fisheries and Wildlife. There are a number of factors contributing to the decline of Northern Diamondback Terrapins in the state. Originally, this species was nearly wiped out by gourmet consumption around the turn of the century. Today, the harvest of diamondbacks is illegal in Massachusetts but the species continues to experience a high nest mortality and decline in numbers caused by human made disruptions and environmental impacts. The Northern Diamondback Turtle's strongest population is located on Cape Cod where recreational activity disrupts nesting turtles and hatchlings. Off road vehicles create ruts deep enough so that the chances of migrating hatchlings getting crushed by vehicles is increased as well as their vulnerability to predation by gulls and crows. These predators have been observed standing on the edges and simply scooping up the turtles as they get caught in the ruts. Off road vehicles also interfere with nesting patterns to such an extent that the females will engage in false nesting. They head for the dunes with the intention of egg laying but turn around and go back to the water at any detection of threatening activity. This disrupts the egg laying processes and reduces the viability of the clutch by prolonging the length of time that the eggs are retained by the females. Beach goers and people walking on the dunes also have this effect as well as disrupting the sand substrate so deeply that nests are impaired due to the increased erosion which results.

An additional cause of mortality observed on Cape Cod is the infiltration into nests and eggs of rootlets from the rhizomes of dune grass. In 1978, the grass Ammophila breviligulata penetrated and surrounded half of the nests that were located on vegetated dunes. Parasitism by maggots of a Sarcophagidea fly also adversely impacts eggs and hatchlings as do mammalian predators like skunks. Reduction of salt marsh habitat and alteration of water composition due to dredging and channelization, loss of sandy beach habitats, and destruction of dune areas continue to contribute to the decline of the Northern Diamondback Terrapin in Massachusetts.

Natural Heritage &
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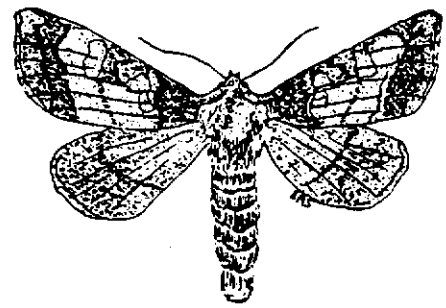
**(508) 792-7270 ext. 200**

## MASSACHUSETTS THREATENED WILDLIFE

### Water-willow Borer
### (Papaipema sulphurata)

DESCRIPTION: The Water-willow Borer is a nocturnal moth of the Noctuidae Family, with a wingspan of 3 to 4 cm (1.25 to 1.5 inches). The coloration of its forewings is predominantly chrome-yellow to ochre, shaded with purple at the base and outer edges. Reniform (kidney-shaped) spots and orbicular spots are present, but are the same color as the rest of the wing. The hindwings are much duller, brown with ochre shading and a medial band.

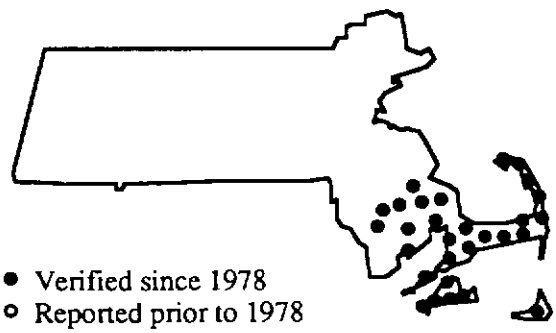


Eileen Sonnenberg, Cape Naturalist, Summer 1988

SIMILAR SPECIES: The Water-willow Borer is almost indistinguishable from the Burdock Borer Moth (Papaipema cataphracta), which is slightly less rusty in color. The larvae of P.cataphracta bore into and feed on many different species of plants, but rarely if ever utilize water-willow (Decodon verticillatus), which is the only plant used by P. sulphurata. In addition, P. cataphracta is absent from the coastal plain and therefore the ranges of the two species do not overlap.

RANGE: The Water-willow Borer is found only in southeastern Massachusetts and nowhere else in the world; it is Massachusetts' most globally restricted species of Lepidoptera.

HABITAT IN MASSACHUSETTS: Water-willow Borers are found only on Massachusetts' coastal plain, in the shallowest portions of vernal ponds and seasonally flooded swamps, and along upland edges of streams, ponds, and other permanent bodies of water. Only wetlands with an significant amount of water-willow within a restricted shallow water zone are inhabited by P. sulphurata.



