New England Plant Conservation Program

Eupatorium leucolepis (DC.) T. & G. var. *novae-angliae* Fern. New England Boneset

Conservation and Research Plan for New England

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SUMMARY

Eupatorium leucolepis (DC.) T. & G. var. *novae-angliae* Fern., New England boneset (Asteraceae), is endemic to the coastal plain region of southeastern Massachusetts and southern Rhode Island. New England boneset is classified as a Regionally Rare taxon (Division 2) in *Flora Conservanda*. The taxon has 16 current occurrences, ten of which are in Massachusetts and six in Rhode Island. Two Massachusetts populations documented in the early twentieth century have been extirpated. The ten existing Massachusetts populations are located in Plymouth County (nine occurrences) and in Barnstable County (one occurrence). The Rhode Island populations are located in Washington County (five occurrences) and in Newport County (one occurrence).

New England boneset flowers lack pollen and are male-sterile. Plants reproduce vegetatively from stolons and through the asexual production of viable seeds and embryos in a process known as agamospermy ("without gametes"). In spite of the absence of pollen, a variety of insects visit the flowers, which are in peak bloom in August. New England boneset fruits are dispersed by wind in the fall.

The habitat for all of the New England boneset occurrences except for one Rhode Island site is sandy coastal plain pond shores. The exception is a wet field surrounded by shrub thickets. These coastal ponds have little or no inflow and outflow. Pond water levels fluctuate: a shoreline may be inundated one year, and dry in the next year. The size of New England boneset populations is correlated with pond water levels: there may be hundreds or thousands of plants at a particular site in a low water year, and few in a year when the shoreline is flooded and the plants are dormant. A number of regionally rare plants associated with New England boneset are also limited to coastal pond shores. Examples include *Fuirena pumila*, *Polygonum puritanorum*, *Sabatia kennedyana*, *Sagittaria teres*, and *Scleria reticularis*.

Human impacts are responsible for the extirpation of New England boneset at three sites and its decline at several others. Many coastal plain ponds are surrounded by residential, commercial, and industrial development, and the shores are heavily used. Trash, off-road-vehicle (ORV) traffic, trampling, beach clearance, and degradation of water quality have damaged a number of populations. The plant's restricted distribution on heavily used sites in a densely populated region presents a challenge for conservation.

Conservation of the taxon will require permanent protection of the populations at all 16 of its current sites. Landowner cooperation at privately owned sites, public education, public or private conservation agency acquisition of critical shoreline areas, systematic monitoring of all populations, and population augmentation at sites with depleted populations are measures that will be needed to provide a secure future for the taxon. Systematic surveys are strongly recommended for a better understanding of site and regional population numbers, dynamics, and natural fluctuations in response to changes in pond water levels.

PREFACE

The New England Plant Conservation Program (NEPCoP) is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published "*Flora Conservanda*: New England." which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of *Flora Conservanda* species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of individuals and federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP's Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection.

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I. BACKGROUND

INTRODUCTION

Eupatorium leucolepis (DC.) T. & G. var. *novae-angliae* Fern., New England boneset (Asteraceae), is endemic to coastal regions of southeastern Massachusetts and southern Rhode Island. New England boneset is classified as a Regionally Rare taxon (Division 2) in *Flora Conservanda* (Brumback and Mehrhoff et al. 1996). The taxon has a Global Ranking of G5T1, meaning that *Eupatorium leucolepis* as a species is globally secure but that the *novae-angliae* variety is critically imperiled.

The taxon has 16 presently known occurrences, ten of which are in Massachusetts and six are in Rhode Island. One of the Massachusetts occurrences has two distinct subpopulations. The ten existing Massachusetts populations are located in Plymouth County (nine occurrences) and in Barnstable County (one occurrence). Two Massachusetts populations documented in the early twentieth century have been extirpated. The Rhode Island populations are located in Washington County (five occurrences) and in Newport County (one occurrence).

This plan reviews each of these *Eupatorium leucolepis* var. *novae-angliae* occurrences and recommends conservation actions for those populations threatened by human and natural impacts.

DESCRIPTION

Eupatorium leucolepis var. *novae-angliae* is a robust, erect member of the Aster (Asteraceae) family. Mature individuals of this perennial forb range from 0.4 to 1 meter in height. Its inflorescence is composed of corymbs of white, conspicuous flowers with three to seven flowers in each head. New England boneset leaves, which are arranged in an opposite pattern on the stem, are lance-shaped, sharply-toothed, and 0.8 to 2 centimeters in width. The leaves are sessile, flat, and covered with soft hairs on the undersurface. The plant's stems are also hairy. *Eupatorium leucolepis* var. *novae-angliae* spreads by means of underground rhizomes, and plant populations frequently grow in dense colonies (Fernald 1950, Massachusetts Natural Heritage and Endangered Species Program 1986, DiGregorio 1991, Gleason and Cronquist 1991).