- Verified since 1978
- Reported prior to 1978

Massachusetts Distribution by Town

BEHAVIOR / LIFE HISTORY: Adult female Water-willow Borers mate and lay eggs in late September or early October, presumably at the base of a clump of water-willows. The eggs lie dormant through the winter, and the larvae hatch in mid to late May. They must immediately find a fresh willow shoot and then bore into the stem, where they feed for most of the summer. A water-willow stem occupied by a larva can be recognized by a large round hole on the lower end of the stem, through which the larva removes its droppings. Pupation occurs inside the stem in mid-August, and the adult Water-willow Borer finally emerges from the stem in mid to late September. Adult Water-willow Borers are excellent fliers, and have a relatively long life span (three weeks) compared to many other moths, during which the adult Water-willow Borers must find a mate and reproduce before they die in early October.

POPULATION STATUS: The Water-willow Borer is listed as a Threatened Species in Massachusetts, due to its extremely small global distribution and low population size. There are 2 historical sites and 59 current sites in 29 towns in Massachusetts. Populations of Water-willow Borers at any given site appear to be unstable; local extinctions may commonly occur, followed by recolonization of the site by Water-willow Borers from other nearby areas. It is unknown why P. sulphurata is restricted to southeastern Massachusetts despite its excellent flying ability and the abundance of water-willow in the eastern United States. There are some possible explanations, however. It may be that the water-table fluctuations in Massachusetts' coastal plain are different from any other area in the Northeast; P. sulphurata may only be able to survive in these very specific water-table conditions, which partially expose the lower stems of water-willows above water in summer, but still leave them in enough water to deter predation by rodents. It is recommended that the water level of P. sulphurata habitats not be changed by damming, draining or other activities, as this could adversely affect the moths. In addition, pesticides should not be used in these areas, and trails should not be established along the upper edges of P. sulphurata ponds to prevent trampling of the water-willow.

Natural Heritage & Endangered Species Program

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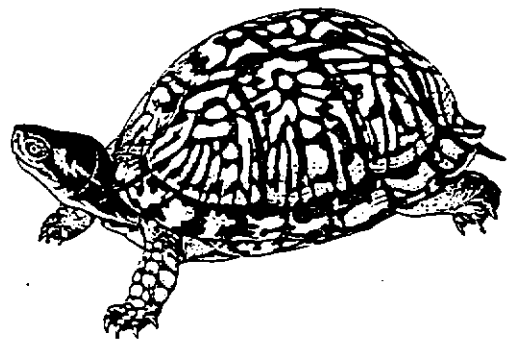
# MASSACHUSETTS SPECIES OF SPECIAL CONCERN

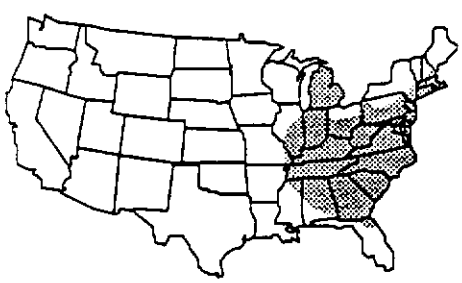
## Eastern Box Turtle
*(Terrapene carolina carolina)*

DESCRIPTION: The Eastern Box Turtle is a small, terrestrial turtle ranging from 11.4–20.3 cm (4.5–8 in.) in length. It is so named because it is the only North American turtle that when threatened is able to enclose head, legs, and tail completely within the protective armor of its upper (carapace) and lower (plastron) shells. The adult box turtle has a short, broadly oval, high dome shell with variable markings and coloration. The carapace is usually dark brown or black with numerous irregular yellow, orange, or reddish spots, blotches, or stripes in each carapace shield. The plastron may be tan to dark-brown or black, patternless or variably patterned light and dark—almost a mottled pattern of dark brown/black or tan/yellow; its surface either concentrically ridged or smooth; and divided into two movable portions by a strong hinge. The head, neck, and legs also vary in color and markings but are generally dark with orange or yellow mottling. The Eastern Box Turtle has four toes on its hind feet; a short tail; and an upper jaw ending in a down-turned beak.

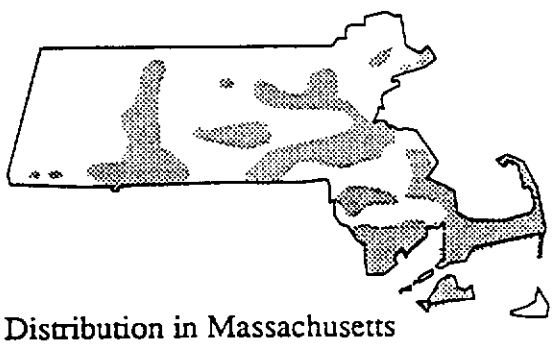


DeGraaf, Richard M. and Rudis, Deborah D. Amphibians and Reptiles of New England. Amherst, Massachusetts: The University of Massachusetts, 1983.

Although there are no striking sexual differences between the male and female Eastern Box Turtles, there are, however, external features that generally distinguish between the male and female. The male box turtle usually has bright-red to red-orange eyes, with those of the female being gray-brown, yellowish-brown or very dark-red. The rear lobe of the male plastron is concave, and that of the female is flat or slightly convex. The hind legs of the male are heavier and the claws stouter, shorter and more curved than the female. Males have longer, thicker tails, with the vent located farther from the shell and closer to the tip of the tail than the female. Both sexes are generally mild-mannered.



Range of the Eastern Box Turtle



Distribution in Massachusetts
Since 1978

Hatchlings have a flat, brownish-gray carapace with a yellow spot on each large scute; and yellow along the outer rim of the carapace, the mid-dorsal keel, and the lower mandible. The plastron is yellow to cream-colored with a black central blotch and yellow margining along the outside edge. The plastal hinge is not functional and poorly developed. The tail is long in comparison with that of the adult. Hatchlings, if molested, emit a strong odor to repel predators; an adaptation that is lost later on.

SPECIES SIMILAR IN MASSACHUSETTS: The Blanding's Turtle (Emydoidea blandingi) is the only species of turtle in Massachusetts that resembles the Eastern Box. Often referred to as the "semi-box turtle," the Blanding's Turtle has a hinged plastron enabling the turtle to pull its exposed part upwards towards its carapace but with less closure than in the Eastern Box Turtle. Outside of this specific adaptation, there is little or no similarity either in appearance or behavior between the two species. The Blanding's Turtle is essentially aquatic whereas the Eastern Box Turtle is terrestrial.

RANGE: The range of the Eastern Box Turtle is from southeastern Maine; south to northern Florida; and west to Michigan, Illinois, and Tennessee. Although the Eastern Box Turtle occurs almost statewide in Massachusetts, the majority of the population occurs in the southeastern section of the Bay State, just west of Cape Cod.

HABITAT IN MASSACHUSETTS: The Eastern Box Turtle is a woodland species, although in the northeast it also occurs in pastures and marshy meadows. It is found in both dry and moist woodlands, brushy fields, thickets, marshes, bogs, stream banks, and well-drained bottomland. It prefers open deciduous forests but has also been found on mountain slopes in Massachusetts. In optimal habitats in Cape Cod pine barrens and oak thickets, the species is generally associated with cranberry dominated swales interspersed with bearberry ground cover, low bush blueberries, and thickets of bracken fern.

LIFECYCLE/BEHAVIOR: The Eastern Box Turtle usually hibernates in the northern parts of its range from late October or November until sometime in April. In the deep south, it may remain semiactive throughout the winter. Hibernation generally begins at the time of the first killing frost. As many as four box turtles may share the same winter quarters, which range in type from loose soil, sand, vegetable debris and mud bottoms of ponds or streams to animal burrows or stump holes. As soil temperatures drop, the turtles burrow into the soft ground for a depth of from three inches to two feet. Females tend to hibernate first, with the males lingering to ensure that all females have been fertilized. They normally emerge from hibernation in April, but some individuals may emerge prematurely during warm spells in winter and early spring and perish from exposure.

Mating may take place as soon as the turtles emerge from hibernation or at any time until they enter hibernation again. Courtship begins with the male circling the female and biting at her shell, head, and legs, before mounting. Females nest from May to July and can lay fertile eggs up to four years after a single mating. Nesting areas may be in hay fields, roadsides, cultivated gardens, lawns, beach dunes, and woodland, and around house foundations. The eggs are deposited in a flask-shaped nest dug by the female's hind feet in loose soil at an elevated site, usually in an open area in close proximity to the previous years' nest. Egg laying occurs during the late afternoon-early evening and continues for up to five hours. Three to eight (usually four or five) thin, white, elliptical eggs are deposited by the female at intervals of one to six minutes; arranged in the nest by the hind feet; and then covered with soil by the hind legs and plastron. After the eggs are covered, the female crawls away, leaving the eggs unattended to incubate. The incubation period depends on soil temperature but generally the hatchlings emerge about 87–89 days after laying, usually in September. They may overwinter in the natal nest and emerge the following spring.

During the first four or five years of life, box turtles may grow at a rate of from half an inch to about three-quarters of an inch a year. Sexual maturity is thought to occur later in New England than in its southern range and may take up to 10 years to attain. It is believed that full growth is reached in about 20 years. The average life expectancy of a box turtle is between 40 and 50 years, but evidence shows that they can live as long as 80 to 123 years.