Eupatorium leucolepis var. *novae-angliae* can be distinguished from the typical variety, *Eupatorium leucolepis* var. *leucolepis*, by its broader, more sharply toothed, and tapered leaves. *Eupatorium leucolepis* var. *leucolepis* leaves are three to10 millimeters in width, have fewer teeth, and tend to be folded along the midrib. Leaves and stems of variety *E. l. novae-angliae* have longer and coarser hairs than variety *E. l. leucolepis* (Coddington and Field 1978). As a further distinguishing feature, the leaves of variety *novae-angliae* have two strong lateral nerves which leave the midrib well above the leaf

base, while those of variety *leucolepis* have a triple-nerved pattern (the midrib and two lateral nerves) starting at the base of the leaf (Fernald 1937).

Eupatorium leucolepis var. *novae-angliae* is endemic to coastal Massachusetts and Rhode Island. With one exception, New England boneset occurs only on the upper shorelines of coastal plain ponds. *Eupatorium leucolepis* var. *leucolepis* has a broader distribution, occurring in damp sandy and peaty habitats on the coastal plain from Long Island to Florida and Louisiana.

Eupatorium perfoliatum and *Eupatorium pilosum*, two boneset species that also occur in coastal New England ponds, are superficially similar in appearance to *Eupatorium leucolepis* var. *novae-angliae*. Leaf characteristics are the best distinguishing field features for the identification of these three taxa. *Eupatorium perfoliatum* leaves enfold the stem, making this species easy to distinguish from the sessile-leaved New England boneset. *Eupatorium pilosum* leaves are shorter and more rounded than those of New England boneset, and frequently branch in an alternate pattern on upper stems. The involucral bracts beneath the inflorescences of these two taxa are another distinguishing feature: those of *Eupatorium pilosum* are acute or rounded, while those of *Eupatorium leucolepis* var. *novae-angliae* have an acuminate tip.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Prior to Fernald's (1937) determination that the New England *Eupatorium leucolepis* populations constituted a distinct variety, botanists treated the plant as a single taxon throughout its range along the coastal plain from Massachusetts and Rhode Island south to Florida and Louisiana. Fernald distinguished the New England *Eupatorium leucolepis* specimens from those to the south on the basis of differences in leaf shape and hairiness of leaves and stems. Populations south of New England are currently classified as *Eupatorium leucolepis* var. *leucolepis*.

Sullivan (1992) suggested that, contrary to Fernald's taxonomic determination based on morphology, New England boneset is a self-sustaining hybrid between *Eupatorium resinosum* and *Eupatorium album*. She concluded that *E. l. novae-angliae* is not closely related to *E. l. leucolepis*, and proposed that New England boneset receive full species status.

Wiefenbach's (1993) follow-up genetic tests ruled out *Eupatorium album* as a parent species, but supported Sullivan's hypothesis that *Eupatorium leucolepis* var. *novae-angliae* is a naturally reproducing polyploid taxon of hybrid origin. Her tests indicated that *Eupatorium resinosum* is a probable parent of *Eupatorium leucolepis* var. *novae-angliae* but that other antecedents are unknown. Wiefenbach (1993: 19) concluded that New England boneset is a paleohybrid of uncertain parentage, which originated after the most recent glaciation (10,000 years ago), and that it is "the product of a unique event from a distant time that cannot be repeated." The genetic relationship

of *Eupatorium leucolepis* var. *novae-angliae* to *Eupatorium leucolepis* var. *leucolepis* requires further clarification.

The first *Eupatorium leucolepis* specimen collected in New England was gathered by W. P. Rich and C. P. Knowlton at a Massachusetts pond in 1908 (this specimen is deposited in the Gray Herbarium). In the two decades between this initial collection and Fernald's 1937 discussion of the taxon, *Eupatorium leucolepis* populations had been identified at five Massachusetts ponds and two Rhode Island ponds. In the 1970's, Bruce Sorrie found five new sites for the taxon in Massachusetts and three additional sites in Rhode Island. In 1979, Richard L. Champlin discovered a new Rhode Island site (Sorrie 1981). Populations had by then permanently disappeared from two of the Massachusetts ponds discovered earlier in the century.

Investigations in the 1980's and 1990's discovered two new Massachusetts sites, including a Barnstable County population, which is the only Massachusetts population outside of Plymouth County. In 1993, Valerie Stone's surveys of the known Massachusetts sites significantly increased the figures of the total New England boneset population from 2500 (Sorrie 1981) to more than 20,000 plants (Stone and Kesseli 1994). Paul Somers' Massachusetts surveys in 1994 and 1995 (documented in unpublished Massachusetts Natural Heritage and Endangered Species Program [MANHESP] file data) confirmed and in some cases added to Stone's 1993 figures.

SPECIES BIOLOGY

New England boneset flowers lack pollen and therefore are "male-sterile" (Sullivan 1992). The plant reproduces by two asexual processes. Clonal growth is the more observable of these processes, and the dense masses of plants found on the upper shorelines of many ponds result from vegetative extensions of stolons and stems. The plant's other reproductive method is the production of viable seeds and embryo without sexual reproduction, a process known as agamospermy.

The flowering period of *Eupatorium leucolepis var. angliae* lasts from late July to mid-September. In spite of the absence of pollen, bees, butterflies, and flies visit the flowers, and the single-seeded fruits are dispersed by wind in September and October (Bawa 1989). Germination rates are high in dry years and negligible in flood years.

The capacity of *Eupatorium leucolepis* var. *novae-angliae* to survive high water levels for extended periods may be a consequence of its flood-tolerant roots and stolons as well as to successful seed banking (P. Somers, MANHESP, unpublished data). The plant has the ability to survive consecutive high water years by entering dormancy and then reappearing in large numbers in dry years. The plant's dramatic population fluctuations are a response to annual changes in water levels, which account for the phenomenon of plants numbering in the thousands at a given site in one year and declining precipitously in the next.

HABITAT/ECOLOGY

Fifteen of the sixteen current New England boneset populations grow on coastal plain pond shores in Massachusetts and Rhode Island. These coastal kettle ponds have little or no outflow and are subject to fluctuating water tables (Sinnott 1927), which are typically high in winter and spring and low in summer and fall. Depending on precipitation, water levels may vary greatly from year to year. Sand and gravel, often with an overlay of acidic peaty material, is the characteristic substrate in pond shore habitats. New England boneset populations typically grow most vigorously at the upper margins of pond shorelines (Sorrie 1981), and are thinly dispersed in the wetter soils of the lower shoreline. *Eupatorium leucolepis* var. *novae-angliae* grows both in full sunlight and in the partial shelter of shrub thickets. The single exception to this typical habitat pattern is a Rhode Island population that grows in a wet, boggy meadow on the edges of shrub thickets.

Plants that grow in coastal plain pond shores are adapted to nutrient-poor conditions as well as to alternating periods of inundation and drought. New England coastal plain pond plants that are frequently associated with *Eupatorium leucolepis* var. *novae-angliae* and also are limited to coastal pond shore habitat include *Coreopsis rosea, Drosera filiformis, Fuirena pumila, Gratiola aurea, Juncus militaris, Polygonum puritanorum, Sabatia kennedyana, Sagittaria teres, Scleria reticularis,* and *Stachys hyssopifolia*.

The New England boneset population at the Rhode Island meadow site grows in a boggy swale at the edge of an expanding shrub thicket (Sorrie 1981; Enser, 1991 correspondence). Associated plants at this site are characteristic of sandy wet meadows and successional old fields: *Aletris farinosa, Aristida longispica, Lycopodium inundatum, Myrica pensylvanica, Panicum virgatum,* and *Vaccinium macrocarpon*.

THREATS TO TAXON

Human impacts are the primary threats to the plant's long-term survival. Development adjacent to pond shorelines, beach recreation, heavy equipment, boat docks, off-road vehicle (ORV) traffic, trampling, erosion, vegetation clearance, maintenance of artificially high water regimes, nutrient inputs, trash, and campfires have been cited in habitat degradation and population declines. Water table drawdown is also a potential threat to the long-term viability of New England boneset populations (The Nature Conservancy and The Association for Biodiversity Information 1999).

Insect larvae, one of which mimics the plant's floral buds (Bawa 1989), dodder *(Cuscuta* spp.), and stem galls are pests that can affect plant vigor and seed production. White-tailed deer and possibly Canada geese graze New England boneset flower heads (at MA .002 [Plymouth], RI .001 [Jamestown], and RI .006 [South Kingstown], for

example). These natural pests and predators may damage individual plants, but appear to have little impact on population numbers and vigor.

Competition from shrubs can limit or depress populations. Succession of shrub thickets has reduced habitat and population numbers at one Rhode Island site, and has been a factor in the decline of a small Massachusetts population (MA .012 [Lakeville]). Removal of shrubs and other competing vegetation along upper shorelines at another pond has allowed the boneset population to expand (for example, MA .004 [Plymouth]). In general, shrubs, which often inhabit the uppermost shore margins of coastal plain ponds and are killed back in periods of extended high water, do not pose so much of a threat as they do a natural limitation on boneset distribution on pond shores.