The Eastern Box Turtle is omnivorous, showing marked changes in food preferences from youth to maturity and from season to season. When young, it is chiefly carnivorous, feeding on insect larvae, slugs, earthworms, snails, spiders, crayfish, millipedes, fish, frogs, salamanders, a small percentage of vegetable material, and even carrion. At

approximately six years of age, box turtles develop a fondness for fungi (primarily mushrooms), berries, fruits, leafy vegetables, roots, stems, leaves and seeds. The adults take animal food with less frequency than young turtles.

In summer, adult box turtles are most often encountered in open woodlands in morning or evening, particularly after a rainfall. To avoid the heat of the day, they often seek shelter under rotting logs or masses of decaying leaves, in mammal burrows, or in mud. Though known as "land turtles", in hottest weather they frequently enter shaded shallow pools and puddles and remain there for periods varying from a few hours to a few days. In the cooler temperatures of spring and fall, box turtles forage at any daylight hour. They are diurnal, and scoop out a "form "(a small domelike space) in leaf litter, grasses, ferns, or mosses where they spend the night. These forms are often used on more than one occasion over a period of weeks. Juvenile box turtles are rarely seen. Immediately after hatching they seek a swamp or pond and immerse themselves in sphagnum moss or mud, remaining well hidden.

The home ranges of box turtles of all ages and both sexes overlap. The turtles frequently occur together and show no antagonism over territorial domain. Movements within the home range vary from random meanderings to fairly direct traverses. Occasional trips outside the range are made by some individuals; these trips include searches for nesting sites. Most adults show some homing tendency over short distances, such as a kilometer or two, but long distances as a result of human interference usually kills them. They orient themselves by the sun and rely on their vision for guidance and mobility. They have very defined home ranges averaging about 100 to 225 meters (100 to 750 ft.) in diameter. Some individual are transient and do not establish home ranges.

POPULATION STATUS: The Eastern Box Turtle has been declining in numbers throughout its range in Massachusetts and is presently listed as a "Species of Special Concern" in this state. Since 1978, only 187 sightings have been reported to the Natural Heritage and Endangered Species Program, with heaviest concentrations in the southeastern part of the state and Cape Cod. Many of the sightings are road crossings or single individuals making it difficult to estimate the size of the population. There are several reasons for this decline: habitat destruction resulting from residential and industrial development and concurrent dissection of the landscape with roads; deliberate and inadvertent highway mortality; collection by individuals for pets; destruction of nests and young by skunks, coyotes, foxes, crows, dogs, and raccoons; and genetic degradation of the native stock by imported captives that escape or are released.

MANAGEMENT RECOMMENDATION: The greatest threat to the survival of the Eastern Box Turtle in Massachusetts is the fragmentation and destruction of its habitat. The bisection of its habitat by roads can reduce or destroy populations. Due to the decline of farming in Massachusetts, agricultural land is being returned to woodland. A mixture of regeneration, selective cutting and even selective burning of woodland may be beneficial to the Eastern Box Turtle. Large roadless areas of optimal habitat need to be preserved, especially in the Box Turtle's stronghold of Cape Cod. Though a law exists to protect against the importation, transportation, and release of wild animals in Massachusetts, this law, and the biological reasoning behind it, need exposure and publicity in the community at large, as well as enforcement. To ensure the long term survival of the Eastern Box Turtle, protection of its habitat is needed, as is education of the public about the detrimental affects of removing turtles from their natural habitats and keeping them as pets. Enforcement of the Massachusetts Endangered Species Act prohibiting the killing, molestation, and possession of the Eastern Box Turtle must also be improved. People should be encouraged to help box turtles across roads (always in the direction the animal is heading), and should be made aware that box turtles should never be transported or captured as pets. Finally, the practice of releasing non-native box turtles must be discouraged to protect the genetic integrity of native populations.

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*(Terrapene carolina carolina)*


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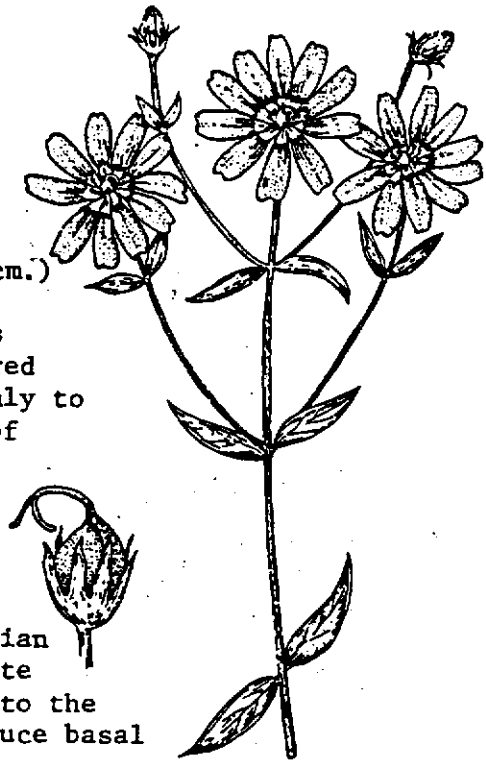
Massachusetts Natural Heritage Program

Natural Heritage & Endangered Species Program
MA Division of Fisheries & Wildlife
Route 135
Westborough, MA 01581-3337
508-792-7270 x 200

# MASSACHUSETTS RARE AND ENDANGERED PLANTS

## PLYMOUTH GENTIAN

(Sabatia kennedyana Fern.)