DISTRIBUTION AND STATUS

General Status

This discussion details the conditions of the 16 present and three historic occurrences of *Eupatorium leucolepis* var. *novae-angliae* (Table 1, Figure 1). The number of documented populations has increased since the first rangewide discussion by Fernald (1937), when there were seven known populations, five in Massachusetts and two in Rhode Island. More than 40 years later, Sorrie (1981) presented the next rangewide analysis of the plant's distribution based on his 1970's surveys of coastal plain ponds in Massachusetts and Rhode Island. Sorrie identified 15 extant populations, nine in Massachusetts and six in Rhode Island. Two Massachusetts populations discussed by Fernald had disappeared. Sorrie estimated the total number of New England boneset plants at the time of his report as approximately 2500.

In the two decades since Sorrie's paper, two Massachusetts populations have been discovered. There are currently 16 extant *Eupatorium leucolepis var. novae-angliae* populations, ten in Massachusetts and six in Rhode Island, and two extirpated populations, both of which are in Massachusetts (Figure 2, Figure 3). One of the Massachusetts occurrences (MA .003 [Plymouth]) has distinct subpopulations at two different ponds. With the exception of a single occurrence in Barnstable County, all of the present and past Massachusetts populations are located in Plymouth County. In Rhode Island, there are a total of six populations: five populations in Washington County and one in Newport County.

More frequent and systematic surveys have increased the known numbers of plants. In 1993, when Stone surveyed the known Massachusetts sites, she counted 2500 or more stems at each of six ponds, and over 1,000 stems at another pond. In 1994, Paul Somers estimated over 100,000 plants at a single site and many thousands at several other ponds. One of the Rhode Island sites also has more than 1,000 plants.

This apparent numerical expansion is most likely an artifact of increased knowledge, and not necessarily of actual population growth during the last 20 years.

Higher population counts in recent years should not obscure the reality that New England boneset is restricted in distribution, specialized in habitat, and threatened at many of its current locations.

The site narratives in the following section summarize the observations, analyze population trends, and discuss threats and conservation strategies for each site. The Element Occurrence (EO) rank category given for each population follows in part the definitions set forth by The Nature Conservancy and The Association for Biodiversity Information's summary paper for *Eupatorium leucolepis* var. *novae-angliae* (1999). To paraphrase these definitions:

"A" Rank: 500-1000+ plants; pond pristine or essentially so, with few or no houses around it and with little or no loss of pond shore habitat.

"B" Rank: 100-500+ plants, pond in very good ecological condition, but not pristine. Some houses/development around pond, with some (relatively minor or concentrated at one end) loss of habitat.

"C" Rank: Up to 100+ plants; pond ecology compromised to a significant degree by development, beach use, off-road vehicles. Long-term protection possible after degradation has ceased. OR, very small population (up too 25 plants) and pond habitat in very good condition.

"D" Rank: Up to 25+ plants; pond ecology severely compromised, little hope for long term protection. OR population very small and remnant and not likely to persist.

To these listings I have added an "X" category for extirpated populations.

There are problems in adhering strictly to these definitions. The most obvious difficulty is the dynamic nature of boneset populations, which may be less than 100 at a given site in one year and 1,000 or more in the next. Small, but healthy and persistent populations located in pristine sites and large, vigorous populations inhabiting impacted sites also present problems of definition. In evaluating the quality of a population, I have placed particular weight on plant numbers in a low-water year in combination with habitat conditions.

Stone and Kesseli's paper (1994), which is based on a comprehensive survey of the Massachusetts populations in 1993, and Paul Somers'1994-95 field observations are the most useful sources for evaluating the overall condition of the Massachusetts populations. The years from 1993-1995 were low-water years with high plant numbers at most sites. After 1995 population information is less comprehensive, but field records exist for several ponds through the 1999 and 2000 field seasons.

Enser's discussion (unpublished data, 1991) of the status and trends of each Rhode Island occurrence, in conjunction with updates from periodic field observations

through the 2001 field season, are the basis for evaluating population quality at the Rhode Island sites.

Census methods have varied among investigators. Most observers have counted mature shoots or ramets; several tallied both mature and immature plants; one counted clumps; others estimated population numbers; one or two did extrapolations from linear transect counts; and a few did not quantify their observations. These mixed approaches lead to confusion in the numbers, but overall population trends for each site are reasonably clear. In the future, a systematization of census methods would clarify the conditions and trends of the New England boneset population at individual sites and for the region in its entirety.

Table 1. Occurrence and status of *Eupatorium leucolepis* var. *novae angliae* in the United States and Canada based on information from Natural Heritage Programs.

OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE UNVERIFIED	HISTORIC (LIKELY EXTIRPATED)
Massachusetts: S1;E (10 current occurrences)	New York: SU	not applicable	not applicable
Rhode Island: S1 (6 current occurrences)			

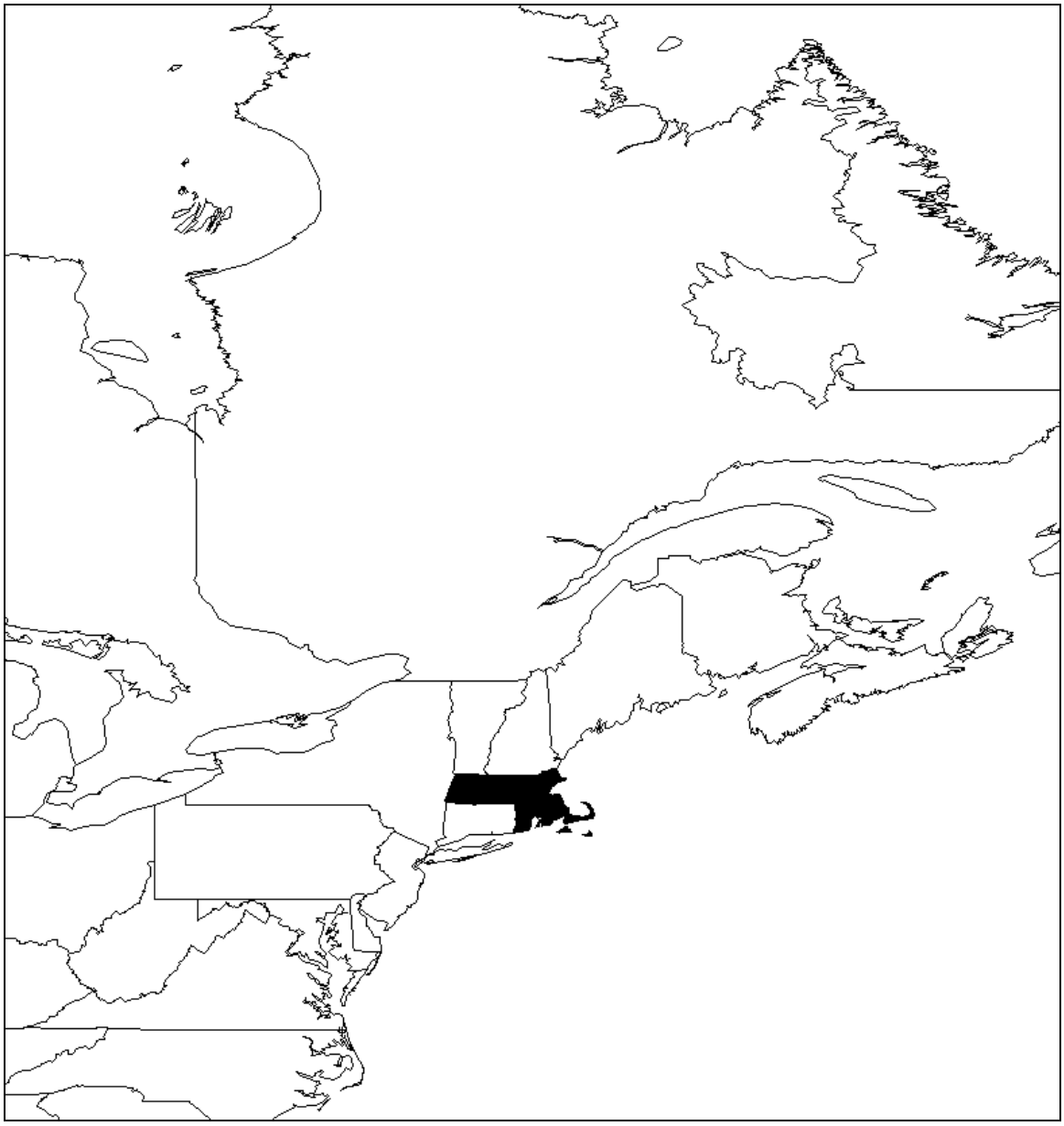

Figure 1. Occurrences of *Eupatorium leucolepis* var. *novae-angliae* in North America. States shaded in black (Massachusetts and Rhode Island) have more than five extant occurrences of the taxon.