### DESCRIPTION

The Plymouth Gentian is a perennial herb, 12-25" (30-65cm.) tall, with narrowly lanceolate leaves 1-2" (2-5cm.) long. Its stems often bear a few alternating branches which terminate in long-pediceled flowers. The flowers are about 2" (5cm.) across, with a yellow center bordered with red and have 9-11 petals. It blooms from early July to mid September, depending on water levels. As a means of reproduction, it sends horizontal branches (or stolons) at or near the base of the plant that take root and develop into new plants.

### SIMILAR PLANTS IN MASSACHUSETTS

Pink Tickseed (Coreopsis rosea) resembles Plymouth Gentian in this habitat except that Pink Tickseed has a composite flower that is much smaller and without the red border to the yellow center. It has linear leaves, and does not produce basal leaf clusters.

### HABITAT IN MASSACHUSETTS

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This species is found only on sandy to peaty shores of freshwater ponds on the coastal plain. It grows in large linear patches along the shore when water level drops. The water level of these ponds must fluctuate periodically to inundate the margins and stop invading shrubs. Species found in association with Plymouth Gentian include Eleocharis melanocarpa (Black-fruited Spike-rush), Drosera filiformis (Threadleaf Sundew), Fuirena pumila (Umbrella-grass), Gratiola aurea (Golden-pert), and Coreopsis rosea (Pink Tickseed).

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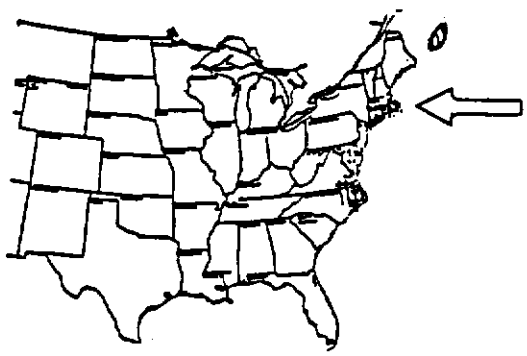
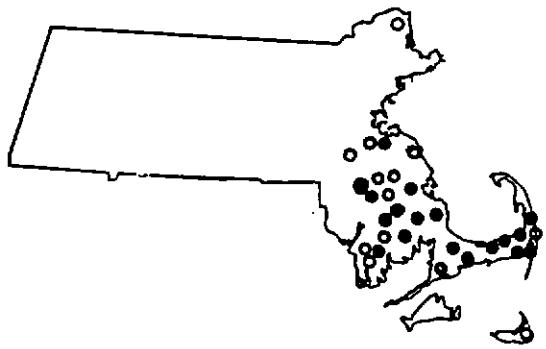


Distribution of Plymouth Gentian



● Verified since 1978
○ Reported prior to 1978

Distribution in Massachusetts by Town

RANGE

Plymouth Gentian has a disjunct range, occurring only in small areas of southern Nova Scotia, southeastern Massachusetts, Rhode Island, North and South Carolina.

POPULATION STATUS

Plymouth Gentian is considered a species of "Special Concern" in Massachusetts. Currently, 1978 to present, 112 occurrences have been verified: historically 37 other occurrences have been reported. This species is rare because of its limited range. Additionally, development and recreational use of coastal plain ponds leads to trampling and destruction of this habitat, and pond contamination from run-off and faulty septic systems.

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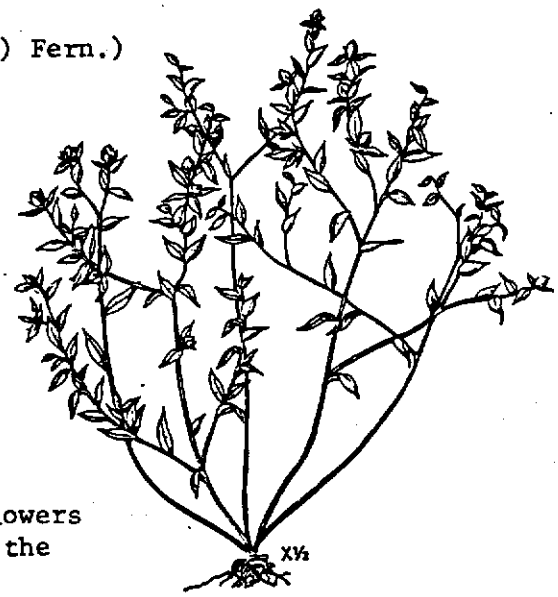
# MASSACHUSETTS RARE AND ENDANGERED PLANTS

## BUSHY ROCKROSE

(Helianthemum dumosum (Bickn.) Fern.)