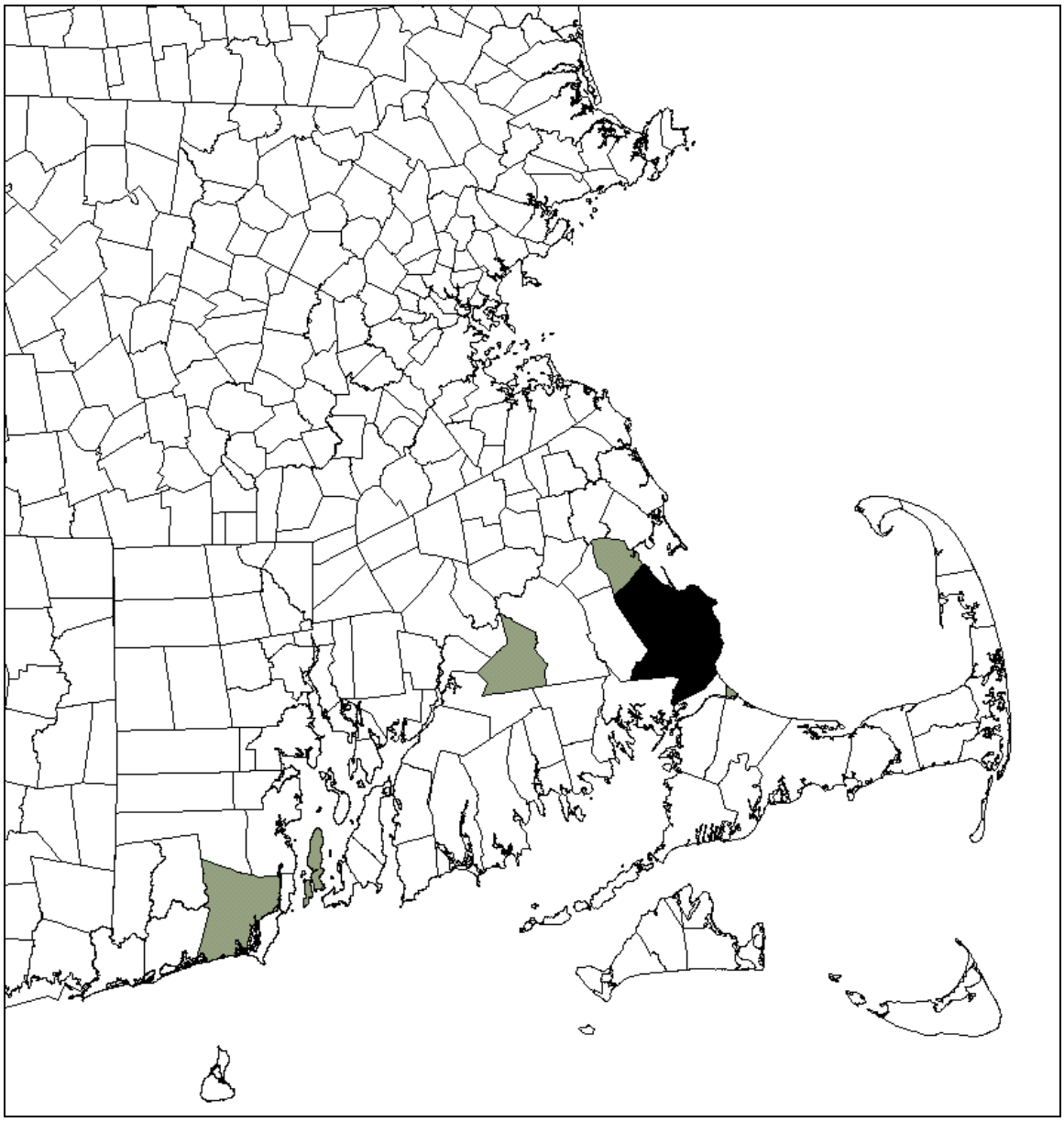

Figure 2. Extant occurrences of *Eupatorium leucolepis* var. *novae-angliae* in New England. Town boundaries for Rhode Island and eastern Massachusetts are shown. Towns shaded in gray have one to five confirmed extant occurrences of the taxon. The town shaded in black (Plymouth, Massachusetts) has more than five extant occurrences.