Gleason, H.A. The New Britton and Brown Illustrated Flora of the Northeastern U.S. and Adjacent Canada. New York Botanical Garden, 1952.

### DESCRIPTION

Bushy Rockrose is a perennial herb, loosely branched spreading to reddish stems that form low mounds from 1-10" (2.5-25cm.) high. Stems are covered with short coarse hairs. Leaves are elliptic to narrowly oblong, usually 1/3-2/3" (8-15mm.) long, green above and pale below; very densely pubescent with simple and stellate (branched in star-like pattern) hairs. Bushy Rockrose has two kinds of flowers, maturing at different times during the season and at different positions on the plant. In late May to mid-June flowers with yellow petals appear singly and terminally on the main branches. Along branches produced in July to September grow self-pollinating flowers which lack petals and do not open.

### SIMILAR SPECIES IN MASSACHUSETTS

There are three other look-alike Rockrose species that occur within the habitat and range of Bushy Rockrose and could be easily mistaken for this species. Canadian Rockrose (H. canadense) is always erect, not as branched as Bushy Rockrose and is much less hairy. Low Rockrose (H. propinquum), a very uncommon species, has short ascending branches, prolific asexual flowers and only stellate hairs on the leaves and sepals. Hoary Frostweed (H. bicknellii) is usually unbranched, much taller, and covered with white fine stellate hairs.

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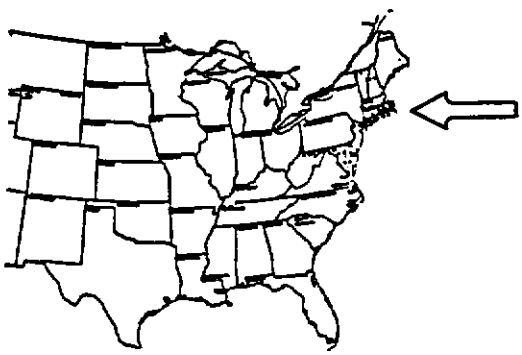
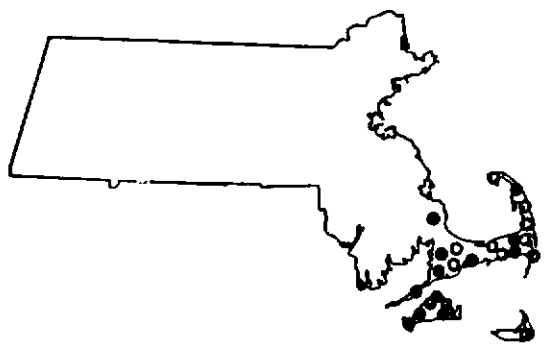


Distribution of Bushy Rockrose



● Verified since 1978
○ Reported prior to 1978

Distribution in Massachusetts by Town

## HABITAT IN MASSACHUSETTS

Bushy Rockrose inhabits dry, open sandplains, low-shrubby moors, and grassy openings in pine barrens. This plant seems to be intolerant of shade and moisture. Human altered habitats include cemeteries and golf course roughs. Species often found in the same habitat with Bushy Rockrose include Myrica pensylvanica (Bayberry), Arctostaphylos uva-ursi (Bearberry), Gaylussacia baccata (Black Huckleberry), and Andropogon scoparius (Little Bluestem).

## RANGE

This species is endemic to southern New England and ranges from southeastern Massachusetts to Rhode Island and Long Island, New York.

## POPULATION STATUS

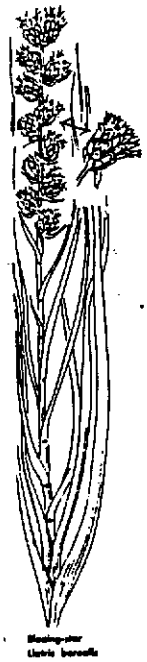
Bushy Rockrose is considered a species of "Special Concern" in Massachusetts. Forty-nine occurrences have been verified from 1978 to the present; twenty-four other historical occurrences have also been recorded. This species has a very limited range. In addition, succession of its habitat to shrubs and forests, as well as loss of habitat to development, have contributed to its decline.