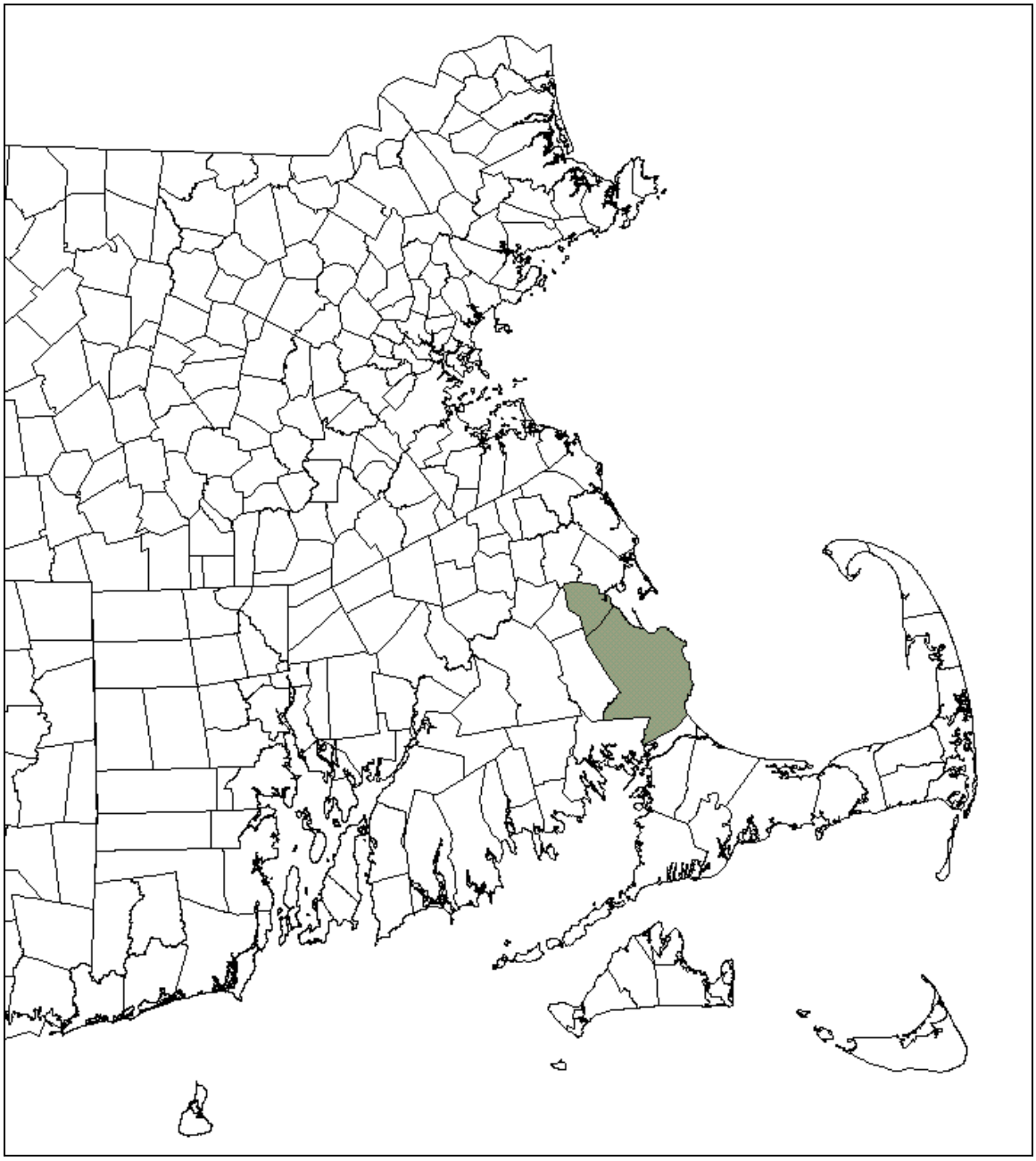

Figure 3. Historic occurrences of *Eupatorium leucolepis* var. *novae-angliae* in New England. Towns shaded in gray have one to five historic occurrences of the taxon.

Table 2. New England Occurrence Records for *Eupatorium leucolepis* var. *novae-angliae*. Shaded occurrences are considered extant.

State	EO #	County	Town
MA	**.001**	**Plymouth**	**Plymouth**
MA	**.002**	**Plymouth**	**Plymouth**
MA	**.003a**	**Plymouth**	**Plymouth**
MA	**.003b**	**Plymouth**	**Plymouth**
MA	**.004**	**Plymouth**	**Plymouth**
MA	**.005**	**Plymouth**	**Plymouth**
MA	**.006**	**Plymouth**	**Kingston**
MA	**.007**	**Plymouth**	**Kingston**
MA	**.009**	**Plymouth**	**Plymouth**
MA	**.012**	**Plymouth**	**Lakeville**
MA	.013	Plymouth	Kingston
MA	.014	Plymouth	Plymouth
MA	**.016**	**Barnstable**	**Sandwich**
RI	**.001**	**Newport**	**Jamestown**
RI	**.002**	**Washington**	**South Kingstown**
RI	**.003**	**Washington**	**South Kingstown**
RI	**.004**	**Washington**	**South Kingstown**
RI	**.005**	**Washington**	**South Kingstown**
RI	**.006**	**Washington**	**South Kingstown**

CURRENT CONSERVATION MEASURES IN NEW ENGLAND

The Nature Conservancy, the Wildlands Trust of Southeastern Massachusetts, and state conservation offices have implemented protection programs for the taxon by enlisting landowner cooperation, educating the owners and the public about the significance of pond shore habitats, and purchasing sensitive shoreline areas. As an example of conservation education projects, the Wildlands Trust of Southeastern Massachusetts has distributed coastal plain pond posters to all of the private owners owning property at the Plymouth County ponds with New England boneset populations.

The Nature Conservancy in Rhode Island either owns or has established cooperative conservation arrangements with landowners at five of the six sites where the taxon occurs in that state. At the sixth site, which is state-owned, botanists are actively monitoring the population and managing its habitat.

In Massachusetts, pond shore acquisition by the state (MA .002 [Plymouth]), a private conservation agency (MA .004 [Plymouth]), and cooperative conservation arrangements with landowners (MA .007 [Kingston], and MA .016 [Sandwich]) afford protection for four of the ten Massachusetts populations. In the past there has been landowner cooperation, monitoring, and some habitat management at a fifth Massachusetts site (MA .012 [Lakeville]), but ownership of that site has changed and its population is on the brink of disappearance.

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Eupatorium leucolepis var. *novae-angliae* populations occur at a total of 16 sites. Of these sites, seven have large and stable populations; five have small but apparently stable populations; three sites have fluctuating populations exposed to a variety of impacts; and two sites have populations on the brink of extirpation. The primary conservation challenge with respect to this taxon is securing the permanent protection of the populations at all 16 existing sites. Many sites are privately owned and subject to severe recreational impacts. Popular activities such as swimming, camping, fishing, hunting, boating, and off-road vehicles often conflict with plant and habitat protection, and recreational demand in this densely populated region will grow in the future. At several sites, erosion and nutrient loading are long-term threats to New England boneset populations and to coastal plain pond shore communities.

Conserving the taxon so that it permanently maintains its current number of 16 populations will require landowner cooperation, conservation education for landowners and the general public, and systematic monitoring. At heavily impacted sites, acquisition of shoreline habitat and plant reintroduction or population augmentation may be the only means of saving populations. Acquisitions must include sufficiently large areas of shoreline and buffer to allow for population expansion and protection from immediate impacts. The possibility of reintroduction is facilitated by *ex situ* success at propagating the plant (Chris Mattrick, New England Wild Flower Society, personal communication). Suitable habitat for a reintroduction project exists at one site where the plant is on the verge of extirpation.

All 16 of the current sites should be protected in a way that maintains their present populations levels (14 sites) or restores their populations to the approximate numbers documented in the past (two sites). For the future, this means seven or eight sites with hundreds or thousands of plants in low water years, and eight or nine sites with stable populations of several to 100 plants in low water years.

The twelve sites with stable populations should be monitored to assure that these populations remain secure in the future. Seven of these sites have naturally high plant numbers, and five have low numbers. No active management is recommended for any of these populations at present, but a permanent drop in numbers at any of the sites will warrant intervention in the form of more vigilant shoreline conservation or population augmentation.

The three sites with variable populations subject to human and natural impacts should receive immediate management attention. Enlisting landowner cooperation and securing shoreline easements at two shoreline sites exposed to recreational abuse, and

habitat management at one meadow site where shrub succession is a threat will serve to secure these populations.

The two sites with miniscule and possibly extirpated *Eupatorium leucolepis* var. *novae-angliae* populations will most likely require a reintroduction program in order for their populations to recover. One of these two sites, which is the type locality for the taxon, has suitable habitat for a reintroduction project. The other site has artificially manipulated water levels, which limits the prospects for reintroduction as long as the cranberry operator has rights to the water in the pond. The state or a private conservation group should investigate the acquisition of those rights if there is an ownership transfer. Experimental studies on the taxon's germination requirements prior to reintroduction efforts would enhance the prospects for success of re-establishing these populations in the wild.

The discovery of two previously undocumented populations in the 1980's holds out the possibility that there may still be undocumented New England boneset occurrences. The most recent comprehensive regional inventory of coastal pond shore flora was Bruce Sorrie's 1970's survey, which greatly increased the number of known occurrences and population numbers from Fernald's 1937 discussion. However, Sorrie's 1981 estimate of the total number of New England boneset plants (2500) has proven to be a significant undercount as more information has been collected during the last twenty years. Long-term, systematic census efforts at coastal ponds will shed more light on the plant's regional population profile.

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APPENDICES

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1. An explanation of conservation ranks used by The Nature Conservancy and Natureserve

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The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis -- that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction -- i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks. (The lower the number, the "higher" the rank, and therefore the conservation priority.) On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups -- thus G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EO=s have received such ranks in all states, and ranks are not necessarily consistent among states as yet.