Natural Heritage & Endangered Species Program

**Commonwealth of Massachusetts**
**Division of Fisheries & Wildlife**
**Route 135**
**Westborough, MA 01581**
**(508) 792-7270, ext. 200**

# MASSACHUSETTS PLANTS OF SPECIAL CONCERN

## New England Blazing Star
## *(Liatris scariosa* var. *novae-angliae)*



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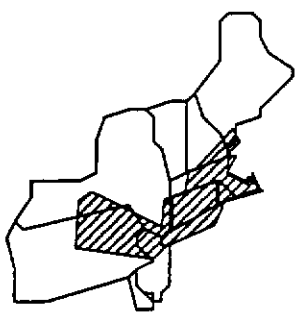
**Description:** New England Blazing Star, a member of the composite family, Asteraceae, is an attractive herbaceous perennial plant with tall purple spikes of flower heads in late summer. Particularly striking in mass, blazing stars are cultivated in gardens and for florists. The flower spike of New England Blazing Star has from 3 to 30 tufted, rose - purple heads of 35-60 flowers on smooth or weakly hairy, unbranched stems. The axis of the inflorescence is hairy and is 3 to 35cm (1 to 14 inches) long. The floral bracts are reddish, broad, and rounded, with narrow, almost petal - like margins. The fruits are hard and dry, and are 0.6 - 0.7cm (about a quarter inch) long. New England Blazing Star blooms from late- August through October, down from the top of the stem. The plants grow to 30 - 100cm (12 to 39 in) tall and arise from an underground corm. The stem has 20 to 60 densely crowded long narrow leaves below the flower spike; the leaves become smaller above the base of the stem. The basal leaves are 0.5 - 2.5cm wide.

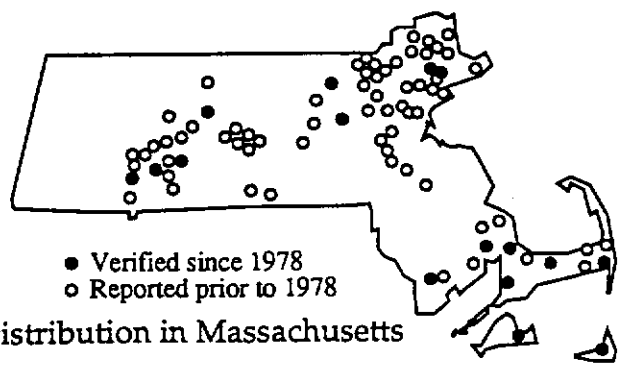
**Similar Species in Massachusetts:** New England Blazing Star, or Northern Blazing Star, is the only Blazing Star native to Massachusetts. It is part of a complex of species that is typified by a high degree of variation, the occurrence of hybrids where distributions overlap, and poor representation in most herbaria - all of which have rendered classification difficult. Several features distinguish this plant from other taxa, including numerous smooth, narrow basal leaves and numbers of flowers and flower heads. The most common scientific synonym for New England Blazing Star is *Liatris borealis*, the name that is used in the Federal register.

**Range:** Historically, New England Blazing Star occurred along the coastal plain from southwestern Maine to eastern New York and south to northern New Jersey and inland to central Pennsylvania. No plants have been seen recently in the western New York sites. Unfortunately, it no longer occurs naturally in New Jersey; the last site now has a highway on it. Because of hybridization, the status is confused in Pennsylvania, with the northeastern sites being closest to New England Blazing Star.

**Habitat in Massachusetts:** New England Blazing Star occurs in open areas with dry, sandy, low nutrient soils that are supporting early to mid-successional communities, usually sandplain grasslands or coastal heathlands. These rare and local plant communities are scattered along New England coast, persisting where human land use practices and natural stresses from salt spray, fire and storms inhibit the growth of woody shrubs and trees. These conditions are encountered in southeastern areas of Massachusetts, and on sand terraces along the Connecticut River.



New England Blazing Star
Historic Range




Distribution in Massachusetts

New England Blazing Star can also grow in maintained or disturbed areas such as road edges and powerline openings as long as trees are excluded. Species found co - occurring with New England Blazing Star include species of coastal grassland, heathland, and dune systems: Little Bluestem (*Schizachyrium scoparium*), Pennsylvania Sedge (*Carex pensylvanica*), Sweet Fern (*Comptonia peregrina*), Bayberry (*Myrica pensylvanica*), Golden Aster (*Chrysopsis falcata*), and Stiff Aster (*Aster linariifolius*). Sandplain grassland communities generally include Little Bluestem, Pennsylvania Sedge, Hair Grass (*Deschampsia flexuosa*), Wild Indigo (*Baptisia tinctoria*), Bush Clover (*Lespedeza* spp.), and Goat's Rue (*Tephrosia virginiana*). Symbiotic nitrogen fixation aids the survival of the legumes in the highly leached, nutrient poor soils characteristic of grasslands and heathlands; then the litter from these species provides some nitrogen to other species. Also characteristic of grasslands are other low, broadleaved herbs such as asters, Bird's foot Violet (*Viola pedata*), dewberries (*Rubus* spp.) and Bushy Rockrose (*Helianthemum dumosum*). Coastal heathlands, limited to the coast from Maine to northern New Jersey, are dominated by ericaceous shrub communities but have many of the same species occurring in sandplain grasslands. These communities are characterized by the dominance of Bearberry (*Arctostaphylos uva - ursi*), golden heather (*Hudsonia ericoides* ), huckleberry (*Gaylussacia baccata*), lowbush blueberry (*Vaccinium angustifolia*), or scrub oak (*Quercus ilicifolia*). Heathlands occur as openings within pitch pine scrub oak communities, as parts of mosaics with pine barrens or grasslands, and other places extend over large areas. Community composition in these areas is in part defined by land use history and fire patterning.

**Population Status in Massachusetts:** New England Blazing Star is currently listed as a Species of Special Concern in Massachusetts and is a candidate species for federal listing. As with all species listed in Massachusetts, individuals of the species are protected from unauthorized collection, picking or killing, and sale under the Massachusetts Endangered Species Act. This species clearly prefers frequent disturbance and shows intolerance of shade or competition from encroaching woody plants; it has lost habitat to widespread succession of open grasslands and heathlands to forests. Changes in human land use practices have had a major part in changing the amount of open land. In the past, grazing, agriculture and fire opened up abundant suitable habitat for this species, as indicated by MNHESP records of historical occurrences from 62 towns and current records from 16 towns (35 documented sites within those 16 Massachusetts towns). Currently it persists in the Southern Connecticut Valley, near Fort Devens, and Middlesex and Essex Counties, but the Cape and the Islands support the largest populations.

Most populations are small and have fewer than 200 individuals. Only a few coastal and inland populations have numbers near or greater than 1000 individuals. Nantucket may have the greatest number of occurrences but the number of individuals per colony is low (<200). Presently, the species is undergoing a significant decline throughout most of it s range with recruitment of juvenile plants into wild populations occurring at a very nominal rate. Throughout its entire range, with 67 known (1991) sites, only 20 sites had more than 50 individuals.

MANAGEMENT RECOMMENDATIONS: As with most rare plants, exact needs for the management of New England Blazing Star have not been clearly identified. The following comes from observations of the populations in Massachusetts and studies done with populations in heathlands in southern Maine.

The research conducted in southern Maine demonstrated that prescribed fire increased the number of seeds per flowerhead, possibly as a result of increased nutrient availability for perennial plants whose roots remain viable after a fire. The populations of seed-eating insects immediately after a fire was dramatically less than in unburned plots, or those plots in later years. For sprouts and seedlings, fire removed a thick organic litter layer and left an exposed substrate that maximized the contact between seeds and the soil, which increased germination, and improved light and moisture conditions for the germinated seeds.

While the plant fares well in early to mid - successional communities its ability to compete lessens as shrubs and trees invade the communities. The relationship between the success of New England Blazing Star and the role of fire as a disturbance mechanism indicates that the fire tolerant plants will display more vigorous growth in those periods following a fire. The fire serves to maintain the communities at earlier successional stages and lessens competition. Prescribed burns might be experimentally incorporated into management practices while concurrently serving as a vehicle for research. Mowing, timed to avoid the growing season, would provide some of the benefits seen from fire: woody plants would be reduced and kept from maturing. However, mowing increases thatch layers, so would not have the benfits of increasing seed ontact with mineral soil, and probably would not effect the seed predators.

Preservation of sandplain grasslands and heathlands is of the utmost importance as they are being threatened by lack of fire, human caused disturbance such as off-road vehicle use, and complete loss due to development. With the active suppression of fire in moderately natural areas and development on much of the flat, easily drained sandplain soils, the available habitat for New England Blazing Star and other associated species has been disappearing.

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Telephone conversations in December 1995 between Patricia Swain, MNHESP and staff at Connecticut Natural Diversity Database, Maine Natural Areas Program, New Hampshire Natural Heritage Inventory, New Jersey Natural Heritage Program, New York Natural Heritage Program, and Pennsylvania Natural Heritage Diversity Inventory-East, and maps from Tom Bredon, NJNHP, and Robert Zaremba, The Nature Conservancy-New York Regional Office.